



The Importance of Early Invention Education

Early educational experiences are foundational to students' academic trajectory. From self-led to sensory-rich exploration, curating hands-on learning opportunities for primary students through invention education can improve academic outcomes and maximize sustained STEM interest. As K-6 students make authentic connections exploring real-world STEM challenges, their odds increase to continue exploring those subjects and developing interest in STEM-enriched careers. With significant brain development underway, sparking early interests through educational experiences is crucial to students making positive associations between science, discovery, inventing and fun.

At the elementary school level, students engage in a variety of formative experiences that are essential to building early connections, informing both short-term and long term academic paths. Moreover, primary-aged students' aptitude for new experiences lands at a pinnacle stage of development. Through active problem solving and imaginative thinking, invention education works in tandem with primary learners' cognitive development to enhance their academic trajectory.

What Is Invention Education?

Invention education is a pedagogy that leverages children's natural inclination to create and guides them through the act of hands-on invention to build an innovative mindset and essential life skills. It demonstrates to young learners how to think like inventors by encouraging them to identify real-world problems and develop their own solutions. In contrast to passive learning environments, invention education invites students to be active participants in their own learning experiences.

Invention education transcends the baseline for STEM subjects, giving students the chance to engage in active learning that transforms the way they approach everyday challenges and leads them to develop lifelong skills through the process of invention. That's why many schools and districts are now integrating STEM and teaching durable and 21st-century skills as part of their programming lineup.¹

Why Invention Education?

While invention education is rooted in STEM, the pedagogy extends beyond the standard paradigm of STEM education, broadening early learning experiences to accelerate career connections, strengthen critical thinking skills and inspire motivated, autonomous learning. For instance, not only does math competency predict later school success, but all areas of STEM contribute to other developmental goals, such as language and executive function².

Designed for open-ended exploration, invention education programs empower young learners to be co-creators in their first experiences with STEM and invention. The scientific questions children ask, such as why questions, show that science is natural and motivating for young children, as are engineering and technology.³ Without necessitating proficiency in STEM, these early learning experiences improve confidence in developing new skills through inquiry and experimentation. For example, prototyping — creating models that bring their ideas into 3D form — is a dynamic way to engage young children with fine motor skill development.

Striving to implement innovative educational experiences, teachers of all backgrounds can set the stage for academic growth that improves motivation, attendance and academic outcomes. Research demonstrates out-of-school-time (OST) programs are highly effective for STEM learning and early engagement, and often are crucial to sparking and sustaining children's STEM career interest⁴ — and invention education programs take these benefits even further.

Benefits of Invention Education

- Combats Absenteeism
- Increases STEM Interest and Aspirations
- Aligns with State Science, Math and ELA Standards
- Supports Differentiation in the Classroom
- Mitigates Behavior Challenges in the Classroom
- Increases Creativity and Problem-Solving Skills
- Promotes Divergent and Convergent Thinking Skills
- Increases Student Engagement and Agency
- Increases Math and Reading Scores
- Lowers Science and Math Anxiety

1. LittleBits, "Early Exposure to STEM and Its Impact on the Future of Work" (LittleBits, 2018), https://gems.education.purdue.edu/wp-content/uploads/2019/02/STEM_in_Schools_v1-2.pdf.

2. Douglas H. Clements and Julie Sarama, "Math, Science, and Technology in the Early Grades," *The Future of Children* 26, no. 2 (2016): 75-94, <http://www.jstor.org/stable/43940582>.

3. Clements and Sarama, "Math, Science, and Technology in the Early Grades," 75-94.

4. Patricia J. Allen, Rong Chang, Eriko Fukuda, Britt K. Gorrall, Todd D. Little, Gil G. Noam, and Luke Waggenspack, "From Quality to Outcomes: A National Study of Afterschool STEM Programming," *International Journal of STEM Education* 6, no. 37 (2019): 1-21, <http://dx.doi.org/10.1186/s40594-019-0191-2>.

Tapping into children's innate curiosity, high-quality invention education programs provide essential experiences with STEM and innovation that serve as a foundational advantage. While the traditional classroom has particular pacing needs, these invention education experiences introduce new concepts while empowering students to explore at their own pace and discover and refine their ideas in a self-led format. Primary participants might not be used to having the freedom to choose what they learn. Invention education is an empowering, and potentially new, experience. Young children are capable of using engineering habits of mind (e.g., systems thinking, creativity, optimism, communication, collaboration, supported persistence and attention to ethical thinking) in their free-play activities⁵. Encouraging these students to explore helps them develop an authentic desire to learn and grow.

Young children exercise their creativity freely, in a manner that often inspires more novel thinking in others around them. Invention education gives children opportunities to discover autonomy as creators in their own right, leading them to develop enthusiasm for exploring and finding new ways to see the world. Studies report that students are more likely to pursue STEM majors at universities and colleges if introduced to these topics in grade school. In addition, exposing students to STEM at a young age could capture their imagination and help retain them in STEM jobs in their early career stages⁶. To help young students approach STEM concepts with greater confidence from the start, invention education combines behavioral, cognitive and social engagement, leveraging student curiosity with experiential learning.

Research indicates that innovative programs like these are preparing children for bright futures and versatile career paths in STEM. According to the Department of Labor, more than 65% of today's students will grow up to have careers that do not exist yet. Today, more than ever, it is crucial to prepare our students to become future-ready and to have the confidence to invent the world they want to live in.

Why Partner With the National Inventors Hall of Fame to Implement Invention Education?

The National Inventors Hall of Fame[®] takes a unique approach to invention education by developing curricula inspired by the stories of more than 650 Hall of Fame Inductees. Through hands-on, STEM-based experiences informed by these real-world inventors, students strengthen confidence, creativity and problem solving as they take on authentic challenges that involve designing, prototyping and building entrepreneurship skills and Intellectual Property Literacy[®]. This educational model reimagines how schools can integrate student-centric learning experiences that encourage primary learners to sustain a lifelong interest in STEM and innovation.

Developed in partnership with its Inductees, the Hall of Fame's invention education programs not only connect students with

remarkable inventors and show them how the world's most impactful innovations are relevant in their daily lives, but they also give children unique opportunities to begin seeing themselves as capable innovators. Supported with high-quality instructional materials and a turnkey curriculum, educators can facilitate these transformative programs with ease.

Partnering with more than 3,000 schools and districts nationwide in 2025, the National Inventors Hall of Fame supports districts' education initiatives with invention education programs that fulfill evolving student needs. From deductive reasoning to STEM vocabulary, these programs create comprehensive learning experiences that benefit primary learners across subjects.

The importance of early invention education corresponds to how an innovative mindset is essential to solving everyday challenges and developing effective solutions. The National Inventors Hall of Fame's invention education programs are informed by and designed to instill the I Can Invent[®] Mindset — an open, curious and innovative mindset made up of nine key tenets that equip children to unlock their full potential.

This is the same mindset National Inventors Hall of Fame Inductees have used to develop world-changing inventions. All children are capable of building and applying the I Can Invent Mindset, which consists of the following competencies:

- Confidence
- Design Thinking
- Persistence
- Creative Problem Solving
- STEM
- Entrepreneurship
- Collaboration
- Intellectual Property
- Innovation

Cultivating unparalleled pathways to STEM, the invention education programs created by the National Inventors Hall of Fame support primary learners to build confidence in their own competencies. For example, according to research focused on Camp Invention[®], the Hall of Fame's nationwide K-6 summer program, children demonstrated significant gains in creativity, STEM interest and creative problem solving after participating in the program — specifically in critical areas of fluency, flexibility and elaboration.⁷ Over the long term, from one to four years after the program, there is even stronger evidence of growth in these areas.⁸

Upholding a strong commitment to independent research, the National Inventors Hall of Fame continuously measures the impact of our programs to highlight the leading benefits of invention education. Proven to reduce rates of absenteeism⁹ and increase math scores¹⁰, invention education helps children develop creativity and problem-solving skills¹¹ that translate into broader academic outcomes. As children develop a higher aptitude for inventiveness and strengthen their academic trajectories, sustained investment in research consistently substantiates the benefits of invention education through rigorous inquiry and evaluations.

5. Beth Van Meeteren and Betty Zan, "Revealing the Work of Young Engineers in Early Childhood Education," SEED: Collected Papers from the SEED (STEM in Early Education and Development) Conference (2010), <https://ecrp.illinois.edu/beyond/seed/zan.html>.

6. LittleBits, "Early Exposure to STEM and Its Impact on the Future of Work."

7. ChangeMaker Consulting LLC, 2014 Camp Invention Evaluation Report (ChangeMaker Consulting LLC, 2014).

8. John H. Falk and David Meier, Camp Invention 2017-2018 Pilot Study Report (Institute for Learning Innovation, 2018).

9. Summit Education Initiative, "Equity and Achievement for All Students," n.d., <https://seisummit.org/>.

10. Summit Education Initiative, National Inventors Hall of Fame Akron Public Schools Innovation 365 (I365): Wraparound Summer 2022 (Summit Education Initiative, 2023).

11. Summit Education Initiative, "Equity and Achievement for All Students."

Sparking student engagement through a blend of immersive, hands-on experiences and real-world connections, these programs set a standard of excellence for what authentic invention education experiences can help students achieve. Within each invention challenge, participants experiment with everyday materials (e.g., cutting recyclables and using tape effectively) to bring their ideas into physical form. As they engage in the process of inventing and bringing products to market, they encounter STEM phenomena, practice entrepreneurial thinking and make early career connections through project-based learning.

As primary learners retain important takeaways from exploring STEM phenomena, discovering accomplished inventors and practicing creative problem solving, they develop habits that benefit their academic performance long term. STEM habits of mind — such as critical thinking, persistence and systematic experimentation — are important across all subject areas and may be essential to how children learn to learn.¹² Invention education also prompts useful moments of metacognition, where students are able to identify how their thinking is evolving while sustaining their interests in STEM subjects.

Inspired by Hall of Fame Inductees and their impact, invention education programs from the National Inventors Hall of Fame connect early educational experiences with authentic stories of invention. Positioning inventors as relatable role models in whom children can see themselves reflected, these programs not only introduce visible STEM career pathways but also guide children to build the skills and confidence they will need to forge their own pathways and make their own mark on the world.

Sustaining Children's Interest in STEM and Innovation

National Inventors Hall of Fame invention education programs guide primary students to remain interested in STEM and innovation through the following core curriculum objectives:

- **Hands-On Exploration**

Guiding students to manipulate and experiment with materials through active learning experiences (e.g., cutting recyclables and using tape effectively) to develop intrinsic motivation as they bring their ideas into physical form.

- **Creative Problem Solving**

Building critical thinking, persistence and a growth mindset by empowering students to create visual representations as they sketch their original ideas. Placing an emphasis on children's ideas and vision versus the functionality of their invention(s).

- **Positive STEM Associations in a Safe Learning Environment**

Ensuring a strong sense of security with no “wrong” answers while helping students get comfortable with risk-taking and learning from failure. Planting seeds for positive associations between science, discovery, inventing and fun through inquiry and experimentation.

- **Self-Led Learning**

Supporting free-choice learning by encouraging primary students to explore and create while nurturing curiosity and personal interests.

- **Project-Based, Multidisciplinary Learning**

Creating new entry points for learning through integrated, cross-curricular experiences that empower students to develop solutions to real-world challenges.

- **Innovative Role Models**

Connecting students with relatable innovators who inspire new possibilities and pathways to STEM.

12. Greg J. Duncan and Katherine Magnuson, “The Nature and Impact of Early Achievement Skills, Attention Skills, and Behavior Problems,” in *Whither Opportunity? Rising Inequality, Schools, and Children's Life Chances*, ed. Greg J. Duncan and Richard J. Murnane (Russell Sage, 2011), 47–69.