Introduction

According to the U.S. Department of Education a strong STEM (Science, Technology, Engineering, and Mathematics) education is a key driver of opportunity for our nation’s youth. Yet, there continues to be a shortage of students entering and remaining in STEM fields – even though STEM jobs pay well and are in high demand. Studies show that close to half of students who intend to study STEM in college – eventually drop it as their major. Students get out of STEM for two reasons – they aren’t prepared for the challenging coursework or they decide they don’t like the work as much as they originally thought they might.

It Takes a Village

Student interest and success in STEM comes from a synergistic collaborative approach – one that provides a continuum of STEM experiences that start early, reach beyond the classroom, and provide opportunities for students to connect with STEM professionals in the field. Impactful STEM programming includes rigorous, engaging instruction, a focus on math skills, hands-on activities, and opportunities to develop a STEM mindset. STEM is not merely a group of subjects learned in school, but rather a way of looking at the world – using knowledge and data to design solutions to complex problems, collaborating and communicating with people worldwide, and persisting and continuing to work, even when things get hard.

Local education foundations (LEFs) are uniquely positioned at the “intersection” of K-12 education and the greater community, including local employers seeking STEM talent. They can make valuable connections and provide the resources necessary to support this collaborative approach to STEM interest and success and to be a driver of opportunity for youth.

There are many outstanding STEM programs available to schools and districts across the country. To support decision-making for LEFs as they consider which STEM approaches and programs to support, advocate for or implement, this report includes the strategies that are considered most impactful for driving interest and success in STEM. The most important recommendation is to embrace a collaborative “it takes a village” approach – leveraging the skills of all community stakeholders when designing impactful STEM programming. Florida’s LEFs can connect the dots between what happens in schools, out of school, and at home – providing access to critical partnerships and resources.

Elements of STEM Program Success

Early Exposure to STEM Studies have shown that students who have an increased interest in science, mathematics, and engineering in the early years of their education are more likely to pursue a STEM-related career. Young children, through the process of exploration and discovery, see that STEM is everywhere. Through STEM-themed play, curiosity and the desire to learn, young children develop a sense of confidence in STEM, a sense of belonging in STEM.
Energizing early learners with STEM in Seminole County. The Foundation for Seminole County Public Schools, in partnership with the Jeunesse Kids Foundation, raised $150,000 to create an innovative STEM lab classroom and outdoor play area at SCPS’s Early Learning Center in Sanford. Here, pre-kindergarten students develop an early interest in STEM through play and hands-on activities. At Indian Trails Middle School, part of SCPS’s K-12 pipeline for students to study STEM through the lens of renewable energy, students meet before school at the STEM Activity Center – funded in part by Duke Energy – to develop and teach STEM lessons to the students from the neighboring elementary school. When these middle schoolers head to high school, they can take their enthusiasm for studying energy with them – preparing for careers in the solar, wind, biofuels, hydrogen, energy auditing, photovoltaic, and energy management segments of the electrical energy industry.

Early Exposure to Engineering increases the likelihood students will pursue engineering as a career. Despite the growing prevalence of educational standards in engineering, it is estimated that only 10% of K–12 students are exposed to engineering-related coursework in school. Engineering's integrated, hands-on approach appeals to students with little previous interest in STEM and/or engineering. When students engage with engineering to solve real-world problems, they are more likely to see STEM as a subject that is not only interesting but also relevant to their own lives and important to improving society at large.

Excellent STEM instruction requires both deep content knowledge and expertise in teaching that content to all kinds of learners. Teachers need sustained STEM-specific training, including how to engage students and personalize learning. To increase student success in STEM, the research advocates:

♦ A focus on algebra-readiness skills for all students. Research has shown this to be especially true in mathematics, often viewed as the “gatekeeper” to academic opportunity in general and specifically for STEM learning.

♦ Multiple opportunities for hands-on learning. Hands-on learning is the most popular type of learning reported by students – they say the “doing” helps them to gain a better understanding of the material. Hands-on learning allows students to experiment with trial and error, learn from their mistakes, and understand the potential gaps between theory and practice.

♦ Project-based learning. Problem/Project Based Learning (PBL) has been shown to be an effective strategy in engaging students and building awareness between what happens in the classroom and how that prepares you for the real world. With PBL, students engage in designing solutions to real-world problems. They connect with the content on a personal level and share their solutions with authentic audiences. This makes STEM learning more meaningful and increases student interest in pursuing a STEM career.

♦ Career and Technical Education (CTE) programs make STEM learning more meaningful and engaging through applied, student-centered approaches. In addition to technical skills, CTE programs help youth acquire key employability skills such as critical thinking, problem solving, collaboration, communication and creativity. Research funded by the National Science Foundation has identified CTE programs, which help a broad range of students explore the practical applications of STEM subjects and prepare for STEM-related jobs, as a significant factor in supporting the U.S. in meeting its educational goals in STEM. "When secondary CTE programs infuse applied STEM learning into rigorous programs of study, align with post-secondary programs, award credentials, and offer dual enrollment programs that provide college credits, it propels youth toward college and career goals."

Engaging in STEM informal learning opportunities is seen as a critical component for sustaining comprehensive and lasting improvements in STEM education. K-12 students spend only 20% of their waking hours in school – the other 80% is spent outside of school, including in supervised out-of-school programs that meet after school hours, on weekends and during the summer. Many of these programs incorporate strategies that support STEM learning, such as hands-on learning experiences, inquiry-based pedagogy, and connecting STEM to everyday life. Successful programs leverage community resources and partnerships and connect informal learning opportunities to what is happening in schools.
Programs such as Robotics, Coding Clubs, and Makerspaces – opportunities designed to turn kids from consumers into creators – have produced real results. Students suddenly gain interest in careers they might never have considered, and they gain tangible, technical skills.⁶

**Community partnerships** between STEM employers and K-12 schools offer students (and teachers) the opportunity to see STEM in action. These partnerships create opportunities for students to see themselves in a STEM career – providing clear, well-defined pathways to higher learning and workplace success. STEM employers can provide innovative mentoring, on-the-job learning opportunities, and student and teacher externship programs. They can generate excitement for STEM careers by providing guest speakers, encouraging STEM professionals to engage with students in Project-Based Learning, hosting students for tours or job shadowing, and coordinating internships or dual-enrollment courses.

**Hands-on Learning with Community Partners.**

Through decade-long partnerships with AT&T and Motorola Solutions Foundation, the Consortium has leveraged dollars for real-world, hands-on learning opportunities that connect classroom curriculum to one or more STEM areas through grants to member foundations. Since 2010, nearly 98,000 students have worked side-by-side with STEM industry partners on projects like launching model rockets, programming robots for competition, growing vegetables in a hydroponic garden and filtering plastics from waterways. These students see STEM professionals excited about their careers, connect classroom learning to actual world problems and get the opportunity to ask one-on-one questions about education pathways to such careers.

**STEM mentors** are especially important for increasing STEM interest, especially among underrepresented groups. The research is clear: “63% of middle school girls who know women in STEM feel powerful doing STEM.”⁷ “Girls need to understand what opportunities are available to them, what those opportunities involve, and what the quality of life looks like for someone in that role. Having a real-life mentor gives girls the support needed to further their interests in STEM topics, while reinforcing the fact that skill proficiency is based on curiosity, will, and persistence – not gender.”⁸ In addition, opportunities to interact and learn from STEM professionals supports the development of a strong STEM identity – a predictor of future career choice in a STEM field – as well as counters the historical biases that have prevented the full participation of marginalized groups in STEM. Without appropriate role models, students, especially those typically underrepresented in STEM fields, have difficulty imagining someone who looks or speaks like them working in that field.⁹

**Family communication** also plays an important role in STEM success – especially for underserved and underrepresented students. Helping families understand the promise and life-changing potential of STEM education is critical to expanding access and awareness. Successful partnerships offer meaningful, accessible opportunities for families to engage with STEM, providing families with the knowledge they need to support and motivate their children to pursue STEM careers.

Through the process of learning and practicing STEM, students develop a passion for inquiry and asking questions. They develop critical skills including persistence, teamwork, and how to design and evaluate solutions to new problems. The complexities of today’s world require students to be equipped with a new set of core knowledge and skills to solve difficult problems, gather and evaluate evidence, and make sense of information. The learning and doing of STEM helps develop these skills and prepare students for a workforce where success results not just from what one knows, but what one is able to do with that knowledge.¹⁰
Changing the Conversation on CTE

According to Florida’s Chancellor of Career and Adult Education, Henry Mack, “If we are to improve the state of the Florida economy, we must double down on all of our CTE programs and initiatives. For too long, CTE has been undervalued by many, often considered a path for students who “cannot cut it,” academically. This perception is isolating, “othering,” and demeaning. By correcting this narrative, approaching a workforce education together with traditional academics, we can empower individuals and uplift whole communities.” Florida’s local education foundations, representing districts large and small, have been tackling this challenge head on – providing critical start-up funds for CTE programs that prepare students for in-demand jobs aligned to their local markets and supporting students in completing CTE credentials.

In Polk County, where there are more than 400 manufacturing companies, advanced manufacturing careers are in high demand. Responding to this need, a high school teacher reached out to the Polk Education Foundation in 2017 for seed money to start an engineering program. His challenge-based program (funded in part by Duke Energy) included “Automated Can Crusher Competitions” judged by local engineers. Currently, his students are working on completing an Associate’s Degree in Applied Engineering (approved by Polk State College) onsite (and debt free!) at Lake Wales Charter School.

The Lake County Education Foundation, in partnership with the City of Umatilla and AT&T, supported the development of Lake County School’s first Aviation Club – where students meet weekly to BUILD an AIRPLANE. When completed, the airplane will be sold, and funds used to sustain the program. Plans are currently in the works to expand the club to a full CTE program at Eustis High School.

When two private aviation companies relocated to Port St. Joe purchasing the local airport and drone programs were expanding at both Tyndall Air Force Base and Gulf Coast State College, The Education Foundation of Gulf County took notice. They received grants to begin a drone program at the junior/senior high schools, and with support from other private partners (Verizon and Duke Energy), hope to build momentum for students to complete drone pilot certifications, get college credit through GCSC and become drone pilots for local businesses.

Florida’s local education foundations are uniquely positioned to provide the necessary resources to create a continuum of STEM learning opportunities – by creating synergistic relationships among schools and STEM industries, funding informal learning environments and forging other community and workforce partnerships. Students will ultimately benefit from the “it takes a village” approach – they will emerge knowing that STEM is everywhere, and with the development of STEM skills, all students will be able to achieve at high levels and aspire to STEM careers.

Resources


2Roberts, T., Jackson, C., Mohr-Schroeder, M.J. et al. Student’s perceptions of STEM learning after participating in a summer informal learning experience.

3Community for Advancing Discovery Research in Education. (2013). STEM Smart Brief - Engineering: Emphasizing the “E” in STEM Education.

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5Community for Advancing Discovery Research in Education. (2013). STEM Smart Brief - Engineering: Emphasizing the “E” in STEM Education.

6Rethinking the Three R’s: Why We Need a New Model of Education. (2015). Huffington Post.


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