Chapter 5

What Would Maria Montessori Say About the iPad? Theoretical Frameworks for Children’s Interactive Media

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Introduction

On the evening of December 8, 1913, a 43-year-old Maria Montessori gave a talk in New York City following a 14-day trans-Atlantic journey by ship.

She set foot on U.S. soil as a celebrity, in part because of the translation of her book The Montessori Method, first published in the United States in 1912 by Frederick A. Stokes Company (Montessori, 1964). According to the New York Times coverage of her visit, 1000 people were turned away from Carnegie Hall, where she was introduced by John Dewey. In her closing remarks, she said she was seeking nothing less than the perfection of the human race (New York Times, 1913).

Today, the same trip takes just 9 hours and there is no fear of icebergs. Transportation technology has certainly changed in this 100-year period. What about pedagogical tools? It is important to consider the historical context of Montessori’s work and this particular visit. She came by invitation of Thomas Edison and Alexander Graham Bell, who had already used technology to make a mark on the new 20th century. American educators were concerned more with delivering measured doses of curriculum and measuring progress, so Montessori’s child-centric methods must have seemed as radical as the light bulb, telephone, or airplane.

Looking back, we know that Montessori’s methods were simply applied theory—the theory coming from Froebel and Pestalozzi—and they were having remarkable success with the hardest to teach “idiot” children from the slums of Rome. These ideas were easy to contrast with America’s behaviorism-steeped curriculum that was strongly influenced by Pavlov, Watson, and especially Edward Thorndike. We no longer call children with learning problems “idiots,” but there still is no shortage of hard-to-teach children who, in Montessori’s words “have not lived up to their genetic potential.” In 1913, a cultural shift was in full swing, from agricultural to industrial. As with that time, we now find ourselves in a cultural shift; from industrial to information, marked by social media and touch screens. The inventions of Edison and Bell have served us well. We’re now dealing with the likes of Jobs, Bezos, Page, Brin, and Zuckerberg.
Figure 5.1 What would Montessori, Piaget, Skinner, and Vygotsky say? A Theoretical Dream Panel, Discussing a Tablet

Illustrations by Jenna Buckleitner

Under this new cultural shift are the same stable theories of learning that guided Montessori 100 years ago as she tried to reach the underserved children of Rome. As the field of early childhood education begins to adapt, guided in part by the recent technology position statement from National Association for the Education of Young Children (NAEYC) and the Fred Rogers Center (2012), these theoretical frameworks can provide welcome traction in the slippery discourse surrounding technology and young children. This chapter explores digital play and learning in the context of three theoretical frameworks. This is only a preliminary exploration of some select theories.

What Would This “Dream Panel” of Theorists Say About the iPad?

Imagine that Maria Montessori, Jean Piaget, and B.F. Skinner walked into the speaker ready room before their panel at the NAEYC annual conference. Montessori is angry. “I typed my last name into iTunes and came up with 500 apps! Some are good, but others are merely low-rate flash cards.” “Really though, what’s the harm with an occasional flash card, as long as it’s used with a reward?” asks Skinner. Montessori’s cheeks are flushed with emotion. “Some of these apps don’t
go deeper than lowest level ideas—shapes, colors, letters, and numbers. Take ‘Approach to Montessori—Numbers HD Free Lite’ [Brain Counts, 2012],” she says. “It combines my name with noisy pedagogy and free offers, and uses my own words for marketing . . . ‘prepare for greatness’!!!’” (see Figure 5.2).

Piaget nods in the direction of Skinner. “She has reason to be angry, B. F. Some of these apps imply the acceleration of development, even for infants. We should all be concerned with app quality.” Lev Vygotsky, who has been sitting quietly nearby, speaks up. “Isn’t the quality you speak of in itself an artifact of culture?” Piaget takes a long, thoughtful puff of his pipe. “Yes, Lev, but we have other concerns. I’ve noticed that my own daughters now prefer their iPads to the observation of mollusks! But I’ve been observing them as they play and I’m pleased to report that my stage theory maps well to this digital medium.”

“The hands are the instruments of man’s intelligence, Jean,” reminds Montessori. A glass screen is abstract and symbolic, which must be considered when dealing with preschoolers . . .”

Piaget waves a finger, “. . . but that won’t influence the developmental sequence. A child born 100 years ago developed in much the same way as a child born this year. What is different in 2013 are the experiences due to

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Figure 5.2 Screen Capture From Approach to Montessori, Numbers HD Free Lite
the technology. Candlelight can be provided by LEDs. But we still have the choice of real candles. Parents have genetic screening, antibiotics, and their babies can have bedtime stories read by grandparents who live half a continent or half a world away.” Vygotsky quietly adds. “Mobile devices help ideas flow across geographic and economic chasms. Services like Google, Facebook, YouTube, and Twitter can move ideas from Leningrad to San Francisco at the speed of light.” He starts getting very excited. “The knowledge elite could dissolve. Every teacher could have a virtual mentor and unlimited professional development. That, my friends, is worth getting excited about.”

Piaget has been intently puffing on his pipe, which has creating a cloud around the group, and cleared the nonsmoking room. “And these devices have cameras . . . electronic eyes that can instantly bridge the concrete and the symbolic. But I must agree with Maria—and the recent NAEYC & Fred Rogers Center (2012) position statement on young children and technology—it can never replace the touch of a butterfly wing.”

Skinner chimed in over the game of Candy Crush (King.com Limited, 2013). “. . . and mankind still manages to use incredibly powerful technology for extremely unpowerful activities; like this game. My first teaching machine was cobbled together with plywood and punch cards. These tablets let us deliver the most sophisticated programmed instruction at a low cost. Friends, we can now mass-produce the perfect curriculum and deliver it to every child, and accurately measure the results! No child will be forgotten.”

Montessori's iPad is now on reserve power, but she's stumbled on an app called The Human Body (TinyBop, 2013). She's been watching a single blood cell move through a maze of heart valves, as she speeds and slows the heart (See Figure 5.3). Skinner takes a turn as the others watch, amazed. “I would've loved this app as a child,” she says quietly. “I believe there are apps for each of us . . . we just have to know what we're looking for.”

The Dramatic Digitization of Theory

There are now 24 platforms for children’s interactive media, although all but eight are largely extinct. These include Android 4.4 (called KitKat), the Kindle Fire OS (called Fire OS, which is a platform based on Android), Microsoft’s Windows Phone 8 for touch screens, Windows 8 for computers and Laptops, and Mac OS Mavericks (10.9.1) for non-touch-screen Macintosh computers. Video game platforms include the Microsoft Xbox, Sony PlayStation, Nintendo Wii, and DS. But the leader by a wide margin is Apple’s mobile operating system, called iOS. Children’s products, called apps, were first introduced for the iPod and iPhone in 2007. The first children’s apps were limited in function and by a small screen size, but they cut the ties with the mouse and keyboard, and introduced many children to their first multi-touch capacitive screens. In the spring of 2010, Steve Jobs introduced the iPad, with a larger screen and 10 hour batteries that created the perfect storm for children’s digital content.
In 2007, there were fewer than 10,000 children's interactive media products for children produced between 1984 and 2007. For 2013, that number is the total number of new products in just 1 year, for Apple iOS products alone. Apple reports that there are "over 1,000,000 apps" for both small and large screen iOS devices (T. Miller, personal communication, December 8, 2013). Of these, 475,000 run on the iPad, as the fall of 2013 (Apple, 2013). The next task involved with counting children's apps requires a definition for what a children's app is. A rough solution is to use a smaller sample; in this case, the 200 best-selling apps. At Children's Technology Review, we tagged 20 of these apps as being "specifically designed for children." If you use this 10% amount as a conservative estimate, there are about 47,500 iPad apps for children. Keep in mind this is just one subset of one platform (see Figure 5.4).

Each individual app is in itself a human artifact—a bundle of ideas from a team with ideas about how a child should play or learn. At Children's Technology
Figure 5.4 Source: Children's Technology Review

Review: we skim a subset of these products—607 in 2013—selected for being newsworthy, for review.

**When Glacier-Like Theories Meet Rivers of Apps**

Imagine this panel at the next NAEYC annual conference: “Technology and Young Children: A Discussion by Piaget, Skinner, Montessori, Bruner, and Vygotsky.” And while we’re at it, we’ll invite Fred Rogers to be the moderator. Each panelist will be asked to discuss the strengths and weaknesses of using technology with young children and bring examples of apps to support their theories. What would they say, and which apps would they demonstrate?

This fictional exercise asks you to layer new media across existing frameworks, which is, at best, an interpretive art. In reality, many apps are an eclectic mix of theories that are, in themselves, continually adapting and not cast in stone. In trying to play out this scenario, I’m well aware that I’m glossing over just a few key theories.

**Behaviorism**

B. F. Skinner (1904–1990) might have described behaviorism’s view of a child starting life with a blank slate, prepped for a future of knowledge and skills. The key to a good outcome is careful preparation and results that can be accurately measured. A lesson can be repeated if necessary, and the child’s behaviors can be shaped toward mastery. The positive, desired behaviors should be encouraged; the undesirable behaviors are negatively reinforced and extinguished. Many have contributed to Behaviorism’s core ideas. Ivan Pavlov (1849–1946) showed that
he could condition a dog to salivate with the sound of a bell through association. In the 1900s at Columbia University, John Watson (1878–1958) conducted stimulus-response experiments, and Edward Thorndike (1874–1949) worked to infuse the U.S. curriculum with rewards and consequences and pedagogy designed to be broken into small parts that could be mastered and measured. The move to automate this type of instruction started at Ohio State when Sidney Pressey (1888–1979) began working on a teaching machine, and B. F. Skinner took the entire idea up a notch by documenting responses to stimuli and rewards in both children and animals. He tried to bring a commercial teaching machine to market in the late 1950s. Some attributes of behaviorism in children’s apps might include:

- **Token economy**: Any game that uses collectible items such as coins, stars, or jellybeans is reinforcing a desired behavior. In LEGO Star Wars, you collect thousands of studs—the little bumps found on LEGO blocks that can be used to rebuild the machines you need to get to the next level. Disney’s Club Penguin (Disney’s Interactive, 2013) lets you play games to earn coins to purchase new items for your igloo.

- **Intermittent events**: Conditioning stimuli including intermittent reinforcements are used in apps like Candy Crush or Bejeweled. One of the best-known examples, Angry Birds (Rovio Entertainment, 2009) is a physics game that applies this technique masterfully. You first launch a bird, which is a game of chance. Sometimes you get a huge payoff, but not always. Your big reward might happen any time, and the effect is intoxicating. Skinner could point to many examples of negative reinforcements commonly used in video games either intentionally, such as making a child replay a level, or making a child wait while an activity loads.

- **Mastery learning**: Edward Thorndike might have liked the individual tracking and scoring system in Moose Math (Duck Duck Moose, 2013). The better you do, the more levels you can unlock, as your progress is remembered, like a bookmark. In addition, the app can keep progress for different children. You can find some excellent examples of mastery learning in Bugs and Buttons 2 (Little Bit Studio, 2013) with 18 math and logic activities with careful challenge leveling mixed with management features.

**Constructivism**

The constructivism framework has cast a wide net over teaching, learning, and app design. It is well named—a child “constructs” his or her own knowledge internally throughout the lifecycle. The core ideas go back to Switzerland, where Johann Pestalozzi (1746–1827) and his student Friedrich Fröbel (1782–1852)—who coined the word *kindergarten*—clearly painted the theoretical brush so that Maria Montessori’s (1874–1952) could begin designing classroom techniques. The giant of constructivism, however, was Jean Piaget (1896–1980), who defined
different stages of development, along with the notions of assimilation, accommodation, and equilibration. These ideas heavily influenced the open classrooms of the 1970s, and such ideas as whole language, LOGO, Scratch, and the Maker movement today. Some examples of constructivism in children’s interactive media might include the following:

- **Apple's concept of the Home key.** This single control mechanism may be the biggest contribution to technology-based constructivism, because of the control it offers a child or an adult. It makes it possible for a child to get out of whatever he or she gets into.

- **Linking forms of language.** Piaget and Vygotsky both wrote a great deal about language as a vehicle for packaging knowledge and would undoubtedly have a lot to say about word/object association techniques used in apps like ABC Actions (Peapod Labs, 2013) that pairs words with still, clear photos and videos of meaningful objects. It is possible to toggle from Spanish to English at any time. Other Peapod apps with a similar design, cover topics such as underwater life, bugs, the farm, transportation, and music.

- **Self-correcting problems that dynamically adjust.** Both Thorndike and Piaget would’ve liked Motion Math: Hungry Guppy (Motion Math Games, 2012); a bottomless pitcher of finger driven, self-correcting math manipulatives. The better you do, the harder the challenge, which is evidence of the eclectic design of apps.

- **Instant formative feedback.** Montessori wrote about automatic or auto-didactic materials that provide instant feedback to a child. She might have liked the way LetterSchool (Sanoma Media Netherlands B.V., 2012) quietly directs a child toward the correct result, in a way that is driven by the child’s initiative.

- **Programming.** Sometimes interactive media experiences can allow a child to control a screen, rather than the other way around; representing an embodiment of constructivism ideals. One of the first programming languages specifically adapted for children was Logo, which was created at the Massachusetts Institute of Technology (MIT) by a team led by one of Piaget’s coworkers, Seymour Papert. More recently, Scratch 2.0 (Maloney; Resnick, Rusk, Silverman & Eastmond, 2010) and Hopscotch (Hopscotch Technologies, 2013), a Scratch-like programming experience for the iPad, let children “code” using jigsaw-puzzle like commands, routines, and subroutines. Papert coined the phrase *constructionism* around the idea that children can also construct cognitive models outside the head.

## Social Constructivism

Lev Vygotsky (1896–1934) might have agreed with Piaget that learning takes place “inside the head” through active learning. But he’d argue that external, social forces are at play as well. The Russian psychologist and philosopher was
born in 1896, the same year as Piaget, but he died much younger at 37. However, his short but prolific career has indelibly influenced the field of educational psychology and app design. His ideas were inspired by the social changes and challenges in the Soviet Union, and he emphasized the influences of cultural and social contexts in learning and supported a discovery model of learning. Vygotsky believed that learning and development is both internal and external. The internal processes were documented in his book *Thought and Language*, published in 1962, which had a great deal of overlap with Piaget’s major ideas. But he also framed this individual development in a larger societal context. Social video games with leader boards, shared reviews, blogging, all play a role in this cross-cultural transmission of knowledge. Vygotsky’s concept of the “zone of proximal development” is a useful idea for interactive media developers. This “zone” has been defined as the distance between a child’s independent problem solving and his or her capabilities of problem solving while under adult guidance or the guidance of more capable peers. App designers today can construct help mechanisms to give a child support along with increased challenges. Evidence of social constructivism in the app store might include the following:

- **Cross-cultural communication.** Social media, such as Facebook, Skype, Twitter, Google Docs, and YouTube each provide forums for transmitting ideas across geographic, social, and socio-economic boundaries. YouTube for example, posts thousands of videos of “more capable others” showing how to solve math problems, play a musical instrument or win at a video game. Sharing apps like Kindoma (Kindoma, 2013) make it possible for two people to share the same story from any location, as if they are sitting in the same room.

- **Cross-cultural cognition.** Programming and group creativity experiences like Scratch 2.0 (MIT, 2013) encourages sharing of bits of programs. Not only can programs be commented on, but key ideas can be freely copied and pasted into new programs. A game like Minecraft (Mojang, 2011) is a collaborative problem solving game that provides spatial thinking opportunities and mixes thinking that has no regard to boundary.

- **Putting significant others inside an app.** The Human Body (TinyBop, 2013) lets children explore the wonders of the human body without embarrassment. Of particular note are the working models of the human eye and ear that incorporate the features of the iPad camera and microphone to let children play with the function, as if they were inside the body. The more capable other comes into play, when you can create individual profile for your child, and leave a recorded message for the child. So a teacher could explain the function of the heart in a personal way. Oceanhouse Media apps (Oceanhouse Media, 2013) are a series of e-books that let you add and save your own soundtracks. So a child can hear a favorite Dr. Seuss story like “Green Eggs and Ham” (Oceanhouse Media, 2013), narrated by his or her choice of a grandmother, grandfather, uncle, or friend.
Position Statement Alignment

Early childhood educators are the decision makers in whether, how, what, when, and why technology and media are implemented through applying their expertise and knowledge of child development and learning, individual children's interests and readiness, and the social and cultural contexts in which children live.

NAEYC & Fred Rogers Center (2012), p. 6

So What Would Montessori Say About the iPad?

If one could revisit Carnegie Hall 100 years ago and ask Maria Montessori about the digital revolution to come, what would she say? Would she condemn digital media as being overly commercialized and abstract? Or would she embrace it, recommending the purchase of tablets for use in the programs that now bear her name? Probably both.

Among Montessori groups, the use of technology-based materials like the iPad continues to be debated. One Montessorian who doesn’t seem afraid of the tablets
is Virginia McGee Goodwin, the Executive Director of the Association Montessori International/USA. She told me in a phone interview that “Montessori would appreciate the deep, intuitive connection the iPad fosters between content and user, taking working with knowledge to another level.”

Other clues can be derived from Montessori’s book, “The Montessori Method.” You’ll find plenty of evidence that Montessori was a bit of a geek. She wrote about the promise of Roentgen Rays (later renamed X-rays) in 1912 and accurately predicted “wonderful things from the Marconi Telegraph” (aka the radio).

She was also a consummate maker, or game maker, constantly fiddling with innovative materials like sandpaper to perfect a new self-teaching gadget. Because she’d always put a child’s interests ahead of any formal curriculum, it’s a safe bet that she would’ve encouraged young Sergey Brin’s (Google co-founder) play with a Commodore 64. Said Goodwin, “Maria Montessori would view the iPad—and devices like it—as a tool for tomorrow’s mind.”

So when Montessori wrote that education was “seeking the release of human potentialities,” it is easy to imagine her including a tablet, loaded with some carefully designed apps, in her materials. Let me recap the “pro-tablet” reasons:

- **Montessori was a scientist who was future-centric.** She understood that she was living in a changing time and that children needed to be exposed to modern materials. She was in the business of preparing children for their future, to live to their full human potential, so she would’ve wanted them to embrace and feel empowered by every element of their environment, including technology.

- **She would be discriminating about the types of apps she loaded on her tablets.** She’d look for noncommercial apps that promote active learning, are self-correcting, are multi-leveling, don’t talk too much, and empower children. Another word Montessori used frequently was “didactic” as in “didactic materials,” or working toward one right answer; a feature found in many better-designed apps.

- **In designing apps, she’d compensate for the iPad’s sensory limitation of just sight and sound, using apps in concert with real, concrete experiences.** She would use the iPad to supplement and extend traditional experiences rather than to replace them. A field trip to an apple orchard would include the chance to pick the apples from the trees; perhaps followed by apple tasting; where each child can have their own apple, to hold, smell, and taste. Only then would she read a story from a book about the apples, or let them “pick” the abstract apples on a multi-touch screen. Too often, Montessori might argue, this concrete to abstract process is reversed.

**Position Statement Alignment**

Technology and interactive media are tools that can promote effective learning and development when they are used intentionally by early childhood
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educators, within the framework of developmentally appropriate practice to support learning goals established for individual children.
NAEYC & Fred Rogers Center (2012), p. 5

Montessori’s Influence on Google, Amazon, and The Sims

Four of today’s most successful technology innovators and leaders attribute a Montessori-inspired education to their formative development. Google co-founder Sergey Brin attended Paint Branch Montessori School in Adelphi, Maryland, and talks about his Montessori education. Brin later tried unsuccessfully to get into MIT and went to Stanford instead, where, in 1995, he got into a 2-day argument with another younger student who was visiting Stanford from the University of Michigan, named Larry Page (Google co-founder). Larry Page, son of Carl Victor Page (Michigan State University computer science professor), attended Okemos Montessori School (now called Montessori Radmoor) from 1975 to 1979. He also attended Interlochen Academy and the University of Michigan; taking a class from Elliot Soloway. Will Wright, the designer of The Sims and co-founder of Maxis had a “brief, intense” elementary Montessori experience in Atlanta, GA, until sixth grade (Crecente, 2009). Amazon.com founder Jeffrey Bezos took his crib apart with a screwdriver. By his mother’s account, the young Bezos got so engrossed in the details of activities at his Montessori school that teachers had to pick him up in his chair to move him to new tasks (Hof, 2009).

Before attributing such technological and financial success to a Montessori education or any other specific curriculum, it is important to consider that Montessori schools are often private, expensive, and cater to parents who themselves may be highly educated or may have large incomes. In the case of both Brin and Page, both had parents who were college professors. Other factors, besides exposure to Montessori ideas, could be associated with a future successful career of a child.

But you have to wonder what would Maria Montessori have to say about the success of these former Montessori School students.

Position Statement Alignment

The challenge for early childhood educators is to make informed choices that maximize learning opportunities for children while managing screen time and mediating the potential for misuse and overuse of screen media, even as these devices offer new interfaces that increase their appeal and use to young children.
NAEYC & Fred Rogers Center (2012), p. 3

Words of Caution

Before you rush out and purchase every child a tablet, consider these words of caution, again extrapolated from Montessori’s ideas:

* Keep an open mind about this issue. Tablets are like chameleons—they take the form of the app they are running. Some apps match a child and your
learning philosophy; others don't. Like anything new, it must be observed and studied to maximize the strengths and minimize downsides. As a scientist, Montessori was trained to systematically study various techniques, use what works, and discard the rest.

- **Keep things in balance.** She'd urge modern parents not to upset the balance of diet, exercise, and the development of the senses through exposure to water, wood, sounds, and sand. Technology-based experiences can supplement this mix. For example, the camera on most iPod Touch is an ideal tool for capturing observations on a field trip.

- **Screens are inherently abstract.** Said Goodwin “She'd (Montessori) remind us that any screen is an abstract, two-dimensional object that is removed from reality.” In other words, the movements of a virtual fish in the Koi Pond HD app (The Blimp Pilots, 2011), might fool your cat, but one sniff tells you they're not real. What app could replace the smells and sounds of a marsh pond on a spring day?

- **Technology tends to be expensive and quickly becomes obsolete.** You can buy a lot of chromatic silk frames and sandpaper letters for $500, and anyone knows that next generation iPad will be “newer, better, faster, and cheaper.”

- **Don’t sugar coat the learning.** She'd like apps that are simple and stripped "of all that is not absolute truth," sans licensed characters, long musical introductions, or links that steer a child toward a shopping cart. Because she frowned on the notion of shaping a child's behavior with external prizes and punishments, she'd recommend apps where the process, in itself, is rewarding. She might ask, “What type of society exposes its young to manipulative tricks with commercial motives?” Montessori would probably insist that every children's app should have a "no candy lane" mode, which perhaps costs a few Euros more.

In the century since Maria Montessori gave her famous Carnegie Hall address, a lot has changed. But a lot is still the same. We still have many of hard-to-teach children with limitless potential, and the job of creating environments where they can thrive is expensive and challenging. But today, it's nice to think that we have better materials.

**Teacher Takeaways**

Now that you know what I think Montessori might have said about multi-touch screens, what do you think? Here are some ways to apply the key concepts in this chapter:

- Try the Theoretician role-play game.
- Together with a small group, start a popular app, and make sure each person is familiar with what it does and how it works.
• Put the names of five theories on index cards, and have each person draw a theory, at random.
• Next, have them choose a theorist to represent the theory (Behaviorism, John Watson; Cognitive Science, Jerome Bruner; and so on).
• Use Wikipedia and other Web resources if you need a quick refresher on the theories.

References


National Association for the Education of Young Children & Fred Rogers Center for Early Learning and Children’s Media at Saint Vincent College. (2012). *Technology and interactive media as tools in early childhood programs serving children from birth through age 8*. Washington, DC; NAEYC; Latrobe, PA: Fred Rogers Center for Early Learning and Children’s Media at Saint Vincent College.


**Resources**

**Books and journals**


Apps

- *Bugs and Buttons*, Little Bit Studio, www.littlebitstudio.com
- *Facebook*, www.facebook.com
- *Google*, www.google.com
- *Green Eggs and Ham*, Oceanhouse Media, www.oceanhousemedia.com
- *Oceanhouse Media*, www.oceanhousemedia.com
- *Scratch 2.0*, MIT, http://scratch.mit.edu
- *Twitter*, https://twitter.com
- *YouTube*, www.youtube.com

Learn More...

- *AMI, Association Montessori International, USA*, www.amiusa.org
- *Children’s Technology Review*, http://childrenstechnologyreview.com and www.youtube.com/user/childrenstechnologyreview
- *Dust or Magic*, http://dustormagic.com