Tiny Tech

A Pre-Coding Primer for Preschoolers

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Preschoolers practice binary coding by making bracelets with their coded initials (photo by Debbie Roycroft, KidSpace staff member at GBPL).

I grew up in an artistic family—creativity is in our DNA. As a child, I did everything from ballet to theater to writing camp.

Did I do computer science as a preschooler? No.

Did I learn how to code? Surely not—it was the '80s!

However, after studying early childhood education and developmental psychology, I've learned this—coding isn't far from my art background. In fact, coding itself is creative and engages both sides of our brain. In fact, that National Association for the Education of Young Children states, "Early coding, or precoding, offers children experiences that integrate communication, thinking, and problem solving. These are twenty-first-century skills that are valuable for children's future success in our digital world."[1]

So, what is "precoding" and why is it important to teach children before they enter kindergarten? Coding, also called programming, is simply telling a computer what you'd like it to do. A computer program is a list of specific, step-by-step instructions that tell a computer what to do. Think about this—when you instruct a child to sit down cross-legged on the carpet for storytime, children instinctively understand what to do because the steps are in the muscle memories of their bodies. However, there are many steps involved—placing two feet hips-width distance apart, bending one's knees slowly, crossing one foot in front of the other, and then releasing one's bottom to the ground. The order of these steps is also important. What if a child released her bottom before bending her knees? Ouch! Fortunately, we don't have to code our bodies in order to achieve a desired goal of sitting down.

However, a computer doesn't have the same innate knowledge that our bodies do. A computer needs step-by-step instructions in order to perform the task you want. These step-by-step instructions are a computer's *language*.

Coding encourages preschoolers to think about efficiency and something called *decomposition*—being able to articulate a problem and think logically to break it down into smaller steps. What happens when a child makes a mistake? Coding *encourages* kids to make mistakes because learning comes from trial and error. Just like learning choreography for a dance or the correct finger positions for the flute, coding is about finding the right steps in the right order to find the desired result. In this way, coding is creative! Coding is experimenting, playing, and designing.

Preschoolers in 2020 are digital natives. They learn systems in tablets and phones right alongside reading, writing, and math. A coding foundation will help preschoolers begin to think like problem solvers, critical thinkers, even detectives. How can we break down this mystery to discover the answer? How do we fix a computer "bug" or a technical problem?

Douglas Rushkoff, professor of Media Theory and Digital Economics at Queens College, City University of New York, believes that code literacy is a twenty-first-century requirement. He argues that it not only develops skills like critical thinking and problem solving, but also "learning code—and

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doing so in a social context—familiarizes people with the values of a digital society: the commons, collaboration and sharing. These are replacing the industrial age values of secrecy or the hoarding of knowledge."[2]

Most precoding or early coding is done collaboratively, which encourages socioemotional skills such as distress tolerance and emotional regulation. Globally, I wish we fostered more encouragement and collaboration with each other, rather than fueling ourselves with competition.

So, where do you start pre-coding with preschoolers? There are many options. You truly don't have to be a computer whiz! If you are new to coding, my suggestion is to start tech-free, and then purchase a few tech toys that are non-intimidating and relatively inexpensive. Please know that there are *many* toys and several companies that sell products. I am not endorsing any specific brand; here are some of my current favorites.

For Toddlers and Preschoolers: Directional Language and Patterns

We learn coding just like we learn any language—through understanding a language's alphabet, organization, and order. For example, letters are set in an order to form a word; words are set in an order to form a sentence. Sentences make a paragraph, and paragraphs make a book! Thus, using directional language and practicing simple sequencing is a great way to begin teaching preschoolers coding. Using concept words like forward, backward, up, and down give preschoolers the framework for understanding a sequence. Playing pattern games, such as making a sequence with Skittles or M&M's (red, blue, red, blue) builds the foundation for understanding that coding is a list of actions in a predetermined order.

Screen-Free Coding Activities

In a group discussion, ask children how they do a variety of activities, such as put on their pajamas, read a book, or go potty.

They may describe the activity, tell a story, talk about what they do. But as you discuss with them, break the story down even further into a step-by-step sequence. This uses directional statements, such as "then."

For example, for putting on pajamas:

a. First, you find your pajamas.

b. Then, you pick up your pajamas.

c. Then, you lift one leg into the pajamas.

d. Then you lift the other leg into the pajamas.

e. If you can't get you leg in the first time, you try again.

f. You button or zip your pajamas.

You can take this even further and ask the kids to break down each step even *more*. To find your pajamas, you need to walk to your dresser, reach your hand down, open the drawer, etc. The possibilities are endless. You can also get silly and ask, "What would happen if you buttoned your pajamas before you put them over your head? This would be called a "bug" in the coding, and you would have to "debug" the code by putting the steps in the correct order.

Another Screen-Free Coding Activity Is If/Then or While/Do

Computers will perform your instructions *only if* a certain condition is fulfilled. This is called conditional coding. You, the caregiver or teacher, will be the coder. The child will be the computer. Then state, "While I do ___, you do ___." For example, "While I do the dishes, you brush your teeth." Or "While I rub my tummy, you jump up and down." Then, let the little one be the coder! This teaches children that the computer will *only* do a task if you tell it to in a language it understands.

If/Then is similar. "If I'm rubbing my tummy, you jump up and down." This game is very much like Simon Says. You can make this as complicated or simple as you'd like. The object is for the "computer," AKA the child, to only do what you tell them *if* you are doing the first part of the code. So, in the example above, if you are rubbing your ears or simply doing nothing, your child should not be jumping up and down.

Sharing Coding Books in Storytime

There are many books specifically about coding, such as *How to Code a Sandcastle* by Josh Funk or his new book *How to Code a Rollercoaster*, but I like to think of coding books in storytime more broadly. Picturebooks about problem solving and directions are great options. Any books that involve predicting what happens next or looking at patterns (think about fairy tales, like Goldilocks, that repeat patterns like "not too cold," "not too soft," etc.) are great choices. Bringing in books about robots and other technology is another way to introduce coding. Truly, you can use any book as a baseline and integrate the coding how it best fits you and your storytime style. Here are some of my favorites:

If You're A Robot And You Know It by David Carter

Pete the Cat: Robo-Pete by James Dean

Boy and Bot by Ame Dyckman

Stuck by Oliver Jeffers

Doll-E 1.0 by Shanda McCloskey

A House in the Woods by Inga Moore

Because Amelia Smiled by David Ezra Stein

Beep! Beep! Go to Sleep! by Todd Tarpley

Coding Bracelets or Chains

Computers read code in a system of zeros and ones and translate it to a language called ASCII. A specific string of code determines what numbers, letters, and symbols the computer understands. The reason it is called "binary" code is because there are only two options for coding language. For this project, kids spell out their initials or name, using binary code. They choose one color for 1s and another color for 0s, write out their initials or name according to the ASCII alphabet, and then use the two colors of beads they chose to "code" their initials with those colors on a bracelet.

Using Pre-Coding Technology, Such As Coding Robots and Games

There are many precoding games and toys to purchase. None of them are perfect, and have mixed reviews, but I will share my favorites.

■ **Bunny Trails by Future Coders Alex Toys.** In this game, you help Bunny find a path through the garden. You set down tiles with black lines on a board to create a path to find a delicious carrot. However, there are obstacles, such as bees, foxes, and gates along the way. Kids must strategize and thoughtfully plan out the bunny's course to be successful. Best part: If the path is incorrect, kids simply take off one tile and replace it! This is much different than other robots with buttons, because *you don't have to start over.* You just change out a tile.

■ **Robot Races by Future Coders Alex Toys.** This is like a large motor version of Bunny Trails. In this Twister-like game, YOU are the robot! You put on a robot headband, place arrow cards on a large mat, and then walk the path you've coded, avoiding obstacles along the way. Both of these Future Coders games come with cards that range from level 1 to level 20, each getting progressively more difficult.

■ **Code-a-Pillar by Fisher-Price.** This robot has segments that attach to each other using a simple USB port. You can

Open exploration is a great opportunity for kids to learn coding. These kids wrote the code for the Code-a-Pillar to go through their legs!

make the Code-a-Pillar go forward, left, and right, and each segment lights up when the robot does the movement, so kids can "see" the code they created. There are more than a thousand possible combinations, and this toy encourages experimentation and open play. The one thing that drives me little nuts about this one is the sound. I haven't found a way to turn the sound off, and it can be quite loud.

■ **Bee Bot by Lakeshore Learning and Robot Mouse by Learning Resources.** These two products work very similarly. Kids enter a "code" pressing directional buttons (forward, back, left, and right). Pressing the green GO button starts the Bee Bot or Robot Mouse on its way! I've used both of these robots in drop-in programs, as well as at the end of storytimes. I love to give the kids a visual goal to go to, such as a piece of play cheese for Robot Mouse or a giant Beehive for Bee Bot. Giving a visual goal allows kids to problem solve along the way, to get the robot to the target in as few steps as possible.

What's the best way to use these ideas? It's up to you! My favorite thing is a drop-in open play program, such as something we've had at Gail Borden Library called Tiny Tech. You can circulate coding robots, keep them behind the desk for in-house use only, or make STEM kits with interactive activity ideas. I think the most important thing is to give it a try. I'm definitely more of an artist than a scientist, but it wasn't until I gave coding and robots a try that I realized that I needed creativity in order to code. **&**

References

1. Deanna Pecaski Mclennan, "Creating Coding Stories and Games," *Teaching Young Children* 10, no. 3 (February/March 2017), www.naeyc.org/resources/pubs/tyc/feb2017/creating-coding-stories-and-games.

2. Douglass Rushkoff, "Code Literacy: A 21st-Century Requirement," blog post, https://rushkoff.com/code-literacy-a-21st-century-requirement.