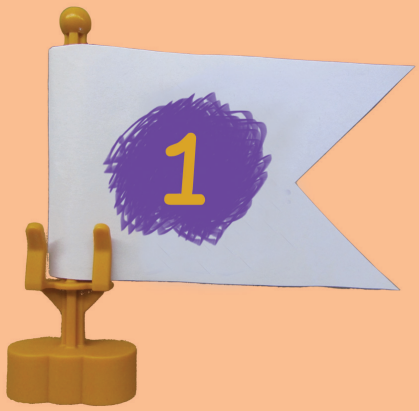
6 Key Benefits of Using Robotics in Your Early Childhood Classroom

KinderLab™ robotics

EARLY CHILDHOOD IS A WONDERFUL TIME

to spark kids' interest in coding, robotics, and engineering. Young children are curious about the world around them, and today that world includes technology. But how best to promote positive, creative, and educational engagement with technology? Integrating robotics and coding into early childhood education is easier than you may think, with hands-on, screen-free tools like KIBO.

Kibo™



Coding Teaches the Literacy of the 21st Century

Coding is becoming as fundamental to work, education, and culture as literacy was in earlier centuries. Not every child needs to become a computer programmer, but coding gives children the tools to create and participate in a culture, society, and working world increasingly structured by computers. We don't teach children to write because we want them all to be novelists or journalists; we teach them to write so they can express themselves. In the same way, **teaching children to code gives them fluency in a new set of tools for self-expression.** Coding with robots shows children that they can create with technology.

KIBO offers an inviting, engaging platform for children to start their journey into creating with code. KIBO's block-based coding language gives children control over the robot's movements, sounds, and sensors, allowing them to express their imaginations with code. Our curriculum encourages children to tell stories, create characters, and explore their world with KIBO.

Supporting research:

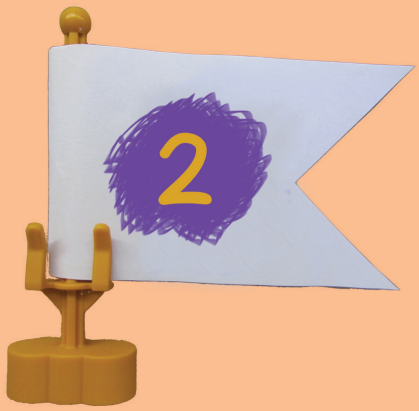
» Bers, M. (2008), *Blocks to robots: Learning with technology in the early childhood classroom.* New York, NY: Teachers College Press.

» Bers, M.U., (2018). *Coding as a playground: Programming and computational thinking in the early childhood classroom.* New York, NY: Routledge press.

» Papert, S. (1980). *Mindstorms: Children, computers and powerful ideas.* New York: Basic books.

"While developing technological fluency is important for understanding the world of bits and atoms around us, it is just as important to provide children with the vision that technology can also be used to make a better world."

(Bers, 2008)



Coding Develops Computational Thinking Skills

How do you solve a problem in a structured way? With computational thinking, you model the problem, break it down into smaller sequential steps, invent solutions, and test them out. The term "computational thinking" grew out of work in the 1980s by Seymour Papert, a pioneer in teaching children to create with code. More recently, theorists and educators have begun to explore the **connections between computational thinking and the cognitive skills developed in early childhood.** For example, when children use code to create algorithms (a series of ordered steps to solve a problem) they develop their sequencing ability: a foundational skill for reading and mathematics.

When children plan a sequence of actions for KIBO to perform, they assemble their program as a line of wooden command blocks. They scan the blocks with KIBO's barcode scanner, one by one in sequence. When the robot acts out the sequence, children can follow along by referring to the blocks they've scanned. **KIBO's programming method is rooted in years of research identifying the most effective ways to introduce coding in early childhood education.**

Supporting research:

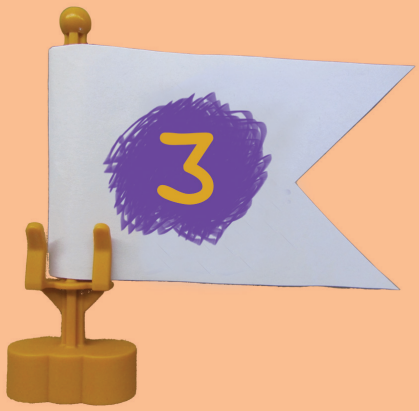
» Sullivan, A., & Bers, M.U. (2015). *Robotics in the early childhood classroom: Learning outcomes from an 8-week robotics curriculum in pre-kindergarten through second grade.* International Journal of Technology and Design Education.

» Kazakoff, E., Sullivan, A., & Bers, M.U. (2013). *The effect of a classroom-based intensive robotics and programming workshop on sequencing ability in early childhood.* Early Childhood Education Journal, 41(4), 245-255. doi:10.1007/s10643-012-0554-5.

» Papert, S. (1980). *Mindstorms: Children, computers and powerful ideas.* New York: Basic books.

"As early as pre-kindergarten, children are able to master foundational concepts regarding programming a robot and that children as young as 7 years old are able to master concepts as complex as programming a robot using conditional statements."

(Sullivan & Bers, 2015)



Technology Becomes the Playground

Young children are naturally curious about the world around them. Today, that world includes technology. As adults – whether educators or parents – we have a responsibility to ensure that children's exploration of technology is age-appropriate, safe, and creative. In her writings, KinderLab Robotics' co-founder Dr. Marina Bers explains that **a technology-rich experience for children should be modeled on the idea of a playground.** On a playground, children move and explore, they invent games and stories, and they collaborate with peers and negotiate conflicts. They are supervised by adults throughout, but they lead their own experience.

The best technology experiences for children are technology playgrounds, filled with creativity, exploration, and social engagement. When building and programming with KIBO, children follow their own creative interests within **a technological space that has been carefully designed to support their developmental needs.** They work together, they discover, and they share as they create.

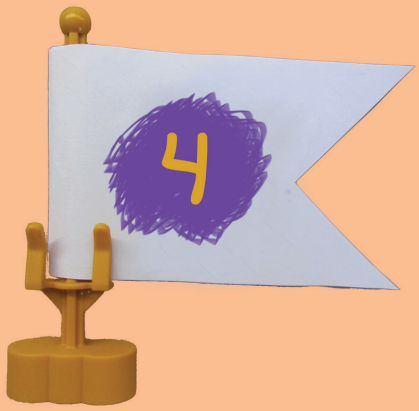
Supporting research:

» Bers, M. (2012). *Designing digital experiences for positive youth development: From playpen to playground.* Cary, NC: Oxford.

» Bers, M.U., (2018). *Coding as a playground: Programming and computational thinking in the early childhood classroom.* New York, NY: Routledge press.

"Coding can become a playground, an environment to be creative, to express ourselves, to explore alone and with others, to learn new skills, and to problem solve. All of this, while having fun."

(Bers, 2018)



Robotics Makes Coding Tangible and Concrete... and Screen-Free!

Educational theorists have long recognized that **young children think and learn best when moving, playing, building, and engaging with concrete objects.** Traditional coding is often screen-based and abstract. But with robotics, children's code affects the physical world – the robot moves and reacts based on the instructions the children give it. The robot is an "object to think with," in Seymour Papert's phrasing.

Even better, with KIBO, the programming language itself is tangible and concrete. Children program KIBO by sequencing physical wooden blocks, similar to familiar educational manipulatives like building blocks and Cuisenaire rods. Coding with KIBO's wooden blocks requires no screen time for these young learners. **Studies with KIBO demonstrate that children benefit from connecting programming concepts to concrete, physical objects, reinforcing learning in an age-appropriate way.**

Supporting research:

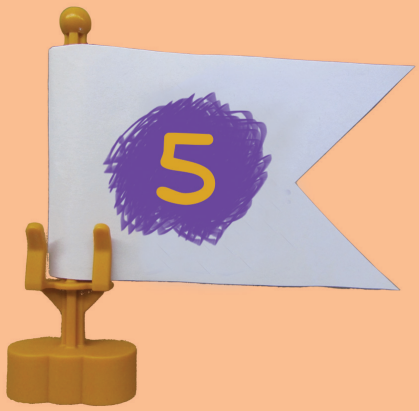
» Papert, S. (1980). *Mindstorms: Children, computers and powerful ideas.* New York: Basic books.

» Bers, M. (2008), *Blocks to robots: Learning with technology in the early childhood classroom.* New York, NY: Teachers College Press.

» Pugnali, A., Sullivan, A., & Bers, M.U. (2017) *The Impact of User Interface on Young Children's Computational Thinking.* Journal of Information Technology Education: Innovations in Practice, 16, 172-193.

*"**S**tudents in the tangible KIBO group scored higher across all four computational thinking categories in comparison to the [screen-based programming] group."*

(Pugnali et al., 2017)



Using Technology Breaks Down Engineering Stereotypes

Scientific and technical fields suffer from a gender participation gap. Research shows that **even in early childhood, children are already beginning to form opinions and stereotypes** about which tools and technologies are better suited towards boys. By engaging young children in coding and robotics activities before these stereotypes begin to take root, we can help them build positive associations with technology and engineering and a self-image as a creator with technology.

KIBO is purposefully designed with a neutral aesthetic and in gender neutral colors so that it is appealing to all children. Though not all children will become engineers or computer programmers, **a foundation in robotics and coding education gives all children an opportunity** to make that choice for themselves. KIBO includes building platforms to allow children to extend and decorate the robot with arts and crafts materials, providing an open-ended building and design experience which draws on a wide range of children's interests.

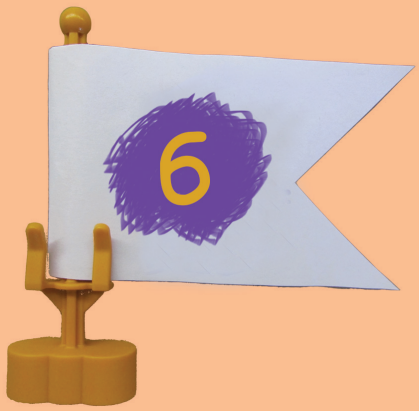
Supporting research:

» Sullivan, A. & Bers, M. U. (2016). *Girls, boys, and bots: Gender differences in young children's performance on robotics and programming tasks.* Journal of Information Technology Education: Innovations in Practice, 15, 145-165.

» Sullivan, A., & Bers, M. U. (2013). *Gender differences in kindergarteners' robotics and programming achievement.* International Journal of Technology and Design Education, 23 (3), 691-702.

"Young children ages 4–7 are already beginning to decide which technology and engineering activities and materials are better suited to boys or girls. This is a pivotal time to introduce children to innovative new technologies, such as robotics, before they form gender-biased opinions of these tools."

(Sullivan& Bers, 2016)



The Engineering Design Process Develops Grit and Perseverance

Working with robotics and coding, especially when facilitated in a classroom, means engaging with the engineering design process. This process encourages children to **identify a problem, imagine and plan a solution, build and test their creation, and share their work** with peers. In this process, things won't always work as intended – ask any engineer! The process is set up to expect students to test, fix, and debug their work, so students focus on continually making changes and improvements rather than on being right or wrong – a "growth mindset." As they seek input and advice from peers, children also develop collaborative social skills around a shared project.

When working with KIBO and KinderLab's curriculum, children are guided through the Engineering Design Process right from the start, first by building and testing sturdy craft constructions and later applying the process to all of their robotics projects. **KIBO gives children clear and concrete feedback about whether their programs are working as intended**, and the wooden block programming language makes revision easy. Each lesson ends with a circle time where kids share the challenges they encountered and trade ideas for improvements.

Supporting research:

» Papert, S. (1980). *Mindstorms: Children, computers and powerful ideas.* New York: Basic books.

» Dweck, Carol S. (2008). *Mindset: The new psychology of success.* New York, NY: Ballantine Books.

» Bers, M. (2012). *Designing digital experiences for positive youth development: From playpen to playground.* Cary, NC: Oxford.

*"**M**any children are held back in their learning because they have a model of learning in which you have either 'got it' or 'got it wrong.' But when you program a computer you almost never get it right the first time… The question to ask about the program is not whether it is right or wrong, but if it is fixable."*

(Papert, 1980)

KinderLab Robotics, Inc. is the creator of KIBO, a robot kit specifically designed for young children aged 4–7 years old. With KIBO, children build, program, decorate, and bring their own robot to life. KIBO is entirely screen free, as children program their robots with "tangible code" made of wooden blocks. KIBO is supported by over 15 years of research, led by KinderLab co-founder Marina Umaschi Bers, PhD., professor at the Eliot-Pearson Department of Child Study and Human Development and director of the DevTech Research Group at Tufts University.

To learn more, or to purchase KIBO for your classroom, visit our website at **www.kinderlabrobotics.com**. There you'll find information about KIBO, all the add-on modules, and our extensive curriculum offerings to support classroom STEAM activities.

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