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Building Possibilities by Changing Minds

The Hidden Opportunities within the STEM Workforce Pipeline

Five Connections in STEM Education That Can Harmonize America's Workforce Pipeline

Bradley Schenker
TIES Lead STEM Fellow
Education Innovation Consultant
Schenker Consulting Group LLC
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Executive Summary

Imagine you're an eight-year-old passionate about science, forced to abandon learning through play for test prep. Or, you're fourteen, and reach high school lacking awareness of STEM careers, unable to access career-connected learning. Now you're eighteen and off to college, only to abandon your STEM major, or you earn your degree only to end up working outside your field. Meanwhile, 69% of employers can't find talent because they lack the durable skills so desperately needed.[1] This is America's STEM workforce pipeline.

"Chaos in the world brings uneasiness, but it also allows the opportunity for creativity and growth" - Tom Barrett, politician and diplomat

- Only 20% of HS graduates meet college STEM readiness benchmarks[2]
- Nearly half of college STEM students abandon their majors[3]
- 62% of STEM degree holders work outside STEM fields entirely[4]

The recent changes to our education system have created a state of uncertainty and instability, which presents a unique moment in time to change systemic design failures that can be accomplished within existing budget, people and resource constraints.

This analysis of research, mostly from 2015-2025, identifies five opportunities in the STEM workforce pipeline to create "Moments of Impact" that can change the direction of a student's STEM education pathway.

Opportunity #1: Engage & Prepare K-12 Students for College & Career

The workforce development problem begins when students can still count their age on one hand. We have reduced recess time, created fragmented STEM curricula, disconnected the learning experience from real-world context, and have failed to help students see themselves in STEM careers. The result is a generation of graduates who have followed the rules, checked the boxes, and still arrive at adulthood confused about their skills, disconnected from opportunity, and unprepared for the realities of today's workforce.

The workforce crisis isn't about student capacity or interest. It's about a K-12 system that has suppressed curiosity and broken connections students need to build foundational STEM thinking needed to see their place in the future workforce.

Play-Based Learning

LEGO Foundation research shows that foundational STEM competencies: spatial reasoning, hypothesis testing and iterative problem-solving, develop through play-based learning in early grades, and can close the achievement gap in less advantaged children ages 3-6. Facilitating free and guided play not only helps with reading, writing and math, but also with self-control, socio-emotional development, attentional regulation and nurturing a joy in education.[5,6]

Recess has been reduced by 60 minutes weekly since 2001[7]

In the book "Century of the Child: Growing by Design 1900-2000", it is written, "Play is to the 21st century what work was to industrialization. It demonstrates a way of knowing, doing, and creating value."

Opportunities are being created for play. The *FIRST* LEGO League robotics program brings play into its early-childhood program, and the importance of play was emphasized in 2024 when June 11th was established as the annual "International Day of Play" by the United Nations.

Even with the correlation between 1st grade "play-based learning" skills to the durable workforce skills needed 20 years later, there has been a systematic elimination of recess and shift from hands-on exploration to test preparation, undermining the very foundation students need for later STEM success.

Early Warning Signs in K-12

Research from Indiana University reveals that while most students report initial STEM interest before sixth grade, the timing and nature of experiences significantly influence whether students maintain engagement through secondary school and beyond.[8]

Within schools offering STEM instruction, curricula remain fragmented and disconnected from real-world context.[9] A student solving equations in algebra never sees how that math applies to the physics problem being solved in the next classroom, and engineering, the discipline that integrates these concepts, is almost nowhere to be found. We need to turn our learning into cross-discipline opportunities of discovery and wonder.

NAEP data from 2022 shows only 26% of 8th graders scored proficient in mathematics, with white students scoring two and three times more proficient than black or hispanic students, respectively.[10] These disparities reflect unequal access to high-quality STEM instruction, not differences in student capacity.

8th Graders Scoring Proficient in Math

- 26% of all students
- 45% White students
- 19% Hispanic Students
- 11% Black Students

K-12 gaps culminate in widespread college remediation, with 70% of 2-year and 30% of 4-year college students requiring at least one remedial course.[11] This is a failure of our education system, not the students or their families.

Preparation Through the Eyes of Students

Students consistently express desire for experiences connecting classroom learning to future careers. K-12's challenge is to provide sufficient connections and engagement to keep students' interest in STEM.

Only 48% of high schoolers and 25% of middle schoolers report their schools' STEM activities align with careers they're interested in, yet well over half indicate they want more career-connected learning opportunities.[13]

High School Grads[12]

77%
would have been more engaged if they better understood their strengths and career options

50%
say they lacked work-based learning experiences

45%
better career-counseling access

Imagine what might happen if the student that wants to be a dancer learns the physics behind their spins?. The football player that understands the mathematics of angles of pursuit? What if all students are learning food chemistry to prepare the perfect Thanksgiving dinner? This is the type of student engagement most schools could easily provide with innovative planning and creativity.

The K-12 Impact Opportunity

Rengaging students is about aligning what research tells us works with what our workforce leaders tell us they need and with students telling us what and how they want to learn. Let's rebuild the conditions for genuine STEM thinking. More exploration, experimentation, and an increase in career-connected learning throughout K12 will build the durable skills and engagement we know drive success. When every student sees their place in the future workforce, we don't just improve outcomes, we begin to harmonize the entire pipeline. Our ecosystem stakeholders have the knowledge, the partnerships, and the opportunity to make this shift. So why don't they?

Opportunity #2: Aligning the K-12 to Career Skills Mismatch

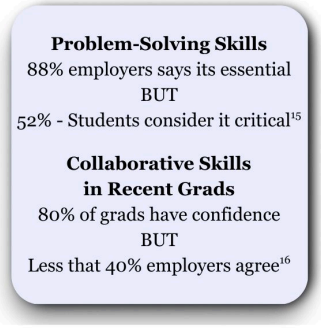
Since 2015, the World Economic Forum's Future of Jobs Report has consistently identified durable skills - analytical and creative thinking, problem-solving, collaboration and adaptability - as essential for workforce success.[14] Yet despite this consistency of needed skills, the majority of U.S. employers report difficulty finding candidates with the competencies they need.

We need to align education, business and industry. STEM education systematically prepares students for a world that no longer exists, while employers remain mostly on the sideline, absent from the educational conversation. The gap between what schools teach and what the workforce needs is the result of a disconnected system where educators design curriculum in isolation from actual workforce demands. Closing this mismatch is essential for America's global economic future.

Skills Perception

While 87% of undergraduates report feeling prepared for the workplace, employers tell a different story, increasingly emphasizing that the more critical gap involves durable skills.

Employers are 70% more likely to consider problem-solving a critical skill compared to students. And while 80% of recent graduates report confidence in their collaborative abilities, fewer than half of employers agree these graduates effectively work in teams.[16]



The Nature of Skills Gaps: Technical and Soft Skills

Research synthesizing over 110,000 peer-reviewed articles on STEM learning practices confirms that durable skills develop most effectively through active, inquiry-based learning where students explore open-ended problems, work collaboratively, and iterate on solutions. These are precisely the experiences most K-12 STEM classrooms fail to provide.[17] As Digital Promise researchers note, active learning through inquiry develops not just content knowledge but the collaborative problem-solving and communication skills employers need.[18]

This reveals a systemic structural problem, where K-12 STEM education emphasizes individual content mastery through traditional coursework, while employers prioritize collaborative problem-solving and communication developed through team-based, open-ended challenges.

The Durable Skills Impact Opportunity

This disconnect cannot be solved by educators alone. Educators must redesign STEM instruction to prioritize durable skills through active, inquiry-based learning. Simultaneously, employers must become genuine partners, helping educators understand workforce realities

through teacher externships, co-designing authentic learning experiences, and showing students that STEM careers are built on teamwork and innovation.

The STEM Ecosystem Initiative is cultivating cross-sector partnerships, such as the Greater Newark STEM Ecosystem, one of eight ecosystems in New Jersey, and 120+ globally
www.newarkstem.org

Collaboration is happening. IEEE's TryEngineering, the *FIRST* Robotics community and regional successes such as Students 2 Science in New Jersey are true education and industry partnerships. When educators and employers align around what it takes to thrive in the modern workforce, we start building the skilled future workforce America needs to lead globally.

Opportunity #3: Persistence - Fostering Belonging to Strengthen Success

Think back to your first semester of college. Remember looking for your people? That moment of scanning a classroom or lab, hoping to find someone who looked like you, thought like you, came from where you came from? Remember how that felt, the relief when you found them, or the loneliness if you didn't? Now imagine being a student in the back of a STEM classroom today, wondering if you belong. You survived the K-12 STEM experience, made it to college interested and capable. Now higher education and future employers are about to lose you, simply because they didn't focus on student identity and belonging.

This is happening to nearly half of college students who declare STEM majors and leave their programs before graduation. Among students who entered college between 2003-2009, 45-50% abandoned their initially declared STEM major, a pattern that has remained.[19]

Why Students Leave: Agency and Belonging, Not Ability

A study on STEM Intervention programs reveals that students abandon STEM majors not due to academic ability or lack of interest in STEM content, but because they don't feel they belong or have agency in shaping their educational experiences.[20] This attrition is the culmination of identity formation that began in primary school, with students who never saw themselves as "STEM people" more likely to leave when challenges arise.[21]

Mentorship
67%
Loma Linda University high school interns majoring in STEM

55%
Program attendees enrolled in graduate programs

Targeted interventions connecting students to mentors who share their backgrounds show significant impact on retention, demonstrating that belonging, not ability, drives persistence. In the Loma Linda University summer research internship program, high school students participating in hands-on lab research were paired with ethnically diverse mentors. Follow-up data showed that 49% of program attendees were in college, 67% were STEM majors, and 55% were enrolled in graduate programs, demonstrating how targeted mentorship dramatically increases STEM persistence.[22]

The Impact of Community

Higher education cannot solve this alone, but must lead by fundamentally redesigning the student experience from day one to build belonging and agency. Grassroots virtual efforts are already taking place where a university's admitted students create online social chatgroups. Institutions can take this formula and use enrolled students and business partners to connect with entering freshmen based upon major, identity and background. This can then extend to campus and classrooms where genuine support systems can be nurtured and thrive.

When colleges prioritize belonging as fiercely as they prioritize grades, and when business partners invest in supporting that culture, we will stop losing half our STEM students.

Opportunity #4: The Access Divide

The opportunity for a STEM career path begins at birth. Two babies are born in the same hospital on the same day, and attend the same pre-school. By kindergarten, one child attends a well-resourced school with labs and experienced teachers, while the other child's school is in an under-resourced community with no meaningful STEM exploration. The well-resourced student is building momentum for a STEM career, but loses access, and passion, due to a family The workforce has now lost two STEM-capable students, all to no fault of their own.

Despite policy commitments of "STEM for All", the reality is a systematic stratification of STEM access, and for millions of students', STEM career opportunities were decided before they ever stepped in a classroom. We need to develop low-friction solutions so every child has the opportunity to pursue a STEM career.

STEM Access Gaps: A Tale of Two K-12 Systems

High-quality STEM educational experiences are not equally available across schools. Schools serving predominantly white and higher-income students are significantly more likely to offer advanced coursework, well-equipped labs, and experienced STEM teachers than schools serving students of color and lower-income communities.[23]

Extracurricular STEM experiences, programs like Science Olympiad, robotics competitions, maker spaces, and industry partnerships, are concentrated in high-resourced schools, creating parallel opportunity structures, some with access to rich STEM ecosystems and some without.[24]

Teacher Preparation: An Upstream Miss

STEM access gaps reflect inadequate teacher preparation. Middle school teachers express particular concern with the following:

- lesson planning
- interdisciplinary instruction
- integrating engineering practices into teaching

These gaps disproportionately affect students in under-resourced schools with less access to professional development.[25]

Traditional pre-service programs treat STEM as separate disciplines taught through content-delivery models rather than integrated, inquiry-based approaches that develop both disciplinary knowledge and pedagogical skills.[26]

However, when undergraduate STEM students served as "engineering ambassadors" working with elementary students, they naturally applied instructional strategies without formal pedagogical training. These included asking open-ended questions, encouraging student-driven investigation, and supporting iterative design. This suggests that when given authentic teaching contexts, even novice educators can implement effective non-traditional teaching practices.[27]

It's Time to Take Care of Our Teachers

Closing the equity divide requires transforming teacher preparation and support. New AI tools can help in this area, but they can also build new barriers and challenges. Pre-service programs must prepare teachers to facilitate integrated, inquiry-based learning. Equally critical is robust, ongoing professional development in under-resourced schools, where teacher support is most scarce. Teacher preparation and continuous professional learning are not optional, and they do not need to impact budget or scarce teaching time. Teacher support is foundational and a moral imperative for our education system to be exceptional.

Opportunity#5: Listening to the Student Voice

Adults design the curriculum. Adults create the standards. Adults set the policies. Adults decide what STEM education should look like. And yet, in all the rooms "where it happens", the students directly affected by these decisions are rarely invited to speak. When students are part of the solution, they feel ownership in a way that adult-only planning never creates. We've built an entire STEM education system and workforce pipeline around the assumption that adults know what's best. We keep trying to fix the student experience without asking the students.

What Research on Student Voice Reveals

When students participate in meaningful decision-making about their learning, their engagement, persistence, and sense of belonging measurably increase.[28]

Young students hold sophisticated perceptions about STEM careers. When elementary students were interviewed about engineering careers, they articulated nuanced understanding of engineering work, identified diverse applications, and recognized that engineers need both technical and collaborative skills, insights that often surprise adults who underestimate children's capacity for career awareness.[29]

Yet when surveyed about whose perspectives matter most in decisions about STEM education, students consistently identify adults (teachers, parents, administrators, policymakers), rarely ranking their own perspectives as important.[30]

The Absence of Student Voice in Policy

STEM policy discussions consistently involve adult stakeholders, such as educators, employers, policymakers and philanthropists, but rarely include students themselves. Students remain subjects of policy rather than participants in shaping it.[31]

Emerging practices are demonstrating what happens when students are part of the design process. Digital Promise's work engaging students as co-designers of STEM learning experiences reveals that students identify barriers adults miss and demonstrate greater ownership when included in solutions.[32] This suggests that excluding student voice isn't just ethically problematic, it results in less effective policies and programs.

The Impact of Listening to Understand, not to Respond

When students have a genuine voice in designing their STEM experiences, they bring insights that transform education, identify barriers adults overlook and articulate what makes learning meaningful. They demonstrate ownership and commitment that adult-only planning never generates. The entire education ecosystem has a responsibility to ask students to co-design and help reshape STEM education. When students become partners and active recipients in policy, the entire system will become more effective and aligned with what works. The time for adults to make decisions about STEM education without students in the room is over.

Conclusion: The Path Forward Is Clear & Doable

Solutions exist, but isolated interventions are failing. What's needed is systemic coordination among K-12 educators, higher education institutions, employers, funders, and policymakers working in concert on solutions that can scale within the reality of today's constraints - time, people, money. This is the role that STEM Learning Ecosystems can play in every community.

Research show us what works and we need to find opportunities to layer them into the existing system: play-based learning in early grades, integrated STEM curriculum (including in and out of school), belonging interventions, inquiry-based pedagogy, career-connected experiences, teacher PD, and student co-design of learning. This requires an ecosystem of organizations focused on these "Moments of Impact", working together to develop the technical competencies and durable skills for every student to participate in tomorrow's workforce demands.

STEM Learning Ecosystem communities are doing work in almost every state, building cross-sector partnerships that connect schools, employers, and community organizations. The Lemelson Foundation's InventEd initiative is demonstrating how coordinated investment in K-8 invention education develops both creative problem-solving and career awareness. Digital Promise has programs and equity-centered research and development to improve learning opportunities.

These efforts show what's possible. The question is whether organizations can lower siloed structural barriers to create collective impact, and scale coordination before another generation of students falls through the cracks of a broken pipeline.

Reflection and Future Direction

Solving the STEM workforce pipeline crisis for the STEM industry is an ongoing effort. This paper originated from the author's desire to break down this complex issue into 'Moments of Impact' at the earliest ages that affect the direction of a student's STEM interest. The desire is to look at each of these issues, and identify research-based solutions that can minimize the amount of time, effort, money and resources to implement. Many solutions and best practices already exist. They need to be identified and built for scale, not profit. If they do not exist then a community of practice (CoP) can be formed to develop innovative solutions.

Author Biography

Brad Schenker is a connector of people and organizations, and the founder of Schenker Consulting Group LLC (SCG). A business development and sales executive with 30 years of experience, he has spent the last 15 years focused on the strategy and implementation of education technology, STEM and career-connected learning and adaptive leadership.

He co-leads and coordinates the Greater Newark STEM Ecosystem, which focuses on connecting, collaborating and being a central STEM education resource for educators, businesses and the STEM community in Northern New Jersey. He is also the Board President for the Achieve Foundation of the South Orange-Maplewood School District.

He was on the U.S. leadership team at LEGO Education and led education sales and partnerships at littleBits Electronics He has worked with organizations such as Digital Promise, Donorschoose.org, *FIRST* Robotics, Google for Education, National Afterschool Association, National PTA, and Pearson Publishing. He recently was the project lead for robotics curriculum development, which was adopted by educators in all 50 states, and over 100 countries. He is the co-founder of a community robotics program, and is a trained improvisational theater actor and sketch comedy writer.

Author's Note

This paper synthesizes research literature, with AI tools assisting in efficiently gathering and organizing research materials. All interpretations and implications represent the author's independent analysis grounded in direct experience with STEM education stakeholders nationwide.

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