



Multiplying Options for Success: Solving our National Math Crisis

MARCH 2024

PREPARED BY
STEM NEXT OPPORTUNITY FUND

WITH SUPPORT FROM
TAKEDA



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INTRODUCTION

The “M” in STEM may well be the most important. Math is the language needed to Engineer new Technologies, as well as understand, model and make new Science discoveries. It’s also the foundation of important life skills like financial literacy, problem-solving, and critical thinking. Math underpins financial systems and economics that drive our global connections and livelihoods. Declining math scores and diminished math skills threaten our nation’s economy, security, and global competitiveness. Our challenges with math also exacerbate pre-existing educational inequities rooted in student’s socioeconomic, geographic, and ethnic backgrounds, continuing to widen the opportunity gap for millions of youth across the U.S.

In 2022, the National Assessment of Educational Progress (NAEP), reported the biggest decline in math scores for 4th and 8th graders in over 30 years.¹ Only 26% of 8th graders scored proficient in math and 36% of 4th graders tested at a proficient level in math; down from 36% of 8th graders and 41% of 4th graders in 2019.²

Today, the average American student is
9 weeks behind in reading but an
alarming 15-24 weeks behind in math.

While this decline was true across all demographics and in almost every state, gaps among certain groups were more pronounced. Black student scores fell by 13 points in comparison with the 5 points of white students. The lowest performing students experienced a decline 4 times that of students performing in the top 90%.

“The United States now has the worst-educated workforce in the industrialized world.”³

This brief explores the significance of math learning and its critical role in the futures of our young people, workforce development, economic growth, and national security. By citing research and practical applications of solutions, this brief underscores the relevance of a proficiency in mathematics for students at all levels and how we might improve the systems that support math proficiency and excellence for students across the country. Addressing challenges and offering recommendations, this document also demonstrates how afterschool and summer programs are an effective strategy to create significant improvements in students' mathematical skills. Finally, this brief outlines the role of corporate and philanthropic partners in developing and supporting more comprehensive efforts to create and scale impactful math-focused initiatives.

In 2021, STEM Next, in partnership with Takeda Pharmaceuticals, launched an intense focus on bolstering math learning in out-of-school spaces for kids across the country. Taking examples from the Million Girls Moonshot, STEM Next's national initiative to close the STEM equity gap and other out-of-school programs, this brief will share things learned from these efforts thanks to the generous support of Takeda.



The Importance of Mathematics for Learners

Mathematics is the study of numbers, shapes, patterns, and relationships; but it is also much more than this simple definition. It is a universal language that provides a foundation for logical reasoning, quantitative analysis, and problem-solving. It encompasses various subfields, including algebra, geometry, calculus, statistics, and more. Mathematics as a discipline is vital—underpinning innovation across industries and playing a critical role in science, engineering, finance, and technology. ⁴

Traditionally, in classrooms, STEM disciplines are frequently presented in a siloed approach, with students studying math through equations with minimal real-world connections. This approach causes students to struggle to understand why math is interesting, useful, or important for solving real-world problems.⁵ Instead, math should be fun and intriguing for kids. Young people should get excited when tasked to solve a problem or think critically about a new innovation; math engages their creativity. Keeping math interesting is critical because it is at the forefront of all STEM learning, as it serves as the common language that unites the STEM disciplines. Notably, math confidence is directly linked to STEM career interest, with research showing that students with lower mathematics self-efficacy have a declining interest in STEM careers.⁶

Beyond building essential foundations for STEM and other career disciplines, math activities encourage critical reasoning, analytical skills, and problem-solving - skills that are essential in the modern workplace, and increasingly harder for employers to find.⁷ A strong foundation in mathematics further allows individuals to develop financial literacy, make informed consumer choices, and navigate everyday life experiences in their own healthcare (e.g. understanding medical dosages and navigating healthcare systems), in travel and navigation (e.g. budgeting and GPS navigation), and in the use of technology (e.g. smartphones and home automation devices).

**“My involvement in
afterschool STEM
programs has really
helped shape my STEM
identity and develop
my confidence in
science and math.”**

**-Madeleine, 2022
Flight Crew**



While, mathematics is the backbone of AI, with algorithms driving the machine learning the powers the technology, AI may provide opportunities for students to deepen mathematical and computational thinking outside their understanding of math in their studies.⁸ The rise of artificial intelligence and its use in business, entrepreneurship, and entertainment exemplifies a comprehension of math that young people will need to use the technology, as well as address pending issues yet to be discovered. From chat bots to task automation, it is predicted that math-based AI, will add approximately \$7 trillion dollars to the global economy.⁹

Thus, access to equitable and relatable mathematics educational opportunities are essential for all learners, as math provides the foundational skills and critical thinking abilities necessary for success in a wide range of academic, professional, and everyday life pursuits.

Math Skills are Increasingly in High Demand in the Workforce and Support Economic Prosperity and National Security

Mathematics is a vital discipline that underpins many fields and industries, including technology, finance, engineering, and science. Basic arithmetic, statistics, probability, calculus, and algebra are foundational skills for any career in finance. Engineers analyze problems and design innovative solutions with trigonometry and differential equations. Pharmacologists use math to determine the chemical components of the latest medicines and cures needed to improve the health of millions. Mathematical modeling is used to predict changes in climate and ecologists use calculus to compare population growth with environmental capacity. Artificial intelligence relies on algorithms based on foundational math principles.

Workers with strong math skills are in high demand, and companies are struggling to find qualified candidates to fill open positions.¹⁰ The Bureau of Labor Statistics reports that overall employment of mathematicians and statisticians is projected to grow 31% from 2021 to 2031, much faster than the average for all occupations. The increasing demand for mathematical expertise is driven by factors such as the growing need for data analysis, technological advancements and the development of complex algorithms across industries. And, while 62% of K-12 students nationally say they're interested in STEM jobs, a third feel that their school is doing a bad job of preparing them for these careers.¹¹

“The advances in technology that are going to drive where the world goes in the next 50 years are going to come from other countries because they have the intellectual capital and we don't.”¹²

Technology will remain one of the largest drivers of economic growth and job creation on a global level.¹³ Global interconnectedness also shows no signs of slowing with at 25% of each region in the world relying on another for critical imports.¹⁴ Investments in STEM skills and math literacy are fundamental to keep the economic growth steady, as well as remain competitive in the global economy. Additionally, increases in digitalization create new challenges to national security with cyber threats and navigation of emerging technologies used in potential conflicts and militaries.¹⁵ Math is at the intersection of workforce development, economic growth and national security.



Investing in mathematics education and workforce development is important for several reasons:

Math is the language of STEM

Math is a foundational subject in STEM, providing a universal and precise way to describe, communicate, quantify, and measure complex concepts and phenomena. It offers a common language that can transcend cultural and linguistic boundaries, ensuring that scientific information can be shared and understood globally. According to the Bureau of Labor, employment in STEM fields is projected to grow by 10.8% between 2022 and 2032, with the demand for mathematical science occupations projected to outpace other occupation growth rates.¹⁶

Math is Critical to Economic Growth¹⁷

A strong foundation in mathematics is essential for a country's economic growth. While STEM occupations are expected to grow by more than 10% in the next decade, only 36% of students were prepared for college in science and 40% were prepared in math.¹⁸ Shortages of skilled STEM workers put a strain on our nation's ability to grow and innovate. The STEM talent gap has the potential for long-term economic growth challenges if it persists overtime.¹⁹ Furthermore, countries with strong math education systems tend to have higher rates of economic growth and development.²⁰

Math is an Important Indicator of Social Mobility

Typically, individuals with post-secondary degrees and beyond earn higher wages than those without.²¹ Overall, individuals with higher levels of education earn more, and can have positive implications for an individual's civic engagement and general health.²² College acceptance, however, is heavily dependent on a student's math performance, especially for STEM majors. Additionally, even when comparing adult workers with the same levels of education, individuals having completed more math courses, even in high school, earn higher wages on average and are less likely to be unemployed.²³ (In May 2022, the median annual wage for math jobs was \$99,590, a significantly higher salary than the \$46,310 median annual wage of all careers.)²⁴

Math is Essential for Innovation

Innovation is a key driver of economic growth, and math plays a critical role in many innovative fields. For example, data science, machine learning, and artificial intelligence are all heavily reliant on mathematical models and algorithms. It is projected that AI will increase labor productivity within the next decade resulting in a 7% increase in global GDP.²⁵ Investing in math education can help create a pipeline of talented workers who can drive innovation and growth in these fields.

Math Plays a Crucial Role in National Security

Mathematical tools and models are used in cybersecurity, risk and threat assessment, intelligence and surveillance, resource allocation, and provide data-driven insights for policy decisions related to national security, allowing for rapid responses to emerging national threats and challenges. Math skills are essential to the 14 critical technology areas the Department of Defense (DoD) has identified as vital to maintaining the United States' national security, including quantum science, AI, microelectronics, and cyber.²⁶ The 2023 National Defense Science & Technology Strategy specifically highlights STEM education as necessary for maintaining the US's global technological and security advantage.²⁷

Math and Equity

Representation of women, Black, LatinX and Native American individuals in mathematics degrees conferred and the workforce is a significant concern. While Black and LatinX students share the same level of interest in STEM as their peers, they are less likely to major in or earn post-secondary degrees in STEM fields.²⁸ According to a 2021 National Science Foundation report, women earned only 40% of all bachelor's and masters degrees in mathematics and statistics in 2018, but under 30% at the doctoral level.²⁹ When comparing race and ethnicity, the same report indicates that in 2018, LatinX individuals earned 9.3% of mathematics and statistics bachelor's degrees, Black individuals earned 4.6% and Native Americans earned 0.3%.

The underrepresentation of these groups extends to the mathematics workforce as well. As of 2019, women represent only 29% of the mathematical sciences workforce.³⁰ Similarly, 2020 data from the U.S. Bureau of Labor Statistics shows that Black, LatinX, and Native American individuals together account for only 14.2% of the mathematical sciences workforce. These statistics are of particular concern because the U.S. population is becoming increasingly multiracial and diverse; thus, the underrepresentation of these populations in the mathematical workforce represents an increasingly larger portion of the population being left behind.³¹

Math education is critical for equity: Math skills are essential for success in many fields, but not all students have access to high-quality math education.³² This can partially be due to the evidence that shows students from low-income backgrounds have access to less robust math curricula and learning opportunities.³³ Poverty cycles are then replicated as gaps in representation lead to greater inequality in income in the future.

Investing in mathematics education, especially in equity-focused, hands-on learning environments, can help address these disparities by supporting programs that provide access to high-quality math education for all students.

“ I UNDERSTAND FIRST-HAND THE IMPORTANCE OF AFTER-SCHOOL AND SUMMER STEM EXPERIENCES AND THEIR ROLE IN DISRUPTING AND REVERSING ALARMING TRENDS, PARTICULARLY THE UNDERREPRESENTATION OF WOMEN IN STEM.

-Isabella, 2023 Flight Crew



What Works:

Math in Afterschool and Summer

Afterschool and summer programs offer a unique opportunity to elevate math competency and interest in STEM careers among K-12 students by providing targeted, engaging, and experiential learning opportunities. High-quality math learning goes beyond timed worksheets, instead using confident, prepared educators to guide socially relevant lessons with real-life applications and computational thinking to spark joyful learning.³⁴ Research shows that students gain greater comprehension and more positive attitudes about mathematics when learning in social settings with a more contextual, real-world approach instead of rote memorization and use of textbooks.³⁵

Leveraging out-of-school time (OST) to support student learning has never been more critical, following the significant learning loss, particularly in math, resulting from educational disruptions due to the COVID-19 pandemic. Existing research shows that children in grades pre-K-12 who participate in summer programs that include mathematics activities experience significantly better mathematics achievement outcomes, compared to control group counterparts.³⁶ These outcomes hold true across poverty levels as well.

“Math helps you to critically think and find solutions that aren’t readily apparent to any problem you might face. School sometimes fails to be as engaging as afterschool programs, which can spark a competitive drive in you and just be fun and more interesting.”

-Adeline, 2023 Flight Crew



Importantly, tackling mathematics skills and learning OST can provide the opportunity to approach the topic in a way students may not otherwise experience as part of their in-school learning. The informal learning environment in which OST programs take place and lack of traditional testing can help both learners and educators feel more comfortable exploring unfamiliar topics and engaging in “productive failure”.³⁷ Active learning has been shown to have disproportionate benefits for underrepresented students at the collegiate level as well, reinforcing the importance of environments that encourage learning beyond traditional classroom lectures.³⁸

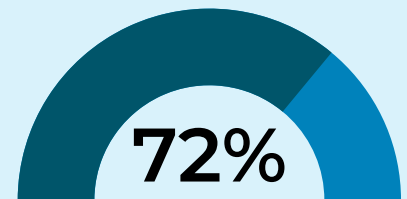
Operating outside of the traditionally siloed and disciplinary in-school approach, OST programs are better poised to approach math concepts using real-world examples, in more social settings, and through an interdisciplinary lens.

Sparking Experiential Learning

A gap in the fundamental skills students need to keep pace with the rapidly changing job market is a critical barrier for young people.³⁹ Research has found that more experiential, project-based learning is most effective in teaching closing the skills gap, the type of learning more traditionally found in out-of-school environments.⁴⁰

More active learning has been shown to support better student comprehension and knowledge in math.⁴¹ Experiential learning involves hands-on, real-world activities that allow students to apply mathematical concepts in practical contexts. Such learning experiences have also been found to increase student's communication skills, critical thinking, and creativity in mathematical thinking.⁴²

Students report that participation in afterschool STEM increased perseverance and critical-thinking by ⁴³

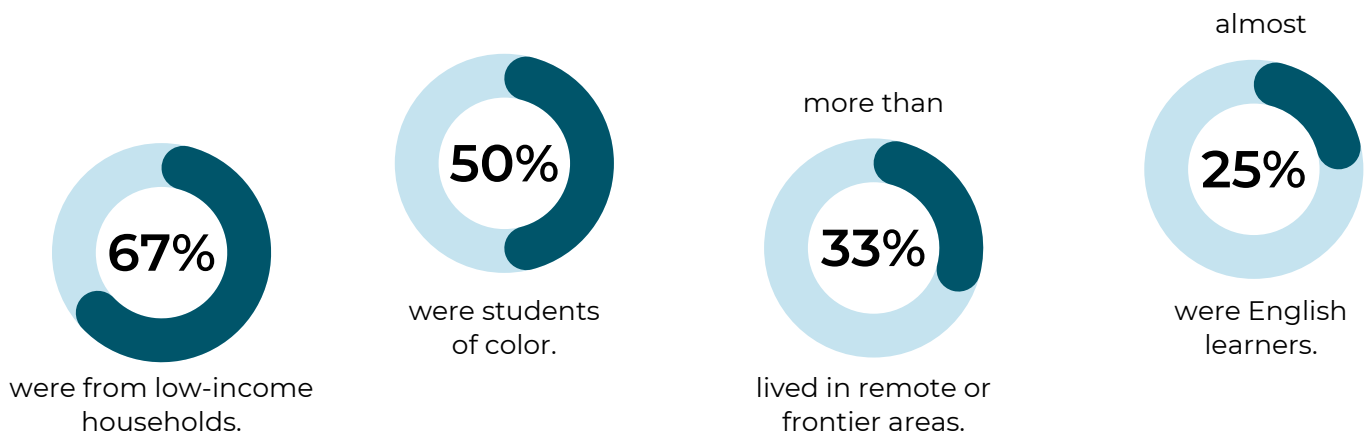


Led by STEM Next, the Million Girls Moonshot initiative was designed to infuse the power of STEM learning, including math, into afterschool and summer programs everywhere. The Moonshot equips community and state leaders with resources, toolkits, training, and expert partners to support the expansion of afterschool STEM in urban, suburban, rural, frontier, and Indigenous communities nationwide.

OST further presents the opportunity to approach the development of mathematical skills and applications from unique perspectives that leverage students' interests and passions. Understanding the nation's challenges with math, and the need for holistic, meaningful, and evidence-based practices, STEM Next's Million Girls Moonshot teams up with expert implementation partners to offer significant math training for educators around the country and easy-to-implement programming for young people outside of the classroom.

Since 2020, the Million Girls Moonshot has reached almost 3 million youth with experiential learning opportunities

Of youth served, 1.4 million have been girls, and



A CLOSER LOOK

Discovering Math Everyday with fhi360

fhi360 works as an implementation partner in the Moonshot initiative to deliver training to hundreds of out-of-school time educators across the country. In 2023, fhi360 introduced the AfterSchool Math Plus curriculum to educators in over 26 states.

“Before the industrial revolution, most of the population was illiterate,” said Maryann Stimmer, Senior Technical Advisor, STEM Programs for fhi360 and Math expert for the Moonshot. “Reading wasn’t a necessary skill for most jobs at the time. We learned to read when jobs were dependent on those skills. Today, math is that critical skill people need for jobs of the future.”

Stimmer reports that most educators walking into a Moonshot math workshop warn her that ‘they are bad at math.’ “People aren’t ‘bad at math,’” said Stimmer. “They are bad at arithmetic, which is what we are typically teaching in the classroom.”

An estimated 12,000 youth have been impacted by the fhi360 workshops and curricula in 2023. By raising awareness and shifting practices to improve youth outcomes, fhi360 is working along the Moonshot’s theory of action to help educators and students find their place in math.

“AFTERSCHOOL IS THE RIGHT PLACE FOR KIDS TO DEVELOP A MATH IDENTITY - NOT JUST BE A VISITOR TO MATHEMATICS, BUT KNOW THAT THEY BELONG.”

“Math in afterschool provides role models for students too,” said Stimmer. “Educators are often from the same communities as students and afterschool allows them to find greater connections to math in their everyday lives within the local context.”

After attending fhi360 math training

78% of educators would implement new math learning in their OST activities

89% of educators felt engaged in the math training.

83% of educators felt the training was relevant to their work.

“Math was not my strongest subject, but you have changed my perspective and increased my confidence.”

-Educator and attendee of fhi360 math training



Photo Courtesy of The 50 State Afterschool Network

A CLOSER LOOK

Learning Equations & Empathy with Basketball

Learn Fresh's NBA Math Hoops leverages students' interests in athletics and tools such as board games and digital apps to develop students' algebra readiness and social-emotional skills. The programs emphasize the power of experiential learning approaches delivered through out-of-school time opportunities.

STEM Next and Learn Fresh partnered to scale Learn Fresh's proven programming throughout the U.S. Third-party research from 2022 shows that youth who participated in their NBA Math Hoops program had 28% gains in math fluency, 21% improvement with higher-order math skills related to stats and data analysis, and 30% growth in attributes crucial in the 21st century including leadership, grit, and resilience. These successes in math, coupled with STEM Next's reach in states where Learn Fresh aspired to grow- made the partnership dynamic in reaching students everywhere.

STEM Next and Learn Fresh are launching the NBA Math Hoops program in ten states - Iowa, Hawaii, Florida, Colorado, Alaska, Montana, Missouri, North Carolina, Louisiana, and Michigan - attracting a minimum of 200 afterschool educators at state conferences to grow their knowledge and skills. Trained educators will receive supplies, implementation support, and evaluation tools to enable the youth they serve to effectively engage in NBA Math Hoops programming to grow their math and 21st-century skills.



Building Youth Confidence

Research shows that students with lower mathematics self-efficacy have a declining interest in STEM careers.⁴⁵ A students' confidence in their math skills is significant to future opportunities. Afterschool educators who support students with math can help young people overcome their fears and anxieties about math.⁴⁶

Positive afterschool environments have also been shown to predict stronger academic skills and perceptions of academic ability, especially for underrepresented youth.⁴⁷

In a survey of 300 girls,



of them said were more likely to think of themselves as “a person who does STEM” because of their Moonshot experience.⁴⁸

A CLOSER LOOK

Out-of-school time programming is uniquely poised to create a safe, healthy, supportive environment where students can develop meaningful and long-lasting relationships with peers and mentors to support their learning needs. MathCorps, a Detroit-based summer math camp for middle school students, is an example of how centering programming to support students' emotional and social needs can lead to meaningful academic outcomes, including higher graduation rates and college enrollment.⁴⁹

“I was really scared to pursue STEM because I didn’t feel like I was good enough. I wasn’t confident in my work and or myself, but through my afterschool experience, I was able to grow and learn that anyone can do STEM. It’s a matter of believing in yourself and that’s been really helpful for me.”

-Emerald, 2022 Flight Crew



A CLOSER LOOK

Shifting Practice Toward Equity

Since 2020, the Million Girls Moonshot has worked within all 50 states to shift the mindsets of educators and build their confidence through professional development. To date, the Moonshot has helped change practice in over 65,000 programs at the national and local levels.

Co-developed by the National Girls Collaborative Project (NGCP) and STEM Next, the Access to STEM framework gives guidance on best practices that encourage girls and marginalized youth to engage in STEM, including selecting topics of interest to all genders, incorporating community issues into activities, and working in cooperative groups.⁵⁰ Culturally responsive instruction has been shown to address social barriers that cause disparities in student achievement.⁵¹

A pillar of the Moonshot centers on equity. Through dissemination of resources related to this evidence-based guide educators in all 50 states have learned to adapt STEM activities to build more inclusive spaces for all students.

Access to STEM Framework



Increasing Access

The Framework shares strategies that address barriers to participation and build on the experiences within the community.

Youth-Centric

The Framework shares strategies that build on the specific strengths, needs, and challenges of youth.



Skill Development

The Framework shares strategies that are personally relevant to youth and enable them to develop STEM and 21st century skills.



Bridging Gaps & Supporting Individual Student Needs

Investing in afterschool and summer math programming can mitigate the impact of student outcomes due to math teacher shortages by offering skill-building opportunities that help make up for lost time in the classroom. ⁵²

With smaller student-to-teacher ratios and flexible pacing, out-of-school programming is better suited to support individualized student learning and needs, thereby addressing learning loss, accelerating learning, and expanding opportunities for student success. ⁵³

A CLOSER LOOK

Operating outside of typical school day and classroom constraints allows out-of-school programs to support individual students in the short and long term, the latter of which allows for bridging student learning and support across school years. The Bridge to Enter Advanced Mathematics (BEAM) Pathway Program, which provides up to 10 years of comprehensive mathematics support to students historically underrepresented in STEM, exemplifies the power of leveraging OST programming to ensure students' continued success across their academic careers.

A CLOSER LOOK

Girls and Math Advocacy

Launched in 2022, the Flight Crew features a group of youth ambassadors giving voice to the importance of afterschool STEM. The group of youth advocates works to change the national narrative around who can participate and succeed in STEM. By sharing their stories, the Flight Crew encourages other young people to get excited about STEM learning, including math.

Flight Crew member Mayumi was selected to join the 2023 cohort based on her local efforts to encourage more young women to pursue math.

“Learning outside of the classroom is important to solidify and expand on what students are learning in school. With my nonprofit SKATE (Solving Kinesthetically and Transforming Education) for Girls, I found that connecting figure skating to math helped middle school girls become more passionate about math and interested in how math connected to the real world.

Math may seem boring if students are in a classroom doing problems all day. Allowing students to see how math connects to the real world will help them understand the purpose behind what they are learning and why it's important. Most importantly, seeing math outside of the classroom can encourage students to learn.”

-Mayumi, 2023 Flight Crew



At the beginning of her 6th-grade year, in Fall 2020, Keira, 2022 Flight Crew, started a girls' math team at her Title I, public school, because she was tired of hearing other girls say they “don’t like math” or “aren’t good at math.”

Keira wanted to participate in the “Girls Adventures in Math” competition, but could not find a teacher to serve as the coach nor could she recruit other middle school girls to participate. Rather than give up, she sought the principal’s permission, started an afterschool math club with younger girls, and served as the team’s coach.

“There’s a saying,” said Keira, “that students are the best teachers... I think it’s true.” Keira has used her Flight Crew experience as well as her connection to the Moonshot to continue serving as an afterschool math coach.

Research into Action: Recommendations for Deepening & Scaling Impact

The nation's math dilemma is not something that can be addressed by one sector, organization, or group. Fast-paced innovation, recovery from a global pandemic, and constraints within the formal education system all contribute to the rising challenge. Here are a few ways we can coordinate efforts to solve the problem.

Business & Philanthropy

Leverage the data and invest in proven opportunities to strengthen student confidence through experiential learning.

Research shows us that out-of-school time learning spaces give students safe, low-risk, confidence-building opportunities to learn math. With experiential, hands-on activities, young people increase their critical thinking, problem-solving, and communication skills.

Philanthropy offers resources and the positioning to lead strategies that maximize impact for kids. Over 80% of a young person's time is spent outside of the classroom, offering time and space for kids to continue learning in environments proven to be most effective. Investing in Afterschool and summer programs offers more time to engage youth in mathematics learning that will carry over into their academics and future careers.



Photo Courtesy of The 50 State Afterschool Network

A CLOSER LOOK

Takeda's holistic approach to building healthy, more equitable communities by investing in math shows us an example of a long-term strategy to address the national math challenge. They understand that competency in math, not only impacts a child's future career success but also influences their ease of daily life, social mobility, and general quality of life. Takeda's investments also show a long-term commitment to a complex problem.

Support promising solutions that can impact sustainable, positive outcomes for more young people, especially the most underserved, at scale.

Complex challenges require solutions that engage multiple partners and work at the systems level to resolve the root cause of a problem. Corporate and private philanthropic leaders can leverage their influence and invite widespread support from experts across all sectors to work toward a solution that addresses the issue on all sides. Collaboration is essential for systemic change.

Long-term commitments to a solution are also invaluable. The most persistent challenges took years to develop, therefore their resolution usually takes time. Real, systems-level change - the type that makes transformational impacts in millions of lives - takes a commitment to the cause. Motivate your peers to stay focused on results at scale by staying the course, cultivating more resources and support, and helping to remove barriers.

Program Providers, Educators, and Families

Spend more time investing in opportunities to practice math learning with every opportunity.

Program Providers

Keep math engaging through partnerships and real-world examples.

Finding more opportunities to make math fun for young people can be challenging, especially with limited resources and time. Partnerships can help your organization utilize existing math expertise and resources without additional capacity.

Afterschool networks exist in all 50 states and offer connections to expand program offerings and professional development. Joining larger projects, like the Million Girls Moonshot, can provide tangible, free resources, trainings, and ideas to use in your program tomorrow.

Collaborating with local businesses and industry partners could offer insight into current careers that require math. Increase student's excitement and interest in math by showing them how math is used in the real world.



Educators

Build confidence and share ideas with caregivers.

Get looped into professional development, communities of practice, and other learning opportunities to grow your own confidence in math. Listening to others share what has and has not worked in their programs is a great way to implement new ideas into your activities.

As you learn how to incorporate math into daily learning, work with students' families to reinforce the learning. Share low-to-no-budget ideas or activities with caregivers that develop a growth mindset toward math.

By modeling behavior, the adults within programs and at home can show students the power of persistence when solving a problem. As a community, a growth mindset and a more confident attitude toward math will develop over time.

Families

Create new memories with math in everyday experiences.

Learning takes place everywhere. No matter the location or child's age, there are always opportunities to engage your student's curiosity. Work with your child's teachers or afterschool programs to get ideas for ways to explore math together with your child at home.

Math can also be intimidating for so many adults, and this includes caregivers. Don't let any anxieties around math stop you from talking about math with your child. Start with the fundamentals like counting or identifying shapes and patterns. Testing ideas and solutions together is a great way to show your child that failure is sometimes a part of the learning process. Make math fun and create new memories by problem-solving together.



Polymakers

Invest in out-of-school time programs to give more kids access to transformational learning opportunities.

For every child enrolled in an afterschool program, there are three more waiting to get in. In fact, over 50% of programs nationwide reported having a waiting list in 2022, with 80% of programs surveyed concerned that children are unable to find afterschool programming despite needing it.⁵⁴

This is happening across communities in the U.S. and is an excellent way to support youth and families within a region. Investments in learning outside of the classroom expand workforce pathways, economic prosperity, and social mobility for local constituents.

Following the U.S. Department of Education's latest initiatives such as Engage Every Student and YOU Belong in STEM, policymakers can also leverage federal initiatives to expand learning opportunities beyond the classroom for millions more students in their community.

Listen to local programs, families, and youth to learn more about the challenges faced and co-design solutions for greater impact.

Hearing directly from youth about the impact of an afterschool program can give critical insight into how the experiences can change the trajectory of a young person's life. By listening to young people and their families, policymakers can make informed decisions from a more comprehensive view of the situation - with both data and insight into the daily lives of the people most impacted by policy.

Towards this, in September 2023, the U.S. Department of Education's National Center for Education Statistics (NCES) and the Institute of Education Sciences (IES), together with policy leaders including the White House Office of Science and Technology Policy (OSTP) convened a three-day summit to bring together national, state, and local leaders to explore efforts to address the mathematics learning deficits exacerbated by the pandemic. There, leading experts discussed strategies for mathematics instruction and academic interventions; highlighted solutions rooted in research and successful classroom practices; and explored emerging resources.

Incorporating youth voices and community engagement is essential to ensure that policies are aligned with the unique needs of those they are designed to serve.

Support policies that remove barriers for young people to access high-quality math learning opportunities.

Equitable approaches to math education and program access, are essential for building a sustainable future STEM workforce. Policymakers can incentivize more intentional efforts for inclusive access to mathematics and other STEM education opportunities by offering the appropriate policy guidance and recommendations.

In September 2021, the Interagency Working Group on Inclusion in STEM, established under the National Science and Technology Council (NSTC), published a report on Best Practices for Diversity and Inclusion in STEM Education and Research. This report included key recommendations, including policy recommendations, on how to promote diversity and inclusion of all groups in the Federal STEM workforce.

Furthermore, an emphasis should be placed on quality, evidence-based approaches to mathematics education. For example, the U.S. Department of Education's IES What Works Clearinghouse has provided recommendations, action steps, practical examples, and the latest evidence on teaching in math.⁵⁵

By developing policies that promote high-quality, equitable, and accessible math learning opportunities, policymakers can help shape a brighter future for students and the country as a whole, where math education plays a pivotal role in shaping well-rounded, empowered citizens ready to meet the challenges of the 21st century.



Resources

1. Mervosh, S. (Sept. 2022). The Pandemic Erased Two Decades of Progress in Math and Reading. New York Times. <https://www.nytimes.com/2022/09/01/us/national-test-scores-math-reading-pandemic.html>
2. Mervosh, S. and Wu, A. (Oct. 2022). Math Scores Fell in Nearly Every State, and Reading Dipped on National Exam. New York Times. <https://www.nytimes.com/2022/10/24/us/math-reading-scores-pandemic.html>
3. Tucker, M. (May 2021). Why Other Countries Keep Outperforming Us in Education (and How to Catch Up). Education Week. <https://www.edweek.org/policy-politics/opinion-why-other-countries-keep-outperforming-us-in-education-and-how-to-catch-up/2021/05>
4. Kline, M. (1972). Mathematical Thought from Ancient to Modern Times. Oxford University Press.
5. Hughes, B. (April 2023). WWL: New Research Shows Overwhelming Support for Improving Math Education. Bill and Melinda Gates Foundation.
6. Blotnick, K. A., French, F., & Joy, P. (2018). A study of the correlation between STEM career knowledge, mathematics self-efficacy, career interests, and career activities on the likelihood of pursuing a STEM career among middle school students. International Journal of STEM Education, 5(1), 1-15. <https://doi.org/10.1186/s40594-018-0118-3>
7. Cresswell, C., & Speelman, C. P. (2020). Does mathematics training lead to better logical thinking and reasoning? A cross-sectional assessment from students to professors. PLoS ONE, 15(7). <https://doi.org/10.1371/journal.pone.0236153>
8. Greenwald, E., Leitner, M., & Wang, N. (2021). Learning Artificial Intelligence: Insights into How Youth Encounter and Build Understanding of AI Concepts. *Proceedings of the AAAI Conference on Artificial Intelligence*, 35(17), 15526-15533. <https://doi.org/10.1609/aaai.v35i17.17828>
9. Goldman Sachs. (April 2023). Generative AI could raise global GDP by 7%. <https://www.goldmansachs.com/intelligence/pages/generative-ai-could-raise-global-gdp-by-7-percent.html>
10. Business Roundtable. Education and Workforce: The Skills Gap, Explained. <https://www.businessroundtable.org/policy-perspectives/building-americas-tomorrow-ready-workforce/closing-the-skills-gap/the-skills-gap-explained>
11. Langreo, L. (July 2023). Students Want STEM Careers, But Think Schools Are Doing a 'Poor Job' Preparing Them. Education Week. <https://www.edweek.org/technology/students-want-stem-careers-but-think-schools-are-doing-a-poor-job-preparing-them/2023/07>
12. Marcus, J. (Sept. 2023). America's poor math skills raise alarms over global competitiveness. The Seattle Times. <https://www.seattletimes.com/education-lab/americas-poor-math-skills-raise-alarms-over-global-competitiveness-2/>
13. World Economic Forum. (2023). The Future of Jobs Report 2023. <https://www.weforum.org/publications/the-future-of-jobs-report-2023/digest/>
14. White, O. (February 2023). How our interconnected world is changing. McKinsey Global Institute. <https://www.mckinsey.com/mgi/our-research/how-our-interconnected-world-is-changing>
15. Jaumotte, F., Oikonomou, M., Pizzinelli, C., Tavares, M. (March 2023). How Pandemic Accelerated Digital Transformation in Advanced Economies. <https://www.imf.org/en/Blogs/Articles/2023/03/21/how-pandemic-accelerated-digital-transformation-in-advanced-economies>
16. U.S. Bureau of Labor Statistics. (September 2023). Employment Projections. <https://www.bls.gov/emp/tables/stem-employment.htm>; Rieley, M. (June 2018). Big data adds up to opportunities in math careers. U.S. Bureau of Labor Statistics. <https://www.bls.gov/opub/btn/volume-7/big-data-adds-up.htm>
17. Melkadze, G. (November 2012). Math Education – an Engine of Economic Growth in the 21st Century. ISET Economist Blog. <https://iset-pi.ge/en/blog/586-math-education-an-engine-of-economic-growth-in-the-21st-century>
18. Educational Policy Institute. (January 2019). ACT High School College and Career Readiness, 2018. <https://educationalpolicy.org/act-high-school-college-and-career-readiness-2018/>
19. Athanasia, G., and Cota, J. (April 2022). The U.S. Should Strengthen STEM Education to Remain Globally Competitive. Center for Strategic and International Studies. <https://www.csis.org/blogs/perspectives-innovation/us-should-strengthen-stem-education-remain-globally-competitive>
20. Hanushek, E. A., and Woessmann, L. (August 2021). Education and Economic Growth. Economics and Finance. <https://doi.org/10.1093/acrefore/9780190625979.013.651>
21. U.S. Bureau of Labor Statistics. (May 2023). Education pays, 2022. <https://www.bls.gov/careeroutlook/2023/data-on-display/education-pays.htm>
22. OECD. (September 2023). Economic & social outcomes. <https://gpseducation.oecd.org/revieweducationpolicies/#!node=41761&filter=all>

23. James, J. (November 2013). The Surprising Impact of High School Math on Job Market Outcomes. Federal Reserve Bank of Cleveland. EC 2013-14 DOI 10.26509/frbc-ec-201314
24. U.S. Bureau of Labor Statistics. (September 2023). Math Occupations. <https://www.bls.gov/ooh/math/home.htm>
25. Briggs, J., Hatzius, J., Kodnani, D., and Pierdomenico, G. (March 2023). The Potentially Large effects of Artificial Intelligence on Economic Growth. Goldman Sachs. https://www.key4biz.it/wp-content/uploads/2023/03/Global-Economics-Analyst-The-Potentially-Large-Effects-of-Artificial-Intelligence-on-Economic-Growth-Briggs_Kodnani.pdf
26. OUSD(R&E). Critical Technology Areas. <https://www.cto.mil/usdre-strat-vision-critical-tech-areas/>
27. Department of Defense. (2023). Sharpening Our Competitive Edge. <https://www.cto.mil/ndsts/#:~:text=National%20Defense%20Science%20%26%20Technology%20Strategy%202023,-Sharpening%20Our%20Competitive&text=%E2%80%9CThis%20Strategy%20helps%20us%20make,security%20over%20the%20long%20term.%E2%80%9D>
28. U.S. Commission on Civil Rights. (October 2010). Encouraging Minority Students to Pursue Science, Technology, Engineering and Math Careers. <https://www.usccr.gov/files/pubs/docs/EncouragingMinorityStudentsinScienceCareers.pdf>
29. National Center for Science and Engineering Statistics (NCSES). (April 2021). Women, Minorities, and Persons with Disabilities in Science and Engineering. National Science Foundation. <https://ncses.nsf.gov/pubs/nsf21321/report>
30. National Science Foundation. (2021). Women, Minorities, and Persons with Disabilities in Science and Engineering. Retrieved from <https://ncses.nsf.gov/pubs/nsf21321/>
31. Jones, N., Marks, R., Ramirez, R., and Rios-Vargas, M. (August 2021). 2020 Census Illuminates Racial and Ethnic Composition of the Country. U.S. Census Bureau. <https://www.census.gov/library/stories/2021/08/improved-race-ethnicity-measures-reveal-united-states-population-much-more-multiracial.html>
32. Davis, J., Patrick, K., and Rose Socol, A. (April 2022). Why Are Black and Latino Students Shut Out of AP STEM Courses? The Education Trust. <https://edtrust.org/resource/why-are-black-and-latino-students-shut-out-of-ap-stem-courses/>
33. Camera, L. (2015). Low-Income Student Shortchanged on Math Curriculum. U.S. News. <https://www.usnews.com/news/articles/2015/09/30/low-income-students-shortchanged-on-math-curriculum>
34. Flannery, M. (2023). Math is Not Boring! neaToday. <https://www.nea.org/nea-today/all-news-articles/math-not-boring#:~:text=Key%20Takeaways,look%20at%20the%20world%20through>
35. Koskinen, R., & Pitkaniemi, H. (2022). Meaningful Learning in Mathematics: A Research Synthesis of Teaching Approaches. International Electronic Journal of Mathematics Education, 17(2), em0679. <https://doi.org/10.29333/iejme/11715>
36. An, L., Lynch, K., and Mancenido, Z. (2022). The Impact of Summer Programs on Student Mathematics Achievement: A Meta-Analysis. (EdWorkingPaper: 21-379). Retrieved from Annenberg Institute at Brown University: <https://doi.org/10.26300/da7r-4z83>
37. Harvey, J. and Yan, V. (2021). Re-thinking Failure in the Math Classroom. Big Ideas Learning. <https://bigideaslearning.com/blog/re-thinking-failure-in-the-math-classroom>
38. Theobald, E. J., Hill, M. J., Tran, E., Agrawal, S., Arroyo, E. N., Behling, S., Chambwe, N., Cintrón, D. L., Cooper, J. D., Dunster, G., Grummer, J. A., Hennessey, K., Hsiao, J., Iranon, N., Jones, L., Jordt, H., Keller, M., Lacey, M. E., Littlefield, C. E., . . . Freeman, S. (2020). Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math. Proceedings of the National Academy of Sciences, 117(12), 6476-6483. <https://doi.org/10.1073/pnas.1916903117>
39. White, E. (2018). State of STEM: Defining the Landscape to Determine High-Impact Pathways for the Future Workforce. STEM Connector. <https://www.stemconnector.com/download-resource/state-of-stem/>
40. Remington, T. F., Chou, P., & Topa, B. (2023). Experiential learning through STEM: Recent initiatives in the United States. International Journal of Training and Development, 27(3-4), 327-359. <https://doi.org/10.1111/ijtd.12302>; Mizzen. (2020). Experiential Learning in Afterschool Programming. <https://www.mizzen.org/the-mizzen-minute/experiential-learning-in-afterschool-programming>
41. Uyen, B. P., Tong, D. H., & Lien, N. B. (2022). The Effectiveness of Experiential Learning in Teaching Arithmetic and Geometry in Sixth Grade. Frontiers in Education, 7, 858631. <https://doi.org/10.3389/feduc.2022.858631>
42. Uyen, B. P., Tong, D. H., & Lien, N. B. (2022). The Effectiveness of Experiential Learning in Teaching Arithmetic and Geometry in Sixth Grade. Frontiers in Education, 7, 858631. <https://doi.org/10.3389/feduc.2022.858631>
43. Allen, P. J., Chang, R., Gorrall, B. K., Waggenspack, L., Fukuda, E., Little, T. D., & Noam, G. G. (2019). From quality to outcomes: A national study of afterschool STEM programming. International Journal of STEM Education, 6(1), 1-21. <https://doi.org/10.1186/s40594-019-0191-2>
44. LearnFresh 2022 Annual Report. <https://annualreport.learnfresh.org/>

45. Blotnick, K. A., French, F., & Joy, P. (2018). A study of the correlation between STEM career knowledge, mathematics self-efficacy, career interests, and career activities on the likelihood of pursuing a STEM career among middle school students. *International Journal of STEM Education*, 5(1), 1-15. <https://doi.org/10.1186/s40594-018-0118-3>
46. Kulkin, M. (2016). Math is Like a Scary Movie? Helping Young People Overcome Math Anxiety. *Afterschool Matters*, n23 p28-32 <https://eric.ed.gov/?id=EJ1095916>
47. New York University. (2017). Afterschool Program Environments Linked to Academic Confidence and Skills. <https://www.nyu.edu/about/news-publications/news/2017/november/afterschool-program-environments-linked-to-academic-confidence-a.html>
48. Public Profit and STEM Next Opportunity Fund. (2022). Million Girls Moonshot Evaluation Report. https://static1.squarespace.com/static/63ddd4d3686ac83bfa8c608d/t/64d6e70d62914d6244b79fe6/1691805457767/Million+Girls+Moonshot+Mid-Initiative+Eval+Report_Year+2+%281%29.pdf
49. Harris, B. and Fox, L. (2022). Participation in Math Corps Increases College Enrollment. *Mathematica*. <https://www.mathematica.org/publications/participation-in-math-corps-increases-college-enrollment>
50. National Girls Collaborative Project. (2022). Access to STEM Framework: Creating Space For All Learners. https://static1.squarespace.com/static/63ddd4d3686ac83bfa8c608d/t/642b771b77255b06727e7e58/1680570141172/Access-to-Stem-A-Framework_Final-11-%C3%97-8.5-in+%281%29.pdf
51. Rodriguez, J. L., Jones, E. B., Pang, V. O., Park, C. D. (2004). Promoting Academic Achievement and Identity Development among Diverse High School Students. *High School Journal*, v87 n3 p44-53 <https://eric.ed.gov/?id=EJ728972>
52. Usiskin, Z. (2001). The Shortage of Qualified Math Teachers: A Major Problem and Some Suggested Solutions. "Talk presented at Seventeenth Annual UCSMP Secondary Conference" <https://ucsmp.uchicago.edu/resources/conferences/2001-11-10/>
53. Peterson, T. K., Vandell, D. L. (2022). The Evidence Base for Summer Enrichment and Comprehensive Afterschool Opportunities. National Summer Learning Association. <https://www.summerlearning.org/knowledge-center/investing-arp-funds/>
54. Afterschool Alliance. (2022). Access to Afterschool Programs Remains a Challenge for Many Families. <https://afterschoolalliance.org/documents/Afterschool-COVID-19-Parent-Survey-2022-Brief.pdf>
55. Blotnick, K. A., French, F., & Joy, P. (2018). A study of the correlation between STEM career knowledge, mathematics self-efficacy, career interests, and career activities on the likelihood of pursuing a STEM career among middle school students. *International Journal of STEM Education*, 5(1), 1-15. <https://doi.org/10.1186/s40594-018-0118-3>

ACKNOWLEDGEMENTS

We are extremely grateful to our partners, and for the support of Takeda to work towards solving our national math problem.

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STEM Next Opportunity Fund

Names to include???

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STEM Next Opportunity Fund is a national nonprofit with a mission to make out-of-school STEM opportunities a reality for millions of young people to help them thrive in STEM and beyond.