Tech Time with Purpose

A Creative Approach to Using Digital Devices with Young Children

Bay Area Discovery Museum

About the Bay Area Discovery Museum

The Bay Area Discovery Museum (BADM) has been a leader in early childhood education since opening its doors more than 30 years ago. Located in Sausalito, CA, on more than 7.5 acres of land, the museum is a special place where children immerse themselves in play, try new things, and make discoveries through exciting (and often messy!) hands-on learning. BADM is known for innovative programs, award-winning summer camps, and for creating spaces and experiences where children can take risks and persist through challenge.

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The CREATE Framework

At BADM, everything we do is backed by high-caliber research from some of the most prominent scholars in the fields of creativity and developmental science. We are passionate about transforming this research into practice, and using it to design meaningful learning opportunities that nurture children's curiosity, self-confidence, and resilience. We do this through a framework called CREATE[1], which stands for Child-Directed, Risk-Friendly, Exploratory, Active, Time for Imagination, and Exchange of Ideas.

BADM's CREATE framework is applicable outside the museum, too. The same lens we look through to develop our programs and exhibits can help you navigate the trickier aspects of parenting at home. For many parents, complicated decisions often center on digital technology. In this paper, we use the CREATE framework to look at the digital world, in order to give parents and caregivers a fresh way to examine the games and programs out there for children. The goal is to empower you to make confident decisions with your family about digital technology, so that using digital devices is not just fun, but also strengthens the skills we know young children need.

What Is Digital Technology?

When we say "digital technology," we are referring to both the physical devices — computers, tablets, and phones — as well as the software they run, meaning the games and the apps. In this paper, we consider: digital games, coding, augmented reality, virtual reality, digital fabrication, social robots, and conversational agents.

About This Paper

This paper is intended for parents and caregivers of children ages 2 through 12. We hope that teachers, librarians, and other informal educators will also find it valuable, particularly given the widespread use of digital technology in classrooms and community spaces.

This paper should give you increased confidence when deciding how your children can get the most benefit from digital technologies. In the pages that follow, you'll find:

- Specific, actionable recommendations for parents and caregivers
- The research and evidence behind our takeaways
- Infographics that explain key concepts
- A Quick Guide for a summary of ideas
- BADM-trusted resources for additional information

DEFINITIONS

Digital Games: Games that are played using a digital device, such as a tablet, mobile phone, computer, or television.

Coding: A process of creating a sequence of instructions and translating it into a language that a computer can understand and implement.

Augmented Reality (AR): A technology where the user's view of the real world is modified by superimposed digital components.

Virtual Reality (VR): A fully immersive experience where an individual interacts with a 3D virtual world via a headset.

Digital Fabrication: A method of using a computer to create a design which is then transformed into a real object, often using tools such as 3D printers, laser cutters, and vinyl cutters.*

Social Robots: Robots designed to respond to social behaviors and interactions with humans and other robots.

Conversational Agents: Digital systems that allow people to use vocal commands to play games, listen to music, obtain information, and more.

**A 3D printer melts plastic at a very high temperature and deposits it in very thin layers to create an object. A vinyl cutter uses a thin blade to make precise cuts through paper, fabric, and vinyl. A laser cutter uses a very bright light to cut or engrave different materials such as cardboard, wood, plastic, glass, or metal.*

A Special Note About Digital Games

We recognize that, out of the seven technologies listed, digital games are overwhelmingly the biggest part of children's lives today. A 2017 study found that on average, 2- to 4-year-olds play video games for 21 minutes per day, and 5- to 8-year-olds play video games for 42 minutes per day.[2] Another survey of nearly 700 elementary school teachers found that 74% use digital games for instruction in their classrooms.[3]

Rest assured: Not all time spent playing digital games is bad. An analysis of 101 studies of children between the ages of 5 and 17 found either a very small or no relationship between the amount of time spent on gaming and low academic success, aggressive behavior, or low prosocial behavior.[4] And one study of more than 3,000 children in six countries found that those who played video games for more than five hours per day were actually less likely than their peers to have problems relating to other children or to have mental health issues.[5]

That said, not all video game play is good. In addition to the recommendations we provide throughout this paper, BADM encourages parents to:

- Limit combined video game and television screen time, as recommended by the American Academy of Pediatrics (AAP). Researchers found that children between the ages of 6 and 12 who spent more than two hours per day watching TV and playing video games, the limit recommended by AAP, "were more likely to be above average in attention problems."[6]

- Limit exposure to violent video games. In one laboratory study of children ages 5 through 12, those who reported playing more violent games at home showed lower levels of empathy than those who played a violent game for 15 minutes.[7]

- Be aware when engagement turns into addiction. Becoming totally absorbed in an activity is normal and part of child-directed learning. However, there is a fine line between absorption and addiction. Look for signs like total preoccupation, lying about the amount of time spent gaming, depression, and irritability when asked to stop gaming as signals to intervene and possibly reach out for help.[8]

Shouldn't I Simply Limit My Child's Screen Time?

We recognize that parents are concerned about the amount of time that children spend in front of screens. This guide is not intended to promote the use of digital technology by young children, nor is it intended to discourage it. We recognize that children are already being exposed to a wide range of digital learning and gaming programs, and our goal is to simply help you navigate those programs so your children's experiences can be as meaningful, educational, and positive as possible.

C Child-Directed

As a parent, you've probably noticed when your child gravitates towards a particular extracurricular activity, or, when asked to pick a topic for a school project, chooses something you could have easily guessed. Child-directed learning involves capitalizing on the natural drive you've already witnessed in your child and allowing them to deeply explore it with minimal adult involvement. In a similar way, certain digital technologies lend themselves to child-directed learning by guiding children along a particular learning path that expands on an already simmering interest.

How to Get — and Keep — Children Motivated

We're all familiar with the stereotype of the "dinosaur child" who lives and breathes all things dino, or the "transportation child" who enthusiastically points out every passing bus or plane. When we encourage children to explore things they already find fascinating — like Tarbosauruses or trains — we are supporting what experts call intrinsically motivated learning. When children are *intrinsically motivated*, they want to learn simply because the topic at hand interests them. By contrast, we say children are *extrinsically motivated* when they want to earn a prize or receive recognition for their actions.[9, 10]

In general, intrinsic motivation is best when you want a child to engage in deep learning or to be creative. But when considering digital technology, research has shown that there's a place for both intrinsic and extrinsic motivation.[11, 12] In some situations, games that include extrinsic motivators can actually lead to better performance.[11] These games are increasingly used in the classroom and by parents, and often include prizes for completing challenges or leaderboards that recognize top performers.

In one study, two groups of 10- and 11-year-olds spent three weeks learning about insect identification. Children in the group that used a mobile game with external motivators — like leaderboards — demonstrated greater expertise at the end of the trial than those who were put in a traditional science class or who used smartphone-assisted learning.[12]

That said, we still need to be careful about utilizing extrinsic motivation when it comes to digital technology and children. Other research has shown that if a child is intrinsically motivated, external rewards can actually be counterproductive. Offering an artificial reward can, in fact, draw attention away from the child's performance and stunt their natural desire to learn.[13]

Motivation

Intrinsic

Driven by a child's own interests or desires, including:

- Autonomy
- Curiosity
- Learning

Extrinsic

Driven by outside influences, including:

- Prizes
- Points
- Rewards

So where does this leave you if you're wondering whether to give your child a digital alphabet game or a book that teaches the ABCs? Start by determining your child's level of intrinsic motivation for the topic. If your child is constantly expressing interest in letters or words, or is constantly pretending to read, they may not need digital technology to motivate them. If, however, they are resisting books, an age-appropriate app or digital game may help to get them going.

A Little Help From You is a Good Thing

There is nothing wrong with allowing your children to occasionally use digital devices on their own. But for those times when you do participate, research suggests it's best to do so through what's called guided play.[14] In guided play, adults can ask questions, make suggestions, or provide materials — but the child is in control. This creates a healthy balance between structure and freedom. Understandably, it can be difficult to stand back when your child struggles, but it's important to resist the urge to "rescue" them or take over a project. Instead, try giving them hints or suggest they ask for ideas from a friend or classmate.

It's important to have a learning goal in mind when you engage in guided play.[14] For instance, if your child is playing Tetris®, the goal could be to learn about spatial reasoning: how to describe objects in relation to one another. You can ask them to explain how they knew that two pieces would fit together, or help them describe why two pieces don't align. Prompts and questions help children learn from their digital experiences.[15]

C Recommendations

Prioritize programs that allow children to express their ideas. For example, ScratchJr puts children in charge by allowing them to design their own interactive story or game.

Spend time with your child using digital technology. Your questions, prompts, and genuine curiosity will help them understand and learn from their digital experiences.

View technology as another tool for creativity. Let your child design an image with paint programs, build a world with Minecraft, or record a podcast using a smartphone. Look for tech tools that give your child the opportunity to express themselves.

Consider using technology as a tool to help reluctant children engage with a task. Introducing an app may give children an extra boost of extrinsic motivation to complete unappealing tasks. For example, an app like Wake Up Mo may help children with their morning routine.

Be wary of educational apps that make inflated claims about what your child will learn. Spend time learning about technology options so that you can serve as a guide for your child. Use trusted sources like Common Sense Media to research and filter apps.

Is This App Educational?

When determining if an app has educational value, ask yourself:

1. Does it encourage active involvement by users? Your child should have to participate, rather than passively observe.

2. Does it engage users? When using the app, your child should stay focused on the task at hand.

3. Does it provide a meaningful experience? The app's content should be relevant to your child's own life.

4. Does it encourage social interactions? There should be opportunities for your child to talk about the content with those around them, or to interact with characters.

5. Does it make sense in an educational context? The app should be designed so your child can achieve a learning goal, such as building content knowledge or practicing a skill.

Adapted from Hirsh-Pasek et al, 2015[16]

R Risk-Friendly

There are benefits to introducing children to age-appropriate risk, both physical — like running down a hill or jumping off a log — and emotional — like responding to disappointment. When children are supported and encouraged to try new things from a young age, it sets them up to be more confident when taking on challenges in the future. Letting your child spend time playing video games or using an AR-enhanced technology could allow them to experience risk in a similar, helpful way.

Find the Appropriate Level of Challenge

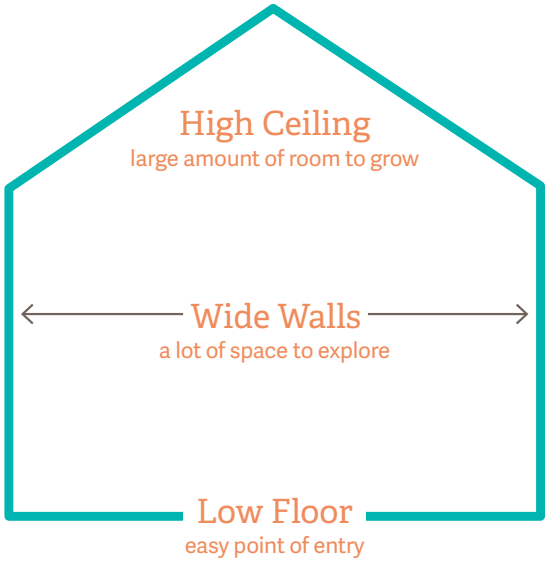
If you handed an 8-year-old a large block puzzle with a handful of pieces, they would be quickly bored by the lack of challenge. Similarly, if you gave a 2-year-old a 50-piece jigsaw puzzle, they would be frustrated by the level of difficulty and give up.

One way researchers evaluate learning experiences is to ask if they have a "low floor", a "high ceiling", and "wide walls".[17, 18] A "low floor" means there is an easy point of entry for the child, a "high ceiling" indicates there is plenty of room for children to grow and develop skills, and "wide walls" denotes an activity with ample space to explore.

Many video games and digital apps have all three components, and include escalating degrees of difficulty to keep children engaged and challenged. A game might have a first level that is easy to complete, thus building the player's confidence. But as the levels become progressively harder, players likely stumble, and are forced to explore new strategies and develop new skills to succeed.[19]

It is this stumbling, or failure, that helps children learn. And because digital games are low-risk — you can always restart a level or bring a character back to life — children can try different strategies without suffering serious consequences. This cycle of exploration — thinking of a new method, evaluating whether it works, and continuing to modify it — is the same trial-and-error approach that propels all kinds of creative work.

Accessibility During Learning



What if My Child Continues to Struggle?

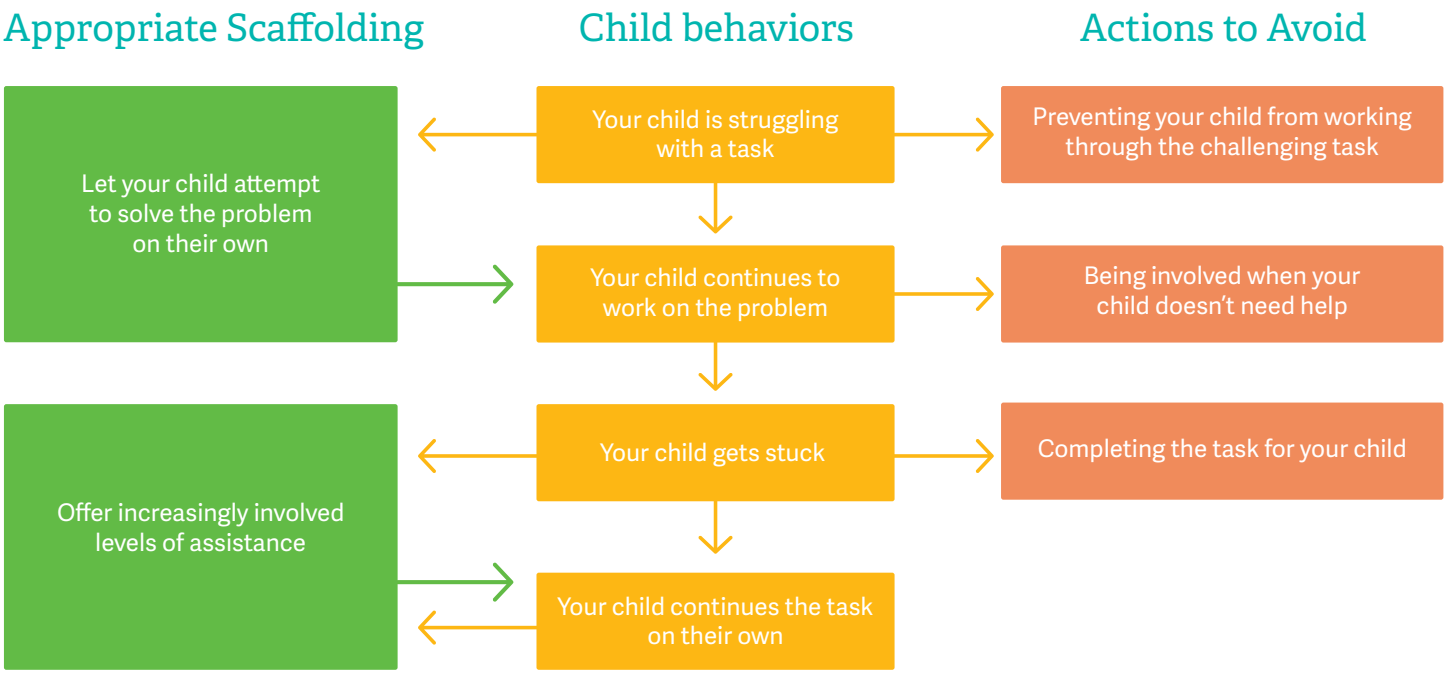
There are times when your child might seem to hit a wall and have trouble with a technology. When that happens, it is important for you to know when and how to intervene. One good way is to use something called scaffolding.[20] With scaffolding, you give hints and ask questions to help your child approach the situation in a new way. In some cases, your child may reach a point where they just can't move forward — and that's okay.

Some digital games and apps contain built-in scaffolding — age-appropriate prompts that can help children proceed — but parents cannot depend on this. As recently as 2018, an analysis of math and literacy educational apps for children ages 3 to 5 found that few programs on the market provided the type of scaffolding that is most useful for young children.[21] There are always new products coming out, but in the interim, this is an area where you can help by providing the encouragement, hints, and questions that support children to carry on.

Try Something New

Children are often hesitant to take a risk and try something new, but sometimes simple exposure to an unfamiliar activity can quickly shift their reluctance. In one study, for instance, a group of 6-year-old girls and boys were asked about their interest in technology. The children were divided into three groups; in one, the girls spent 20 minutes using a drag-and-drop programming system to code a robot's movements. After that short time, when the coding group was compared to others that did more neutral activities, like a card game, or no activity at all, there was no longer a gender difference in interest. In other words, girls expressed less interest in programming than boys except in the group that had the brief exposure to playing with the technology first.[24]

In another study, children between the ages of 8 and 12 were given one of two books to read: a regular book or an AR-enhanced book.[25] The highly interactive AR-enhanced book let them click on words or move pictures, and required that they use information from the story to advance to the next page. Although all the children were assessed to be at the same reading level



Adapted from Hammond et al (2012) and Wood et al (1976) [22, 23]

at the onset, those who used the AR-enhanced book showed more interest in the reading assignment. Some enjoyed it so much that they restarted the book from the beginning.

Using the Right Kind of Praise to Build a Growth Mindset

Children look to others to acknowledge that they've done a job well, and praise from caregivers is critical. But so, too, is the type of praise adults give, especially when children feel they have taken a risk and attempted a new challenge. Certain kinds of praise — those that focus on effort — are more apt to build children's growth mindset, or the belief that hard work can lead to success.[26]

Experts call this focusing on "process praise" instead of "person praise."[27] *Process praise* recognizes the work, or effort, your child exerts. For example, when they get a good grade, you say: "You studied very hard, and it really paid off"! *Person praise* recognizes inherent qualities: "You're so smart"!

Specifically praising aspects of what you appreciate about your child's actions — the way they collaborated with others, or showed patience when waiting their turn, or didn't give up when they made a mistake — will build a growth mindset. Leading researchers say children with this mindset are more likely to try new tasks, risk failure, focus on effort, show resilience, and learn from their mistakes.[27, 28]

Digital devices also give children feedback, and it's worth considering whether that feedback is fostering a growth mindset. In one study, a social robot gave children ages 5 to 9 feedback designed to promote a growth mindset, acknowledging and praising their effort on a puzzle.[29] The robot gave another group of children neutral feedback. The children who were praised for their effort and risk-taking showed more perseverance and resilience when faced with challenges than the other children. Studies like this demonstrate how brief exposure to process praise, even from a machine, can boost children's growth mindset, setting them up to take on new challenges in the future.

Recommendations

Digital games can be an excellent way for children to take risks without serious consequences. Video games often allow for multiple lives and turns so children can try out several strategies, recover from failure, and persist through challenges. Children can also practice social interactions without the anxiety that can come with trying these skills in public, with apps like FlummoxVision or PeppyPals Sammy Helps Out.

Give process praise ("You worked so hard!") as opposed to person praise ("You are so smart!") in order to develop a growth mindset — the belief that one's ability can improve with effort. Pay attention to the type of praise your child is getting from any digital technology.

Be aware of your own mindset toward technology. Do adults, particularly females in your house, ever say, "I'm not tech savvy?" If so, recognize the power of the word "yet" ("I'm not tech savvy...yet!"). Embrace challenges and acknowledge that you can grow your own tech skills independently or by asking your child to teach you.

Know your tech. Have a conversation with your child about the games and technologies they are using, and give those a spin yourself. you'll be better able to give your children guidance and support, and expand upon their educational experience.

E Exploratory

Independent exploratory play — characterized by hands-on, open-ended, experimental learning — helps children understand the world around them.[30] In the same way that children try to get into a closed cabinet or pause indefinitely on the sidewalk to examine something that catches their eye, digital technology can allow children to express and indulge their curiosity in a playful and productive way.

The Age of Experimentation

Children are born scientists, and from a young age, they begin conducting experiments to learn more about their world.[31] As infants, experimentation may entail continuously pressing a toy's button or dropping a spoon off a highchair. As children age, this playful experimentation looks more like trial and error: They can figure out why something did not work as expected and make adjustments to achieve their goal.

Take the popular video game Angry Birds, which requires that players angle a slingshot in just the right way to launch birds at a target. The more a player fails, the more they are forced to experiment, repositioning the slingshot in different angles.[32] One study found that after one week of modest play with this game, 5-year-olds showed an increased understanding of force dynamics and projectile motion, as evidenced not only by their game performance but also by how they did on drawing tests.

Even social robots and conversational agents provide opportunities for experimentation. Programmed devices such as Alexa or Siri are usually simple for adults to use, but for children, they can be a challenge. That's because children tend to ask open-ended questions, and robots and conversational programs typically respond in a set way.[33] If your child is not getting a response or is unable to play a song they've requested, they could become frustrated, and might even speak unkindly to the device.[34]

If this happens, try creating a moment of playful experimentation. Instead of redirecting your child or answering the question for them, encourage them to ask it in a different way. It may take them several attempts to get a response, but they will be learning creative problem-solving strategies in the process.

Hands-On Learning

You already know that young children want to put their hands in and on everything — from a mud puddle to the contents of your handbag. It's all part of a widely held notion that children of all ages learn by doing. Research supports that with hands-on learning, children have better recall and are more successful with complex thinking tasks.[35]

Certain technologies can provide similar opportunities for hands-on exploration. Digital fabrication tools such as 3D printers or laser cutters have both digital and physical components. Children can design an object using a computer graphics program, create the object with the associated tool, then hold it in their hands to explore its size, weight, texture, and shape. With the information they gather by touching the physical object, they can decide how to use it or change it.

Several coding toys for young children also create this bridge between digital and physical worlds. Toys such as Dash and Dot, Ozobot, Cubelets, and Code-a-pillar engage children with digital coding concepts and hands-on experiences with a physical product, often without adult intervention.

Open-Ended Experiences

Children also benefit from open-ended learning experiences, where there is no "right" answer. Adults can engage children in these experiences by choosing games and toys that are designed to be open-ended, like blocks. Parents can also provide questions that lead children to experiment with multiple approaches or possible solutions, questions like, "Can you think of another shape for the base of your tower?"

In spaces that allow extensive open-ended learning experiences — like the Try It Studio makerspace at BADM — children are invited to make things but are seldom given specific step-by-step instructions. Children might be given the option to use a 3D printer or other digital fabrication tool to make an airplane, car, or lantern, and wonderfully, no two products the children make will be alike.

Similarly, coding toys such as Bee-Bot and Sphero are designed to provide children with open-ended experiences that encourage complex thinking. A dozen children could be given the same coding toy and challenge — make a robot move across the room, for example — and each child will craft their own solution. Some will program their robot to walk in a straight line, others in a zigzag. Some will make their robot move slowly, others fast. Once children graduate to writing their own code, even more possibilities will open up.

E Recommendations

Look for makerspaces at museums, public libraries, or schools – BADM's new Try It Studio is one such space. Try signing your children up for a class or camp to get them started. The digital tools found in these spaces allow children to experiment with designs, learn from their mistakes, and make revisions.

Open-ended experiences are those that offer many possible outcomes as opposed to one "right" answer. Find apps, games, and other digital technology that allow your child to make their own decisions and find several solutions. You might consider the Toca Boca suite of apps, which focuses on imaginative play, or Storybird, which uses illustrations and challenges to spark creative writing.

Children as young as preschool age can practice basic coding and computational thinking skills using coding games and toys. Ideally, children can use coding projects to set their own goal and use open-ended learning to achieve it. Try ScratchJr to program a character, for example, or Code-a-pillar to reach a target. Use colored markers to direct Ozobots, or choreograph a dance with KIBO robots.

Use non-digital, open-ended play to prepare young children for later use of technology. Children who are too young to do computer coding can still learn the principles that coders rely on, such as sequencing and pattern recognition.

Find ideas for creative, technology-based activities by visiting BADM.org/Activities. Click on "Topics" then "Technology" to find activities that might be of interest to your child.

What makes a good makerspace?

When evaluating if a makerspace is right for your child, look for those offering activities that:

- Take place in familiar environments, such as at libraries, schools, or museums, and are easily accessible to all individuals.
- Center around the child's personal interests.
- Foster collaboration with other children.
- Allow children to have a central role in their own learning, with possible adult guidance.
- Result in tangible products

Adapted from Iivari et al, 2016[36]

A Active

Technology has a reputation for discouraging physical activity, but certain digital technologies incorporate and even require children to be active. While outdoor physical play will always be an essential part of healthy child development, for many families, it is not practical to allow children to go outside unsupervised multiple times a day for hours on end.[37]

Physical activity boosts creativity and cognition,[38, 39] but today's children are spending less time outside than did previous generations.[40] Parents are understandably concerned about their children's lack of movement. It may comfort you to know, however, that there are digital technologies that help encourage children to move more, in and out of the house.

Up and Moving

When Pokémon GO launched in the summer of 2016, it quickly became one of the most popular augmented reality (AR) experiences. In the game, Pokémon characters are superimposed on live images of the real world on a player's phone. Immediately after its release, it was not uncommon to see people walking around neighborhoods and parks using their devices to "catch" Pokémon. Researchers found that, for many parents, the notion that digital media was a negative factor in their homes was replaced by appreciation because the game got kids out of the house, exploring their neighborhoods.[41]

Some screen-based video games like Wii Sports and Dance Dance Revolution actually use exercise as the main gameplay component, and may have a positive effect on children's development. In 2011, researchers investigated the benefits of movement-based video games for children with Down syndrome,[42] hypothesizing that the variety offered by games may prove more motivating than traditional occupational therapy, which can become repetitive or boring. In the study, children with Down syndrome between the ages of 7 and 12 were divided into three groups. The first group completed 48 hours of traditional occupational therapy; the second group completed 48 hours of physically active therapy using a Wii game; the third group did no physical therapy. In the end, it was the children who played with the Wii game who showed the most improvement in motor and visual skills.

The New Frontier of Virtual Reality

Even if you haven't used virtual reality (VR) yourself, you've probably seen pictures of it: Large goggles cover the eyes, transmitting 3D images while blocking the view of the actual physical world. VR provides physical experiences while immersing users in another world. Unlike most screen-based activities, VR encourages and sometimes even requires users to stand up or move around.

Most current VR experiences were designed for adults, which is evident from the size and weight of the headset and the content of the experiences. Because of this, parents may wonder if VR is safe for children. To answer that question, researchers looked at some of the physical risks associated with VR use, such as issues with vision and balance, by inviting a sample of children between the ages of 8 and 12 to their lab.[43] The vast majority of children who used VR in the lab experienced no negative effects to their vision or balance. While you should always pay attention to age recommendations and trust your knowledge of your child to determine if this technology is appropriate, research suggests VR may pose less of a physical risk than once thought.

A Recommendations

Technology does not replace children's basic need for outdoor physical play. Place consistent limits on the amount of time children can interact with digital devices and ensure those limits allow children sufficient time for other activities such as sleep, outdoor physical play, and other non-technology-based play with friends.

Look for games that encourage or require movement. Children's brains and bodies develop in tandem, and developing both gross and fine motor skills is critical. Try Dance Dance Revolution, Pokémon GO, geocaching or fitness apps. Relatively new VR games like Beat Saber also show promise in promoting movement.

Time for Imagination

You've probably seen your child's imagination flourish when they're playing dress-up or make-believe games. Certain digital technologies — in which children build, design, and invent — can take fantasy play to another level, fostering the kind of imaginative exploration that is critical for original thinking and problem solving.

Bring Ideas to Life

There are lots of ways digital technologies can be used to build on a child's imagination. Coding programs give children the opportunity to imagine what an object can do, and then use programming to make it happen.[44] Similarly, video games like Minecraft and Sims allow players to design and build structures or homes on the screen.

Digital fabrication tools like laser cutters and 3D printers allow children to dream up an entire object in their head — a miniature car, say, or a model airplane — and design and create it within minutes, allowing their fantasies to become real objects. As one child in BADM's makerspace said: "You can see something going from nothing to what you imagined it. It's like your creations are coming to life."

Evidence suggests that stimulating the imagination, even through video games, can have other cognitive benefits, as well. In one 2017 study, researchers found that motivation and collaborative skills improved in a group of elementary school students after they played Minecraft for a prolonged period of time, more than seven hours. However, the researchers cautioned that the play was supported by adults to achieve a learning goal, and that without this structure, students would likely have learned little and had difficulty ending the game.[45]

A Whole New World

It may seem that technologies like AR and VR would be ideal for sparking imaginative play, since these technologies do indeed create alternative realities. But fully created experiences may actually lessen the need for children to exercise their own powers of imagination. In addition, virtual reality may confuse children about which events occurred in real life and which were part of their digital experience.[46]

In a 2009 study, researchers tested the effect that virtual reality had on memory with a group of preschoolers, ages 4 and 5, and a group of elementary school students, ages 6 and 7.[47] Researchers read all the children a story about an unusual event: a child swimming with whales, or a child shrunk to a tiny size who dances with a mouse. Afterward, children were assigned one of four tasks: imagine experiencing the event from the story; use virtual reality to see someone else experiencing the event; use virtual reality to see a simulation of themselves experiencing the event; or do nothing. The preschoolers reported false memories after each of the four activities. The slightly older children, however, reported more false memories if they either imagined experiencing the event or saw a VR simulation of themselves experiencing the event, demonstrating the powerful ability of VR to make false experiences feel incredibly real to young children. This also serves as a reminder that young children's memories are vulnerable to suggestion.[48]

This caveat aside, you can use virtual technology to help your children create their own, healthy fantasies. For example, if they "swam" underwater using a VR headset, ask them afterward what type of creatures might live there, what they look like, and how they interact with each other. By acting as a partner in your child's pretend play — with or without technology — you're encouraging them to be creative.

Recommendations

Pretend play is important even into the elementary school years. Digital technology provides what may be a more socially acceptable way for older children to make believe. Parents might consider enabling the "creative mode" on Minecraft, having children sculpt a scene in VR using Tilt Brush, or creating virtual characters and environments in the Sims video games.

When children come to you with fantastical ideas, think about how they might be brought to life with digital tools. Can they visit a local makerspace to build a 3D model of a rocket to Mars? Can they design a game with characters and stories that they invented in ScratchJr? Using digital technology can help children building problem-solving skills while allowing them to continue to dream.

Have a conversation with children about the difference between fantasy and reality. When children use augmented and virtual reality devices, they can unknowingly mistake fantasy for reality. After your child uses AR or VR, spend some time asking them which parts of the experience were real, which were pretend, and how they were able to distinguish between the two.

E Exchange of Ideas

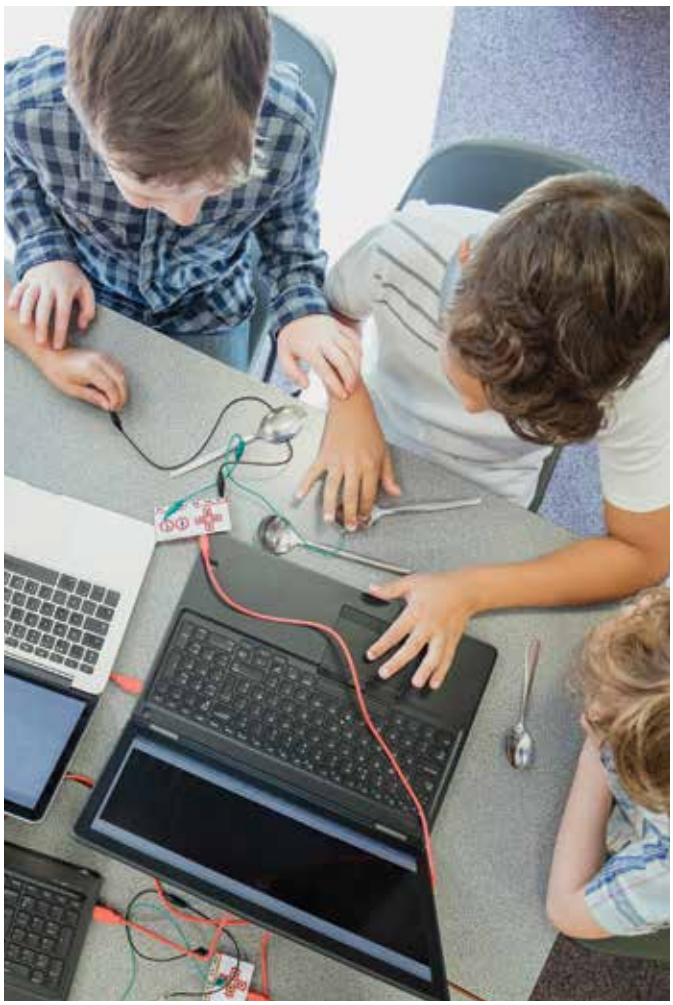
Technology may have a reputation for isolating people, but some digital technologies do provide an opportunity for children to express themselves and engage with others. The question remains, however, as to exactly how technology can or should be used to substitute for human interaction. When a child asks you the same question for the hundredth time, it's natural to wish you had a robot to take your place, but what would that mean for the child? Can technology help children learn to communicate? Can it help them become better listeners, or to exchange ideas with others?

A Little More Conversation

In today's digital world there are more options than ever for children to get an answer to a burning question. They can ask a parent, friend, or teacher, of course. But they can also ask Amazon Alexa, Google Home, or Apple's Siri. While these artificial intelligence devices may not be ideal for the exchange of ideas per se, they do mimic human conversation to some degree. Children can use them to define a word, learn more about a topic, hear about the weather, and more.

When it comes to social robots, some have demonstrated the capability to hold a longer conversation and even to learn from humans.[49] As these social robots have become more ubiquitous, researchers have grown increasingly interested in how children engage with them.

In one recent study, researchers had a group of children between the ages of 2 and 5 learn about animal identification from either a person or a robot, and detected no difference in how much the children learned.[50] In a related study, robots read aloud to groups of children ages 4 to 7 in different tones of voice.[51] While the robot's tone of voice did not have much impact on the children's learned vocabulary, it did affect how well the children appeared to remember and retell the story. Those who listened to the robot tell the story in an expressive tone were more likely to use similar phrases in their own retelling, and repeated the story weeks later as they had immediately afterward, indicating that human-like speech boosts retention. This could be an important feature to consider as social robots and conversational agents become more prevalent.



Creative Collaborations

We've all pictured the stereotypical gamer — someone who sits alone in their room, isolated from the outside world. But some of today's most popular video games are played with other people, albeit often remotely. Known as massively multiplayer online games, or MMOs, they require interaction and cooperation.

Such engagement can help children work on their social skills, but it can also have educational benefits, particularly when it helps make learning fun. In one study, researchers found that when elementary school children played an MMO, they not only improved their understanding of other cultures but reported greatly enjoying the experience.[52] The 9- and 10-year-olds, in particular, expressed excitement at being able to communicate with players located elsewhere.

In a game like Minecraft, where players are encouraged to work together to achieve goals, communication and collaboration go hand in hand. Being able to talk to other players through in-game chat functions allows players from all over the world to share ideas and express their creativity, before ultimately working together to bring their collective vision to life.

Of course, fostering a digital community is hardly limited to gaming. Code-a-thons bring like-minded people together online to write code to solve complex problems. Makerspaces bring people together in real life to use digital fabrication tools, and they are great places for children to be inspired by, and build upon, the work of others. Here, creative collaboration can lead to more ideas than any one child could come up with on their own.

E Recommendations

Digital conversations should not take the place of human conversations. True human connections are still necessary to model appropriate social interactions. Children should use digital conversational agents and social robots primarily to gain information and learn how to ask questions. If children don't get the right response, encourage them to experiment with new ways to pose the question.

Technology can be a great tool for communication, especially when connecting with faraway friends and family. Use Skype, FaceTime, or apps like Marco Polo and Voxer with your child as a way to model how technology can enhance relationships.

Look for gaming experiences that are social and collaborative in nature. Many newer games offer opportunities to work together on a shared task, even when players are scattered around the world. If you're concerned about your child interacting with strangers, familiarize yourself with the game's chat features and settings. You can often monitor messaging or disable it altogether.

Don't think of tech as a one-on-one interaction between your child and a machine. There is always an opportunity to incorporate more socialization into your child's tech use. For example, if you provide just one tablet for siblings or friends to share, they will be required to work together as they finish the game or lesson.

Quick Guide

When faced with new technologies for your child, consider the following suggestions before, during, and after their use.

Before

Gauge your child's interest in the subject. Is digital technology being used as a motivation or reward when none is actually needed?

Review the age recommendations and content of the product. Is the product or app appropriate for your child?

Determine how active the experience is. Are there opportunities for your child to move during the tech experience? If not, how can you incorporate activity into their day?

Ask yourself about your own tech mindset. Do your best to demonstrate openness when it comes to tech, and try to avoid using the phrase, "I can't."

Try out the digital technology for yourself to learn more about it and how your child will use it.

During

Ask your child open-ended questions, such as, "What do you think will happen next?" or, "Why do you think that happened?"

Encourage collaboration and communication by using digital technology with your child, or invite a friend or sibling to share.

Scaffold your child's experience if necessary. What helpful hints or guidance can you provide to encourage them, especially if they get frustrated or want to give up?

After

Ask your child to explain to you what they did and what they learned. For example, "Tell me more about what happened," or, "Did you learn anything that will help you next time?"

Talk to your child about the difference between fantasy and reality. Can they tell you which parts of their tech experience were real and which were pretend? How did they know?

Find opportunities to continue your child's learning. This might be accomplished by introducing more challenge, getting books on the topic, or finding a relevant club or camp.

Additional Resources

For more information on digital technology use with children, BADM recommends the following:

American Academy of Pediatrics
www.aap.org

Common Sense Media
www.commonsensemedia.org

Erikson Institute: Technology in Early Childhood Center
www.teccenter.erikson.edu

Fred Rogers Center
www.fredrogerscenter.org

National Association for the Education of Young Children
www.naeyc.org

Power of Zero
www.powerof0.org

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