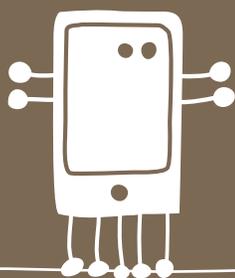


Learning: Is there an app for that?

Investigations of young children's
usage and learning with mobile
devices and apps



Cynthia Chiong & Carly Shuler

The Joan Ganz Cooney Center at Sesame Workshop

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The Cooney Center has a deep commitment toward dissemination of useful and timely research. Working closely with our Cooney Fellows, national advisors, media scholars, and practitioners, the Center publishes industry, policy, and research briefs examining key issues in the field of digital media and learning.

A full-text PDF as well as Appendices A through C of this report are available for free download from www.joanganzcooneycenter.org. Individual print copies of this publication are available for \$20 via check, money order, or purchase order made payable to "The Joan Ganz Cooney Center for Educational Media and Research" and sent to the address below. Bulk rate prices are available on request.

Attn: Publications Department
The Joan Ganz Cooney Center
Sesame Workshop
1900 Broadway
New York, NY 10023
p: (212) 595-3456 f: (212) 875-6088
cooney.center@sesameworkshop.org

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contents

2 executive summary

6 PART 1
family media engagement: probing the pass-back effect

6 Introduction

9 Definitions

11 About the studies

14 PART 2
mobile devices, apps, and learning: research results

22 PART 3
implications: translating research into practice

22 Implications for industry

26 Implications for education

27 Future directions for researchers

28 conclusion

30 references

executive summary

A mobile media revolution that is changing the lives of adults, and now children of all ages, is under way across the globe. This report focuses on how new forms of digital media are influencing very young children and their families in the United States and how we can deploy smart mobile devices and applications — apps, for short — in particular, to help advance their learning. It does so in three parts: Part One discusses new trends in smart mobile devices, specifically the pass-back effect, which is when an adult passes his or her own device to a child. Part Two presents the results of three new studies that were undertaken to explore the feasibility and effectiveness of using apps to promote learning among preschool- and early-elementary-aged children. Though designed to complement one another, each study approached mobile learning from a different angle. Finally, Part Three discusses the implications these findings have for industry, education, and research.

About the studies

Three new studies were commissioned by the Joan Ganz Cooney Center at Sesame Workshop and PBS KIDS Raising Readers, through an initiative funded by a Ready to Learn grant and the United States Department of Education in cooperation with the Corporation for Public Broadcasting and the research agencies listed below.

Are young children interested in and able to use mobile applications?

The Usability Study: Sesame Workshop and the Cooney Center interviewed 114 4-to-7-year-olds to understand young children's knowledge, perceptions, and use of smart phones, with a focus on iPhone and iPod touch applications. Parents of the participating children also completed brief surveys about the types of devices they own.

What are parents' practices and perceptions regarding their children's use of mobile applications?

The Parent Survey: HotSpex, a market research firm, administered web-based surveys to 612 mothers and 198 fathers of at least one preschool- or early-elementary-aged child. The survey asked parents questions regarding childrearing practices around media; their beliefs, attitudes, and perceptions about media; and interactions with their children around these media.

Can young children learn from mobile applications?

The Learning Study: Rockman et al (REA), an evaluation firm, assessed the effectiveness of two research-based, educational literacy apps developed by PBS KIDS and WGBH: *Martha Speaks: Dog Party* and *Super Why*. Researchers gave 90 children (ages 3-7) an iPod touch on which to play the two apps over two weeks. Their parents completed observation logs, and the children were given a pre- and posttest to assess their ability in reading skills and content areas covered in the apps.

Key findings

Together, the three studies provide insight into how children are using and learning from smart mobile devices and apps. Here we present the findings according to our focal research questions:

- **How much access do young children have to smart mobile devices?**

The pass-back effect appears to be a real interactive phenomenon. Young children have access to smart mobile devices, but their access is often limited.

- **What do young children do with smart mobile devices?**

Kids say that they mainly play games with smart mobile devices, while parents report that their kids use these devices for a variety of activities.

- **To what extent do young children like smart mobile devices?**

They like smart mobile devices, particularly the iPhone/iPod touch.

- **How adept are young children at using smart mobile devices?**

Most children were able to use the device on their own without any trouble. Other children needed a little help, but only at the beginning. They quickly became adept users.

- **To what extent do young children learn from apps?**

There is evidence that kids can learn from apps. The *Martha Speaks* application used in the Learning Study shows promise for vocabulary learning, especially for older children. The *Super Why* app may be an effective way to promote literacy skills, especially for younger children.

- **How can apps successfully sustain young children's interest and learning?**

Interest in the apps can be fleeting, but factors such as developmentally appropriate and fresh content, shortened wait times, humorous activities, incentives, goals, and parental involvement can help to sustain interest.

- *What is the role of parents in the mobile media revolution?*

All three studies suggest that parents play important roles in shaping the quality of their children's experiences with mobile devices. When it comes to smart mobile devices, many parents do not yet view them as potential learning tools — especially when compared to other technologies like computers and the Internet — and thus restrict how their children use them.

Implications for education

- Optimize children's time with mobile devices.
- Use mobile devices as supplemental tools.
- Surround children with high-quality educational resources.

Implications for industry

Design principle No. 1: Create apps that are developmentally appropriate.

- Focus content narrowly within a developmental age range.
- Design content to be relevant to what children are already learning.
- Consider children's evolving motor skills.
- Engage children (and adults!) by making them laugh...
- ...but not too much. Balance engagement and learning.

Design principle No. 2: Create apps that sustain children's interest and learning.

- Design for shorter playtimes.
- Provide goals and incentives: Keep them coming back.
- Give kids the option to personalize.
- Involve parents.

Distribution strategies: Bringing educational apps to market.

- *Lead kids (and their parents) to appropriate content:* Protect children from inappropriate content and warn parents of apps with unsubstantiated educational claims.
- *Build parent expertise and promote quality:* Inform parents of the existence of quality educational apps and how to find them.
- *Provide something old and something new:* Using familiar characters and brands may be a way of engaging kids with new apps and gaining the trust of their parents.
- *Bridge the digital divide:* Ensure that children from underserved or underrepresented populations receive the same opportunities to learn using smart mobile devices as their peers.

The trajectory for academic and life success is established in the preschool and primary years, when children are developing new habits for learning and social development. In this *middle childhood* developmental period especially, the growing ubiquity of children’s engagement with media is critical — according to the Kaiser Family Foundation and Sesame Workshop studies, 8-year-olds spend as many hours engaging with various screens as they do in school, and preschoolers are spending about four hours per day on media (The Nielsen Company, 2009), far more than they devote to reading and outdoor play. Policymakers, child development experts, and concerned parents are increasingly drawing a connection between media consumption and academic lethargy and seeking ways to strike a healthier balance. But for better or worse, digital media as a prime pillar of family life is indisputable — and it’s here to stay. And while concerns about health and safety must be addressed, the Joan Ganz Cooney Center is probing the potential of digital media to accelerate learning, especially for children who need intensive support to reach their potential.

This report expands on a previous study, *Pockets of Potential* (Shuler, 2009a), which called for parents, practitioners, industry leaders, and policymakers to closely consider the prospect that mobile media can make a powerful educational impact beginning in early childhood. As *Sesame Street* and other high quality media productions have proven over the past four decades, exposure to research-tested educational media starting early in life can accelerate children’s skills, and help form a pathway towards long-term success. An enduring legacy of those four decades of work is an emphasis on family media engagement, which has helped bond generations of television viewers by watching broadcast productions together. What scholars have referred to as *coviewing* is currently undergoing an apparent shift to digital devices, which the current report addresses.

The Cooney Center research team noted a possible new family media trend in the summer of 2009. The phenomenon was observed in grocery stores, on the subway, at shopping malls, and in coffee shops. What we informally observed were children



Box 1: The pass-back effect

The pass-back effect is when a parent or other adult passes their own mobile device to a child. It usually occurs:

- **When adult family member → child:** An adult, usually a family member, allows a young child to play with his or her smart mobile device.
- **For entertainment:** The child usually plays a game, but could also use the device for pictures, videos, music, and other activities.
- **In short sessions:** Each session is short, lasting 5 to 20 minutes.

— even very young children — playing on digital devices with accessible touch screens. Market reports confirmed that the iPhone and iPod touch were gaining mass appeal, and it seemed that children as young as age 3 were participating. While young children surely were not purchasing their own iPhones, or even iPod touches, we increasingly observed a *pass-back effect* (see Box 1), where a parent or other adult passes their device to a child.

To delve into the role that a new generation of mobile devices might play in children’s learning, in fall 2009 the Cooney Center published a mini-study called *iLearn* (Shuler, 2009b). The short paper is a content analysis of the education category of the iTunes App Store, focusing on the 100 top-selling apps in this section. While the study was small, the implications led the Center to explore how and whether mobile applications — commonly referred to as apps¹ — could emerge as a potentially significant new medium for providing content to children.

One year has passed since *iLearn*’s release, and the app market for young children continues to explode. The iTunes store has opened a dedicated section of Apps for Kids. Major children’s entertainment companies have entered this market en masse, and educational media leaders such as Sesame Workshop and PBS now have numerous apps available for kids and parents alike. If anything, our research team and other colleagues in the field are observing more and more evidence of the

¹The Pew Research Center’s Internet and American Life Project defines apps as “end-user software applications that are designed for a cell phone operating system and which extend the phone’s capabilities by enabling users to perform particular tasks” (Purcell, Entner, & Henderson, 2010, p. 2)



Box 2: Opportunities and challenges in mobile learning

Key Opportunities	Key Challenges
<p>Mobile devices are everywhere children turn, and innovative examples of mobile learning are popping up worldwide. But where should educators, developers, and companies focus their resources now? Outlined below are five opportunities to seize mobile learning's unique attributes to improve education:</p> <ol style="list-style-type: none">1. Encourage “anywhere, anytime” learning: Mobile devices allow students to gather, access, and process information outside the classroom. They can encourage learning in a real-world context and help bridge school, afterschool, and home environments.2. Reach underserved children: Because of their relatively low cost and accessibility in low-income communities, mobile devices can help advance digital equity, reaching and inspiring populations “at the edges”—children from economically disadvantaged communities and those in developing countries.3. Improve 21st-century social interactions: Mobile technologies have the power to promote and foster collaboration and communication, which are deemed essential for 21st-century success.4. Fit with learning environments: Mobile devices can help overcome many of the challenges associated with larger technologies, as they fit more naturally within various learning environments.5. Enable a personalized learning experience: Not all children are alike; instruction should be adaptable to individual and diverse learners. There are significant opportunities for genuinely supporting differentiated, autonomous, and individualized learning through mobile devices. <p>Source: Pockets of Potential (Shuler, 2009b)</p>	<p>Devices such as mobile phones, iPods, and handheld video game consoles have features that can help children develop important skills they'll need to succeed in the 21st century. But along with their potential comes certain challenges that must be addressed:</p> <ol style="list-style-type: none">1. Negative aspects of mobile learning: Cognitive, social, and physical challenges must be surmounted when mobile devices are incorporated into children's learning. Disadvantages include the potential for distraction or unethical behavior, physical health concerns, and data privacy issues.2. Cultural norms and attitudes: Though many experts believe that mobile devices have significant potential to transform children's learning, parents and teachers apparently are not yet convinced. A 2008 national survey found that most teachers see cell phones as distractions.3. No mobile theory of learning: Currently, no widely accepted learning theory for mobile technologies has been established, hampering the effective assessment, pedagogy, and design of new applications for learning.4. Differentiated access and technology: Wide diversity among mobile devices represents a challenge for teachers and learners who wish to accelerate academic outcomes as well as for the technology producers who seek to facilitate such learning.5. Limiting physical attributes: Poorly designed mobile technologies adversely affect usability and can distract children from learning goals. Physical aspects of mobile technologies that may prevent an optimal learning experience include restricted text entry, small screen size, and limited battery life.

pass-back effect, as we track nationwide examples of children playing with iPhones and iPod touches as though the devices were designed just for them. It seems inevitable that engagement with mobile media will only continue to expand with the onset of newer technologies such as the Droid, the iPad, and other tablet devices.

However, it is as yet uncertain what exactly young children like about mobile devices and apps, or to what extent they can use and learn from them. We do not know empirically how common the pass-back effect is yet, but we do know that there is a considerable opportunity to leverage mobile technologies for the benefit of children's development.

We cannot adequately capitalize on the greater use of mobile devices and apps without developing a firmer basis for understanding their potential. Are young children interested in and able to use mobile devices and apps? Can children really learn substantively from them? And what are parents' practices and perceptions regarding their children's use of these devices? This report begins to answer these questions, presenting the results of three new studies — one conducted by PBS KIDS Raising Readers and Rockman et al, one conducted by the Cooney Center and Sesame Workshop, and one by the Cooney Center and Hotspex, a market research company — and discussing their implications in promoting the development of quality educational apps on mobile devices for kids.

Definitions

The Joan Ganz Cooney Center's 2009 report *Pockets of Potential* explores the key opportunities and challenges concerning how mobile devices may be used to promote children's learning (see Box 2). *Pockets of Potential* identifies untapped possibilities that mobile technologies may have for today's youngest users. This report narrows the lens of discussion and focuses on the promise of mobile devices to promote children's learning as defined by the following parameters:

The report specifically explores smart mobile devices, with a focus on iPhone and iPod touch applications (apps)

Smart phones are mobile devices that include all of the capabilities of a phone as well as smart features, such as being web-enabled, location-aware, and having multi-touch-screen capabilities. Based on wide interest among policymakers and industry in educational innovation, our research zeroes in on the smart aspects of mobile devices, since they are the features young children commonly use via apps. This report specifically focuses on Apple's iPhone and iPod touch, as these two devices are known for supporting innovative children's apps on their platform. However, the findings of this report reach well beyond these two devices and have implications for the design of educational content across a variety of smart mobile devices.

The report focuses on U.S. preschool- and early-elementary-aged children (3 through 9)

Recent large-scale studies have documented the use of apps among adults and older children (e.g., NPD Group, 2010; Purcell, Entner, & Henderson, 2010; see also Box 3), while a growing body of research is investigating the potential of apps and other mobile device features in promoting learning (see Shuler, 2009 for review). Until now, little research has been done with younger children, specifically preschool and early-elementary children.

The report concentrates on reaching children in informal learning environments

While we have explored the productive use of mobile devices in classroom and other formal learning settings in prior research, there are significant institutional and policy barriers that must be overcome before use of smart mobile devices and apps in the classroom can become widespread. While many of the findings will be relevant to classroom-based mobile learning interventions, this report focuses on promoting children's informal learning — learning through apps made available for use by children during their leisure or out-of-school time.



Box 3: Recent large-scale studies on apps use

Two additional studies provide context for the smaller studies presented in this report, which focuses on preschool and early-elementary children's smart device use and learning.

The Rise of Apps Culture

Conducted by: The Pew Research Center's Internet & American Life Project and the Nielsen Company (Purcell, Entner, & Henderson, 2010)

Report date: September 15, 2010

Description and methods: The Pew Research Center's Internet and American Life Project published a report describing the "app culture" that has emerged since the release of the iPhone in 2007. It includes data from two large survey studies: (a) The Pew Internet telephone survey of 2,252 U.S. adults age 18 and older (including 1,917 adult cell phone users), conducted between April 29 and May 30, 2010. And (b) Nielsen data from an analysis of 3,962 adults (age 18+) gathered in the December 2009 Apps Playbook, an online, self-administered non-probability sample of apps downloaders originally identified in Nielsen's Mobile Insights survey of cell phone subscribers identified through online panels.

Key findings:

- Eighty-five percent of American adults use cell phones, but only 43% of these users have apps. This equates to 35% of the entire adult population. Of this minority, only 68% actually use the software. (Pew)
- Apps users are younger, more educated, and more affluent than other cell users. The apps-using population also skews male and slightly Hispanic. (Pew)
- Younger cell phone users are more likely to download apps. Only a tenth of all adult cell phone users had downloaded an app in the past week, whereas 20% of adult cell phone users under age 30 reported doing so. (Pew)
- Apps use ranks low compared with other non-voice cell phone activities. Only 29% of adult cell phone users use apps, whereas 79% take pictures, 72% text message, and 34% play video games on their cell phones. (Pew)
- About half (47%) of adults who download apps have ever paid for one, with the rest reporting that they only download free apps. (Pew)

- Games are the most popular apps among app downloaders, followed by news/weather, maps/navigation, social networking, and music. (Nielsen)
- Seventy-one percent of apps downloaders report frequently using apps alone, and 53% frequently use their apps while waiting for something or someone. (Nielsen)

Kids' Mobile Entertainment & Apps

Conducted by: The NPD Group (2010)

Report date: September 20, 2010

Description and methods: An online survey was sent to a pre-identified sample of parents who own an iPhone, iPod touch, iPad, BlackBerry, or other smart mobile device, as well as a pre-identified sample of households with children (ages 0 to 14) who use one of the measured devices. Surveys were conducted from June 18 through July 28, 2010. The NPD Group's analysis includes 1,043 completed surveys from parents of children who use one of the measured devices.

Key findings:

- A majority of smart mobile devices used by parents and children have fewer than 20 apps that were downloaded specifically for a child. Seven percent of these devices have more than 60 kid-targeted apps.
- Games are the most popular type of app downloaded on smart mobile devices used by children, with the average device containing approximately 10 game-related apps.
- Eighty-two percent of all apps downloaded for children were free. However, those who report purchasing apps for their children say they are willing to spend more money for these types of apps.
- Five percent of survey respondents report that the most motivating factor for downloading an app is whether it's free. Other motivators include recommendations from family and friends, a child's desire for an app, and the app's affiliation with a character or personality.
- Most children reuse the same app several times. Only about 1% reported abandoning apps after just one use.

The report examines the general population, but takes a close look at a lower-income demographic

Technologies designed for learning can often have the unintended effect of widening the digital divide. This is a particularly sensitive issue when it comes to examining a popular medium such as the iPhone, one that is increasingly reaching a mass audience but is still associated with higher-income demographics. Thus, though this report examines data that can apply to the general population, we draw from studies that include a substantial low socioeconomic sample. We place special emphasis on how smart mobile devices and mobile applications can be used to deliver high-quality educational content to children from low-income communities.

About the studies

This report presents the results of three new studies conducted by the Joan Ganz Cooney Center at Sesame Workshop and PBS KIDS Raising Readers², through an initiative funded by a Ready to Learn grant and the United States Department of Education in cooperation with the Corporation for Public Broadcasting, Sesame Workshop, and HotSpex, a market research firm. The linked studies were undertaken to explore the feasibility and effectiveness of using mobile applications to promote learning among preschool- and early-elementary-aged children. Though designed to complement one another, each study approached mobile learning from a different angle as presented below (for the complete protocols, see Appendices A, B, and C, which can be downloaded from <http://www.cooneycenter.org>).

Usability Study

Are young children interested in and able to use mobile applications?

Sesame Workshop and the Cooney Center conducted a study to understand young children's knowledge, perceptions, and use of smart phones, with a focus on iPhone and iPod touch applications. They conducted one-on-one interviews with 114 4-to-7-year-olds (see Table 1, p. 12). In the interviews, children were asked questions about various technology devices such as if and how they used

them and how much they liked them. Following these interviews, the researcher observed the child using an iPod touch that was loaded with the Sesame Workshop *Elmo's Monster Maker* app. Parents of the participating children also completed brief surveys about the types of devices that they own.

Parent Survey

What are parents' practices and perceptions regarding their children's use of mobile applications?

HotSpex, a market research and consumer insights organization, administered web-based surveys to 612 mothers and 198 fathers of at least one preschool or early-elementary-aged child. The parent also had to be the owner of a smart mobile device. The survey asked parents questions regarding childrearing practices around media; their beliefs, attitudes, and perceptions about media; and interactions with their children around these media.

Learning Study

Can young children learn from mobile applications?

PBS KIDS initiated this research to gain insight into the potential that smart mobile devices can have for young children's learning, and to inform their design practices around developing educational content for children on these platforms. The study was conducted by Rockman et al (REA), an external research, evaluation, and consulting firm, to evaluate the effectiveness of two research-based, educational literacy apps developed by PBS KIDS and WGBH.

- *Martha Speaks: Dog Party:* WGBH designed this app for children ages 4 through 7. It focuses on introducing new vocabulary through three mini-games and a quiz.



²More information on PBS KIDS Raising Readers and the Ready to Learn Grant can be found on the PBS KIDS website at <http://pbskids.org/read/about/>.

• **Super Why:** PBS KIDS designed this app for children ages 3 through 6. It has four mini-games that aim to increase literacy skills —



specifically, to identify letters, letter sounds, and rhyming words; to spell and write words; and to complete sentences by selecting words to fill in blanks within stories. The games can be played together in a play-all mode, and the app includes a sticker activity.

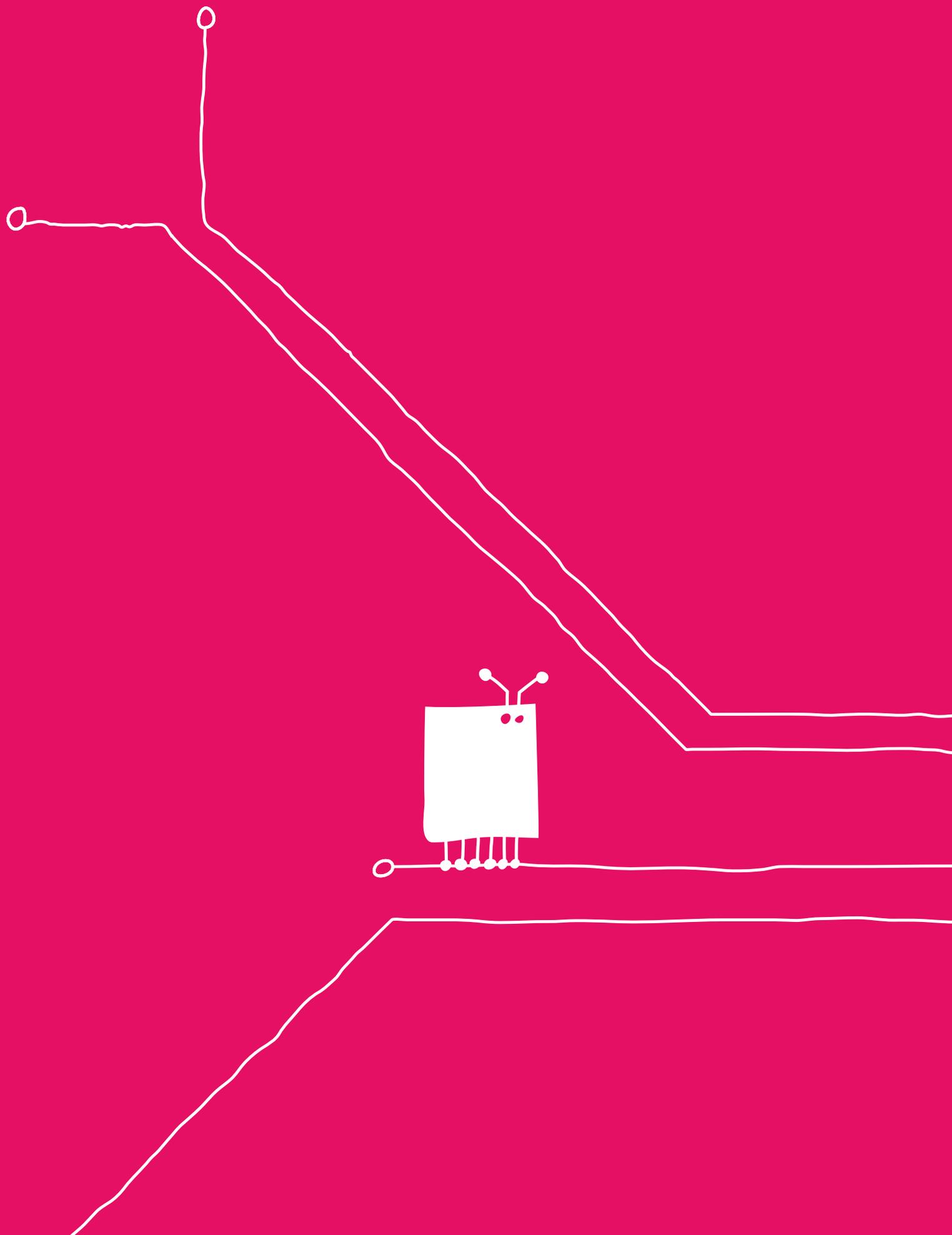
Researchers gave 90 children ages 3 through 7 an iPod touch on which to play with the two apps over a period of two weeks. Their parents completed observation logs and the children were given a pre- and posttest to assess their ability in reading skills and content areas covered in the apps. Some of the children were also videotaped using the iPod touch during the introductory session to gather more qualitative information about their interactions with the learning apps.

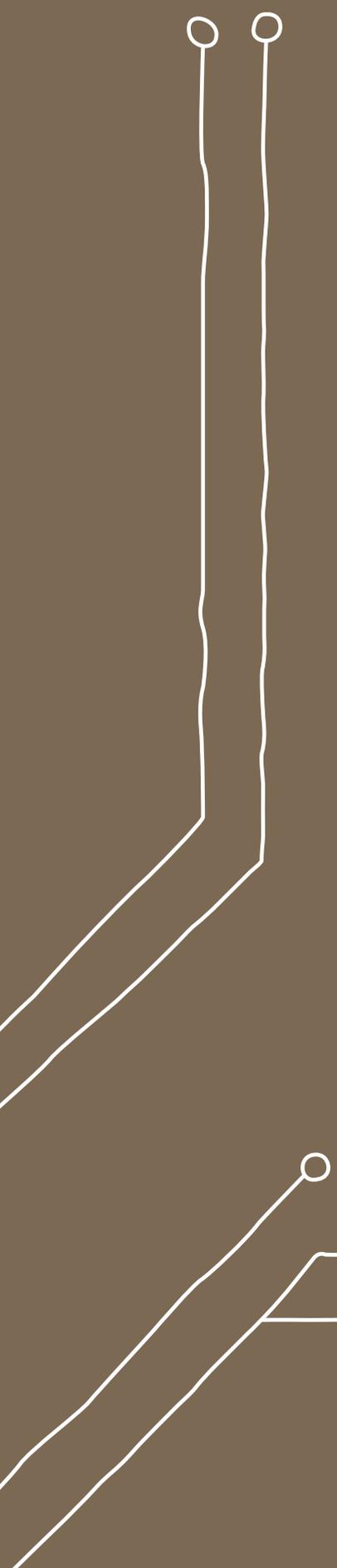
More information on this study as well as other research around mobile technology can be found at the PBS KIDS website (<http://pbskids.org/read/research/mobile.html>).



Table 1: Mobile learning study participants

	Usability Study	Parent Survey	Learning Study
Location	Preschools in the metropolitan New York area	49 U.S. states	Washington, DC, and Bloomington, IN
Participant profile	114 children ages 4 to 7	612 mothers and 198 fathers of at least one child in preschool to fourth grade	90 children ages 3 to 7
Age	Age 4: 27% Age 5: 35% Age 6: 21% Age 7: 7%	Adults	Age 3: 11% Age 4: 17% Age 5: 27% Age 6: 31% Age 7: 14%
Gender	Approximately half were girls, and half were boys	Mothers: 76% Fathers: 24%	Approximately half were girls, and half were boys
Socio-economic status	Approximately half were from low-income families	Almost half (44.5%) come from households earning less than \$50,000	Children were recruited from Title 1 schools
Ethnicity	White: 29% African American: 32% Hispanic/Latino: 29% Asian: 5% Other: 5%	White: 82% African American: 4.6% Hispanic/Latino: 6.6% Asian: 2.8% Native American: 1.5%	White: 64% African American: 16% Hispanic/Latino: 6% Asian: 3% Other: 11%





PART: 2

mobile devices, apps, and learning: research results

Together, the three studies provide insight into how children are using and learning from mobile devices and apps. Here we present the findings according to the following research questions:

1. How much access do young children have to smart mobile devices?
2. What do young children do with smart mobile devices?
3. To what extent do young children like smart mobile devices?
4. How adept are young children at using smart mobile devices?
5. To what extent do young children learn from apps?
6. How can apps successfully sustain young children's interest and learning?
7. How do parents fit into these patterns?

Analysis of the data collected on these questions provides an initial snapshot of what this new pass-back phenomenon entails. Specific findings outlined below are associated with the study of its origin, that is, the Usability Study, Parent Survey, or Learning Study (see Table 1, p. 12).

Study findings

1. How much access do young children have to smart mobile devices?

Finding 1: The pass-back effect appears to be a real phenomenon. Young children have access to an adult's smart mobile device, but their access is often limited.

About two-thirds of the children in the Usability Study said that they have used an iPhone before.

- Eighty-five percent of these children say the iPhone belonged to a family member (90%) or a friend (10%) (see Chart 1).

Most parents at least occasionally allow their child to use their smart mobile device.

- Of the parents who do let their child regularly play with their mobile device, they let their child do so fairly frequently.
 - + The majority report that they allow their child to use their smart phone at least a few times a week.
 - + Each session lasts about 20 minutes or less.

There is a significant portion of parents who do not allow use (see Chart 2).

- About a third of the parents in the Usability and Learning Studies and almost half of the parents in the Parent Survey study say they rarely or never allow their child to use their mobile device.

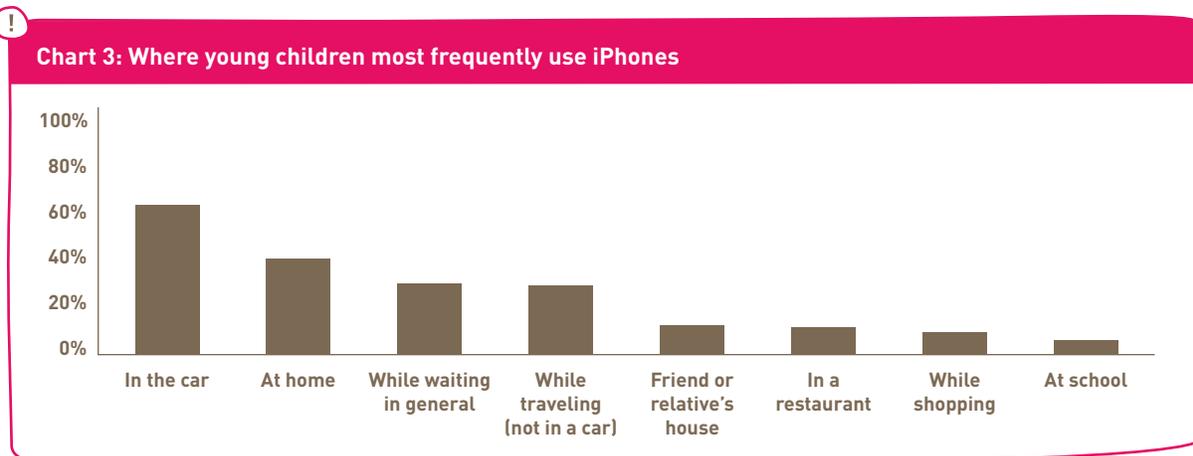
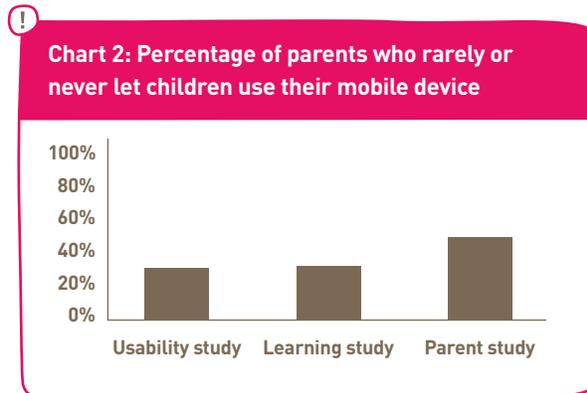
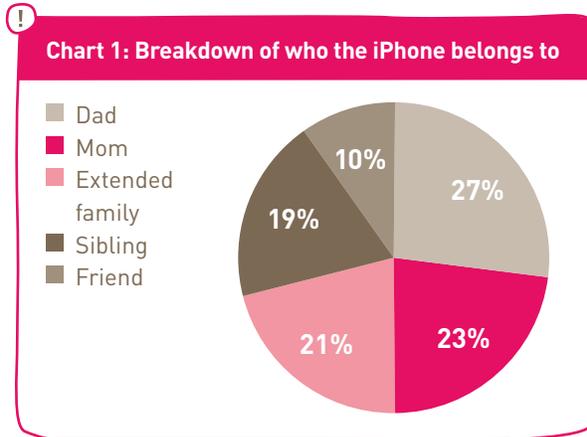
Furthermore, the Parent Survey found that:

- Only 14% of parents allow their child to use their Internet-enabled mobile device.

- About three-quarters of the parents do not believe that children under the age of 7 should regularly play with smart phones.

Finally, kids are passed-back a smart phone most often when traveling (see Chart 3).

- The place where the parents most frequently let their child use their phone is in the car.



2. What do young children do with smart mobile devices?

Finding 2: Kids say that they mainly play games with smart mobile devices, while parents report that their kids use these devices for a variety of activities.

- Of the children who reported using an iPhone before in the Usability Study, 60% said that they used it to play games (See Chart 4).
- Of the parents who own an iPhone in the Parent Survey, most reported that their child used their iPhone for numerous activities, including playing with apps, taking/viewing pictures, placing calls, listening to music, and taking/watching videos (see Chart 4).

3. To what extent do young children like smart mobile devices?

Finding 3: They like smart mobile devices, particularly the iPhone/iPod touch.

Children in the Usability Study were shown images of eight devices (see Chart 5) and asked to rank them from most to least favorite.

- Collectively, children ranked the iPhone as the device they like to play with most after the Nintendo DS and Nintendo Wii (see Chart 5).
- Cell phones and BlackBerries were ranked last, in seventh and eighth places, respectively.
- Girls ranked cell phones and BlackBerries higher than boys did, especially 6- and 7-year-old girls.



Chart 4: Types of activities that young children do with iPhones

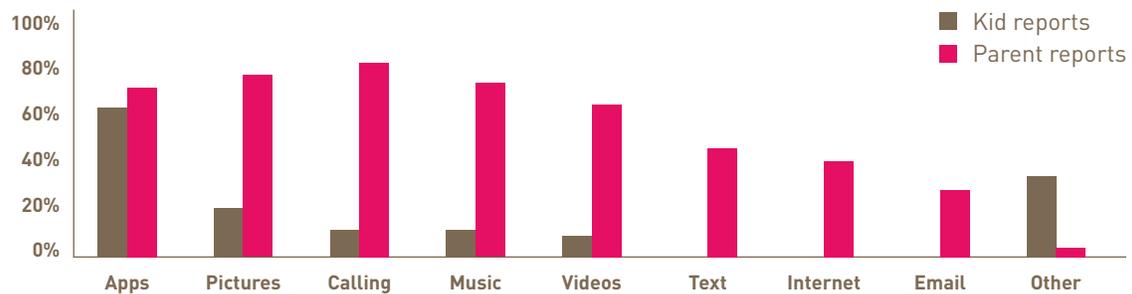
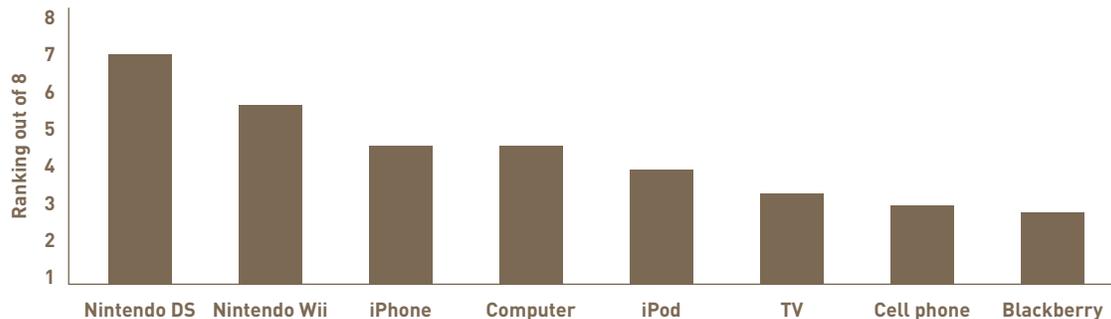


Chart 5: Children's rankings of their favorite media devices



- + Despite higher rankings among the girls, both devices still fell in the bottom half of their preferences.
- Children think of the iPod touch as a device related to games and play.
 - + 54% of the children described the iPod touch as “fun” or as something you play on, with another 11% saying that its purpose is to play games and 6% calling it “cool.”
- iPhones may be slightly more appealing to kids than other smart phones.
 - + Of the parents who owned iPhones, 32% let their child use them once a day or more versus only 19% of parents who owned BlackBerries.
- This difference seems to be due to the child, and not the parent. In fact, 28% of the BlackBerry parents reported that their child stopped playing with the phone because they get bored, as compared with 17% of the iPhone parents (see Chart 6).
- Forty percent of the iPhone parents also said that they have to make their child stop playing with the phone, as compared with 33% of the BlackBerry parents (see Chart 6).
- This may be explained by the greater availability of apps for iPhones. According to the Parent Survey, 71% of children use iPhone apps whereas only 42% of the children use BlackBerry apps.

4. How adept are young children at using smart mobile devices?

Finding 4: Most children were able to use the device on their own without any trouble. Other children needed a little help, but only at the beginning, as they quickly became adept users.

According to the Usability Study:

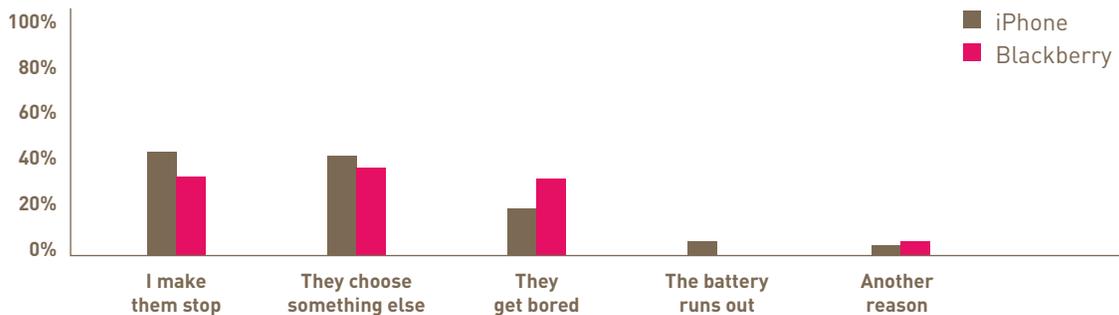
- Sixty-four percent of the kids said that it was “easy” or “very easy” to use.
- Almost the same percentage immediately navigated to Elmo’s Monster Maker app. The children appeared to know that by clicking the Elmo icon they would find something entertaining.
- Fifty-three percent of children in this study did not need an adult to help them play with the iPod touch during the observation period.

Parent responses support this finding:

- **Parent Survey:** Of the parents who reported letting their child use their mobile device, 60% said that their child was comfortable using it.
- **Learning Study:** Half of the parents said that their child needed some help at the start but very little after that. Another 40% reported that their child needed no help at all.



Chart 6: Why children stop playing with smart phones: iPhone versus BlackBerry



Starting out, many had a few problems. In both the Usability and Learning Studies, children had trouble:

- **Turning the iPod touch on:** Many of the children did not know how to turn the device on. Sometimes the children even accidentally turned the device off.
- **Swiping:** Some children did not know how to use their fingers to swipe across menu pages.
- **Tapping icons:** The children often did not directly tap on the icon or would hold the icon too long. The latter often resulted in the deletion of the app.
- **Exiting the app:** For some children, exiting the app was intuitive, while others accidentally exited. When the app was improperly exited, the levels played and scores from that session were not saved.
- **Hearing instructions:** Some children had difficulty hearing the game instructions. The sound quality was not clear enough, especially if the child was in a loud environment. Some of these children didn't know that it was possible to adjust the volume, and others didn't know how to adjust it. It was more intuitive for these children to press the iPod touch to their ears to be able to hear the instructions than to look for a volume button.

Despite the problem areas noted above, the children adapted quickly.

- If children were observed to be confused or frustrated, they didn't seem to give up or get bored.
- Parents also reported that usability issues generally disappeared after their child played with the device a few times.
- The children also demonstrated natural instincts for using the device.
 - + Landscape versus portrait: The Usability Study found that most children naturally held the iPod touch in portrait position but then turned it to landscape as necessary to properly view the game.

5. To what extent do young children learn from apps?

Finding 5: There is evidence that kids can learn from apps.

The *Martha Speaks* application shows promise for vocabulary learning, especially for older children.

- On a vocabulary test where 36 words were chosen from *Martha Speaks: Dog Party*, gains were seen for every age, with the 5-to-7-year-olds gaining more than 20% from pre- to posttest (see Table 2).
- The 5-year-olds seemed to benefit most. They were less likely than the older children to know the words at pretest and more likely than the younger children to be developmentally ready to acquire proficient understanding of these new words and their meaning.

The *Super Why* app may be an effective way to promote literacy skills, especially in younger children (see Table 3).

!

Table 2: Vocabulary gains after playing with the Martha Speaks app

Age	Number of participants	Average gain in vocabulary score
3	6	14%
4	7	10%
5	13	27%
6	16	22%
7	12	21%

!

Table 3: Literacy gains after playing with the Super Why app

Age	Number of participants	Average gain in vocabulary score
3	8	17%
4	13	9%
5	23	8%
6	26	9%
7	12	-3%

- Children were given a test that consisted of 20 items of letter sounds, rhyming, sentence completion, and visual and verbal vocabulary questions.
- Although there were fewer younger participants, results indicate that these younger children made gains, specifically, a 17% gain for 3-year-olds.
- Most of the older children, especially the 7-year-olds, had already mastered some of the skills, such as letter identification and rhyming, thus minimizing the potential to demonstrate sizable learning gains.

6. How can apps successfully sustain young children's interest and learning?

Greystripe (2009) found that adult iPhone users spend an average of 9.6 minutes with an app each session, and use a particular app, on average, 19.9 times before they stop using it at all. That's a little over three hours — much less than what most children spend watching a television series they like, or playing a particular video or computer game. As such, there is reason to believe that children currently may not play with an app for long enough to learn much.

Finding 6: The Learning Study confirmed that interest in the apps can be fleeting, but it also revealed insights into how to sustain interest.

- About half of the parents reported that their child played an average of 11 to 20 minutes during each session, and about 40% reported an average of 5 to 10 minutes.
- However, many of the parents also reported that playtime decreased just after the first few days — about half of them say that their child “played more at the beginning of the study.”

Rockman et al observed several factors in the two PBS KIDS learning apps that affect playtime and engagement:

- **Developmentally appropriate content:** Often, if a younger child found the content of a particular mini-game to be too difficult, s/he would move on to play a different game. Children seemed to appreciate the *Martha Speaks: Dog Party* activities that don't require an answer. Parents commented on how the game mechanics employed by this app were appropriate for younger children, but

the content was not. Meanwhile, the older children easily mastered the literacy content and often got bored and stopped playing.

- **Fresh content:** Families in the study could not download other apps, nor were there new levels or content to update for the two apps. Thus, many children may have burned out on the finite amount of learning content.
- **Wait time:** Children often got bored or impatient if they had to wait for content to load between questions.
- **Humorous activities:** Children sought out activities that made them laugh, even when the content was too hard or too easy. In the *Martha Speaks* app, all the children seemed to enjoy playing it, even the younger children for whom the vocabulary was a bit difficult. They seemed to particularly enjoy making silly outfits for the dogs to wear. Similarly, some of the children who mastered the *Super Why* content would deliberately pick the wrong words in the story-making game. They enjoyed seeing their now funny sentence illustrated in the app. For the sentence, “Rapunzel let down her _____,” they would choose “broccoli” or “cat,” instead of “hair.” The picture then showed a bunch of broccoli or cats falling out of the castle window instead of Rapunzel's hair.
- **Incentives:** In the *Super Why* app, players can collect stickers throughout the games to appear in their *My Super Stickers* book. This seemed to motivate the children to keep playing until they had collected all the stickers. In *Martha Speaks: Dog Party*, players saved the doggie outfits they created and then showed them off to friends and family members. Children in the study also seemed to enjoy telling others about their high scores on the pop quiz.
- **Goals:** Both the parents and the children noted that there was no ending to the games in either app. They mentioned that they would have liked having a goal to reach. Some children saw collecting the stickers in the *Super Why* game as a goal, which increased the duration of their playtime. However, playtime ceased once they had collected all of the stickers, thereby decreasing total playtime. A complete sticker collection may have been too short-term a goal.
- **Parental involvement:** Having a parent as a playmate, especially for the younger kids,

seemed to motivate children to keep playing. Adult playmates provided scaffolding and extra prompts to help their children understand the material. They also helped to reinforce the materials in activities undertaken outside of the app.

7. What is the role of parents in the mobile media revolution?

Research has shown that parental guidance or scaffolding can improve young children’s learning of high quality media’s educational content, promote general language development, and increase engagement in relevant activities (see Fisch, 2004 for review).

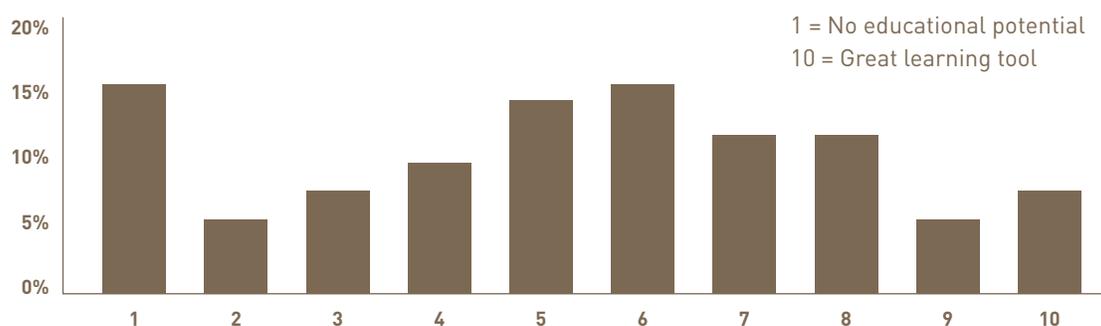
Finding 7: All three studies suggest that parents play important roles in shaping the quality of their children’s experiences with mobile devices.

- **Parents are facilitators:** As seen in the Learning Study, children need adults to explain information that they do not understand. Parents can help their children get started.
- **Parents are teachers:** Parents extend and elaborate on the relevant information that is communicated. This can provide extra motivation for children to keep at it.
 - + Children in the Usability Study reported that they prefer to use smart mobile devices with someone else.
- Ninety-seven percent said they like it when a parent/friend/family member helps them use the iPhone/iPod touch.

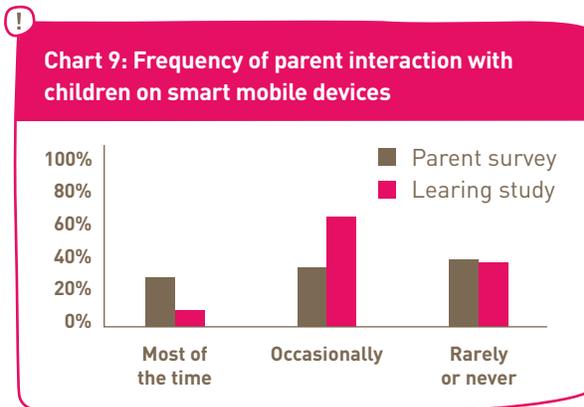
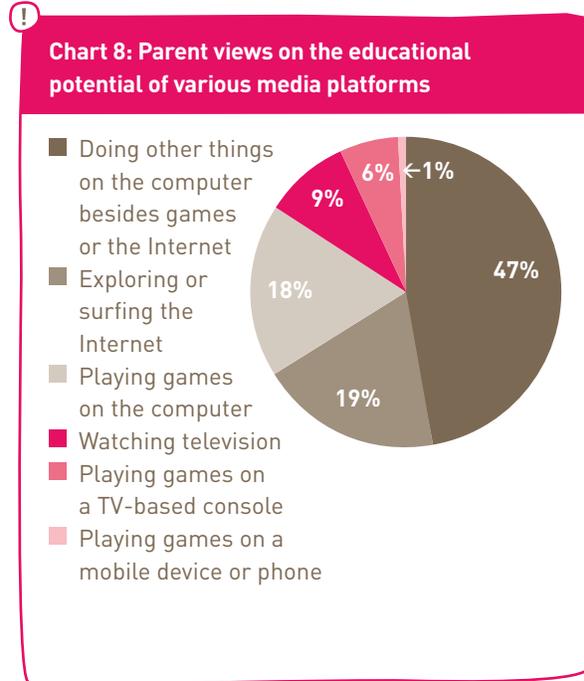
- Sixty-one percent said they like to use the iPhone/iPod touch with someone else more than by themselves.
- **Parents are gatekeepers:** Parents provide rules and regulations. When it comes to smart mobile devices, many parents do not view them as potential learning tools — especially when compared with other technologies — and thus restrict how their children use them.
 - + In the Parent Survey, when asked to rate the educational potential of mobile devices (with 1 as having “no educational potential” and 10 being a “great learning tool”),
- Respondents’ ratings were spread across the scale, with exactly half rating apps as having educational potential, and half as not having educational potential.
- The parents who rated apps as having educational potential tended to provide mid-level ratings.
- Only 12% of parents rated the educational potential of apps either a 9 or 10.
- The parents who rated apps as not having educational potential tended to feel strongly about it. The mode, or most frequently chosen rating, was 1.
 - + When asked which media platform they believe is most educational for their child, only 1% of the parents chose “playing games on a mobile device or phone” (see Chart 8). Parents tended to rate their child’s activities on the computer (e.g., surfing the Internet and playing video games) as possessing more educational value than playing on mobile devices.



Chart 7: Parent ratings of the educational potential of mobile apps



- + In the Parent Survey, concern for a child’s privacy and safety online was cited by over half of parents as a reason for restricting access to technology. This was the second most cited reason, following prevention from participating in a physical activity.
- + Eighty-six percent reported that an adult downloads apps for the mobile device, not the child
- + Perhaps due to parental perceptions of the educational value and safety concerns of mobile devices and apps, children do not often engage in meaningful interactions with someone else on the phone.
- About a third of parents reported that they “rarely” or “never” interact with their child on a smart phone. Just a few reported regularly doing so (see Chart 9).
- Parent perceptions may change with exposure to good educational apps. In the Learning Study, parents were asked before and after the study how happy they were that their child was using the iPod touch.
- + When they started, parents were basically neutral, with an average rating of 3 on a 5-point scale, where 5 equaled “very much” and 1 equaled “not at all.” By the end of the study, they were much more positive, with an average rating of over 4.
- Without knowing the pre- and posttest results, all of the parents thought that using apps at least reinforced concepts and words their child already knew, or that their child learned a few or even several new words and concepts.





PART: 3

implications: translating research into practice

Implications for industry

These three studies have allowed us to paint a better picture of what the pass-back effect looks like (see Box 1, p. 7). They also suggest ways in which app designers, teachers, and parents or other caregivers can engineer positive interactions to promote learning.



Design principle #1: Create apps that are developmentally appropriate.

1. Focus content narrowly within a developmental age range.

As seen in the Learning Study, children ages 3 through 7 have a wide range of abilities. Young children develop significantly as learners during this developmental period. It is important to note that the two apps were not designed for the full age range of the Learning Study: *Martha Speaks* was meant to target 4-to-7-year olds and *Super Why*, 3-to-6-year-olds. But for the purposes of the study, all of the children had access to both apps. This helped highlight the importance of carefully selecting what types of materials should be presented to each age group.

2. Design content to be relevant to what children are already learning.

Some of the parents in the Learning Study reported that their child or they themselves would refer back to the materials in the app when they encountered similar content in another situation. Linking the content of newly developed apps to common early learning content domains — or to, for example, seasonal themes — might help reinforce adult-child interactions that will advance situated learning across settings, in school and or in everyday life.

3. Consider children's evolving motor skills.

As seen in the Usability and Learning Studies, the children had some difficulty using the iPod touch. Developers should consider the following:

- Make the power button more obvious.
- Minimize the necessity of the swiping motion.
- Make the icons large, for easy and accurate tapping.
- Make menu options within the apps more salient, especially how to exit the app without losing information and volume controls.
- Improve the sound quality, so children can clearly hear the instructions.
- Consider when to use portrait and landscape settings: Developers have flexibility here, as children seem to be adept at switching between the two orientations.
- Keep in mind children's smaller hand sizes when selecting motions required to operate an app.



Box 4: Quality control: App stores and educational apps

Better policies for the evaluation and acceptance of content in various app stores could be a means for spurring the development of high quality educational apps for kids. Companies that create operating systems for mobile devices drive the marketplace for apps. Research in Motion (RIM) supports BlackBerry App World, Ovi serves Nokia users, Google has its Android Market, and Apple its iTunes App Store. Each company has its own technical and content requirements for acceptance into its app marketplace.

iTunes App Store: Published for the first time in September 2010, Apple published guidelines for acceptance into its iTunes App Store.

Perhaps the most tightly controlled store, the company explicitly expresses its intention to protect children from inappropriate content. The guidelines also encourage developers to create original and useful content. Although the App Store has a robust education category, developers decide which category their app is organized under, which has resulted in a broad range in educational quality among apps. Apple should consider introducing more specific guidelines around which features of content constitute inclusion in the education category of the App Store.

Android Market: The Android Market employs a laissez-faire approach and has no approval process or content guidelines. As of the publication of this report, Android Market only requires developers to pay a fee and submit a description and screenshots in order to publish an app in the store. The store categories do not include education or children's content categories. Although these policies lower barriers for developers to enter the market, they make it difficult for children and families to discover educational content and do little to stimulate the development of high quality content. The creation of education and children's categories and clearer guidelines to promote innovation in educational content would help strengthen the supply and demand for this genre of apps in Android Market.

4. Engage children (and adults!) by making them laugh...

As seen in the Learning Study, the popular features were ones that were humorous and fun. Humor can capture children's attention and limit unnecessary waiting time. This principle builds on the time-tested elements pioneered by *Sesame Street* and other iconic educational media.

5. ...but not too much. Balance engagement and learning.

There needs to be a balance of features that are engaging but not distracting. The humorous features in the *Martha Speaks* and *Super Why* apps and features that provided incentives, such as *My Super Stickers* book, helped keep children engaged. Having one or two of these features in an app is important to draw children in and hold their interest. However, it is also possible that too many of these features can distract children from learning. They could end up focusing only on the funny parts or peripheral goals — such as collecting stickers — and not on the words or skills connected to these diversions.

Design principle #2: Create apps that sustain children's interest and learning.

1. Design for shorter playtimes.

Since the pattern of playtime indicates that children (and adults) use apps for frequent but short durations, apps should be designed accordingly. For example, learning objectives should be delivered in brief activities that can teach or reinforce skills and knowledge.

2. Provide goals and incentives: Keep them coming back.

- **High scores:** One type of goal is achieving a top score. Recording these scores and providing the ability to share and compare these scores with friends and family could be a great motivator to play again.
- **Teamwork:** The *Martha Speaks* and *Super Why* apps were designed for individual play. However, past research on adult gamers has demonstrated that team game play is highly motivating and explains why multiplayer online role-playing games have millions of subscribers (e.g., Yee, 2006).



Box 5: Lessons from the field: Words of wisdom from Sesame Workshop and the IDEO Toy Lab

Sesame Workshop, in partnership with IDEO Toy Lab, built the *Elmo's Monster Maker* app used in the Usability Study featured in this report. Designers of this popular iTunes Store download share these words of advice for developers interested in creating appealing apps for young children.

It's easy to start playing: Kids have demonstrated that they can quickly learn and remember which icon starts their game.

No menus: Kids (and moms) value being dropped right into the experience.

Touch screens mean kid-friendly UI: A big breakthrough (that seems obvious now) with *Monster Maker* was to design it so that a child's direct touch put the eyes, noses, and hats on the monster. This is much more fun than having menu buttons off to the side, which is an approach used frequently in similar games on devices without touch screens.



Big touch zones and big gestures: Kids are not as dexterous as adults and may get frustrated if apps don't respond to their actions. We would have loved to include clothing as an option, but that would have required a smaller monster with much smaller touch zones. While designing and testing other apps, we found bigger gestures like shaking (in *Sesame Street Bert's Bag*, for example) and tilting (*Sesame Street Grover's Number Special*) are usually more fun!

Don't be afraid to get silly! Funny objects as monster parts were a hit. Egg eyes, light bulb noses, and lamp-shade hats generated big laughs!

Developers should create apps that children of the same or differing ages can play together or with their parents in either co-located or remote and/or asynchronous situations.

- **Include a storyline and/or narrative:** An interesting plot can drive a player through the course of the game.
- **Deliver fresh content:** Providing different levels in one game allows for more goal-directed behavior. A game should not be over once a particular goal has been achieved. Also, periodic upgrades can keep players coming back to see what's new. Beyond this, adding extensions and levels can help the app grow with the player and lengthen the life cycle of a game or suite of games.

3. Give kids the option to personalize.

In the Learning Study, many of the iPod touches were returned with new settings, often a new wallpaper of photos they created in *Martha Speaks: Dog Party*. This illustrates that personalization has great potential as a way to engage children and help them develop digital participation skills that learning scientists contend are valuable in the long term.

4. Involve parents.

Prompts and introductory tasks for parents embedded in apps would not only motivate kids to keep playing, but would help parents see firsthand that the app is beneficial for their child (Chiong, 2009).

Distribution strategies: Bringing educational apps to market

1. Lead kids (and their parents) to appropriate content.

Policymakers should work with mobile industry leaders to engage in consumer protection initiatives.

- One type of protection is from inappropriate content. Apple has taken the first step to broadly screen and control their apps for sexual content. But what about violence, or inappropriate language? For parents to feel completely safe in letting their young children use smart mobile devices, more parental-control features need to

be incorporated into the device itself as well as into the content that is downloaded.

- A second type of protection is more nuanced: The early-childhood apps marketplace should be a free zone from unsubstantiated educational claims. The children's digital media market is replete with products that advertise such claims (Shuler, 2007). iTunes currently risks reinforcing this practice. There is currently no way for parents to tell if an app is educational, or if it is simply being marketed as such. If apps are to be a new medium for learning, industry standards should be established in marketing products.

Guidelines are needed for how to regulate, provide guidance, and support parents to help mediate what young children can and should access.

2. Build parent expertise and promote quality.

Parents will likely only feel comfortable about letting their child use smart mobile devices when they feel settled about the devices' educational potential. The research reported here suggests



Box 6: Power in numbers: Developer communities

With many entrepreneurs and independent developers entering the apps market, new networks focused on developing apps for kids have emerged to support the creation of high-quality apps for children.

Moms with Apps is a group of family-friendly developers who share best practices on creating and marketing mobile applications for kids and families. The group has members from all over the world and is 170-members strong and growing. It aims to support its members in creating high-quality and educational apps, while also serving as a resource for parents about the marketplace. www.momswithapps.com

Dust or Magic Institute's AppCamp convenes annually in May by the creators of the Dust or Magic Institute, an annual children's digital media design institute now in its 10th year. The inaugural event in May 2010 brought children's developers together to test the latest apps and demo their own work. Participants receive a crash course in developmental psychology, as well as feedback from their peers about the design of their apps. www.dustormagic.com

that parents need to see a quality educational app firsthand. However, greater effort is needed to inform parents that quality educational apps exist. Parenting magazines, websites, and groups such as Common Sense Media, *Consumer Reports*, Children's Technology Review, and Parents' Choice should monitor this growing industry to provide consumer information and guidance. Funders and producers should also prioritize quality designs that are linked to measurable educational outcomes that parents understand.

3. Provide something old and something new.

Offering a familiar face or setting can help to engage kids as they explore a new app. Branding may be an effective method for this. In the Usability Study, most children instantly recognized the Elmo icon and immediately opened that app. In the Learning Study, some children recognized materials from the television shows *Martha Speaks* and *Super Why*. One parent even reported that their child asked for their iPod touch when watching one of the shows on television. Producers with no trusted brand should consider licensing or partnering opportunities that could significantly increase their child appeal and parental trust.

4. Bridge the digital divide.

Technologies designed for learning — particularly in informal environments — risk the unintended consequence of widening the digital divide when only a minority of the population has access. However, market trends suggest that smart mobile devices will be available to all socio-economic status (SES) groups in the near future. For this reason, all three studies included a significant low SES sample. Interestingly, no distinct differences were detected regarding lower-income parents' reports of children's behaviors, attitudes, and beliefs. In the long term, these studies indicate that one key issue for policymakers and industry is not whether lower-income and minority demographics would like to use such devices; it is whether they will have access to their educational potential. Market forces may already be narrowing the access gap as the iPhone and other smart mobile devices are increasingly reaching the masses. The iPhone, for example, was priced at \$499 for its 2007 launch; a mere three years later, one can purchase the device for as little as \$99.

Implications for education

1. Optimize children's time with mobile devices.

Mobile devices present a unique opportunity that previous educational technologies have not. A key concern for policymakers, health and development experts, and parents is that media consumption may lead to both physical and academic lethargy. This concern was substantiated in the Parent Survey as the number-one reason that parents reported for restricting technology use. They believed such use would prevent their child from getting physical activity or exercise. However, the patterns of usage reported in these studies suggest that mobile devices can capitalize on downtime without competing with more active opportunities to play and learn. First, as reported in the Parent Survey, since these devices are mobile, children are often using them on the go — while in the car, before and after-school activity/sports practice, or while they wait for someone to pick them up — rather than competing with homework or physical activity. This mobile affordance is unique. Second, parents report that on average their child plays with a mobile device for no more than 20 minutes at a time. Children are using mobile devices in quick sessions rather than prolonged ones like watching television or playing video games.

2. Use mobile devices as supplemental tools.

Educational apps can be used to reinforce what children are already learning in school and at home. Some parents in the Learning Study reported that they would reinforce the vocabulary words from the app in other real life situations, or that their child would talk about the app when they saw the related television show or characters in another setting. Thus, the learning opportunities for educational media producers may lie beyond just the app itself. The studies reported here suggest the power of apps as a supplemental tool, especially if the content is linked to other curriculum or situated learning that goes on at home or in school.

3. Surround children with high-quality educational resources.

The literacy- and math-oriented apps we have reviewed for this study can be viewed as a modernization of the early-literacy repertoire of

a family household circa 2010. Just as educational videos, electronic books, and online sites like SesameStreet.org and PBSKids.org have come to help support early-learning activities in millions of households, it is possible to imagine that low- or no-cost apps will soon become an efficient and enjoyable way to help enrich young children's environments with quality educational materials. The mobility of the devices has the potential to extend a family learning environment with high-quality products that reach children anytime and anywhere.

Future directions for researchers

The three studies reported here were important exploratory studies. As research in mobile devices with this age group is in early stages, these studies have provided insights in establishing appropriate methodologies and revealed new topics for further investigation.

1. Use research to inform industry.

Researchers should continue to guide industry by providing more evidence of how smart mobile devices can be used to teach. Specifically, they should:

- Conduct more nuanced follow-up studies to the ones presented here with larger samples, control groups, and different types of apps to provide reliability and generalizability.
- Further investigate longer-term effects of apps on learning, interest, and usage.
- Examine specific issues of interface design and learning sciences issues related to use of time, cognitive functioning, and early-stage multitasking.

2. Use research to inform parents.

Parents need to be convinced that smart devices are good educational tools. They also need to be convinced that they can and should use these tools with their child. Researchers should:

- Further explore parent perceptions and their patterns of digital use.
- Explore parent-child interactions with smart phones.

3. Use research to inform educators.

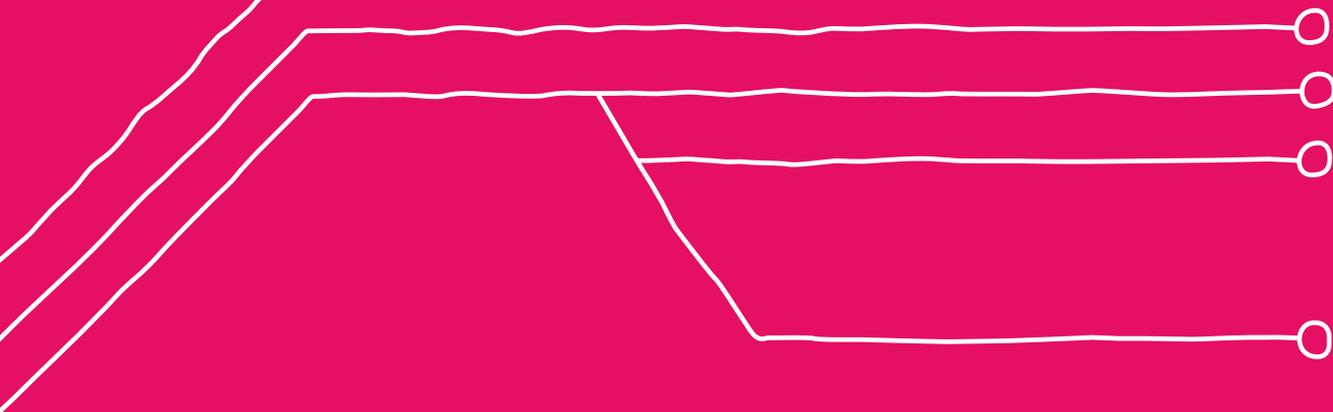
Eventually, we envision smart devices being used widely in both formal and informal learning settings. We need to inform educators on how students' smart mobile device use differs between these two settings so that they can more effectively deploy mobile technologies as supplemental materials both in and outside the classroom.

Researchers should:

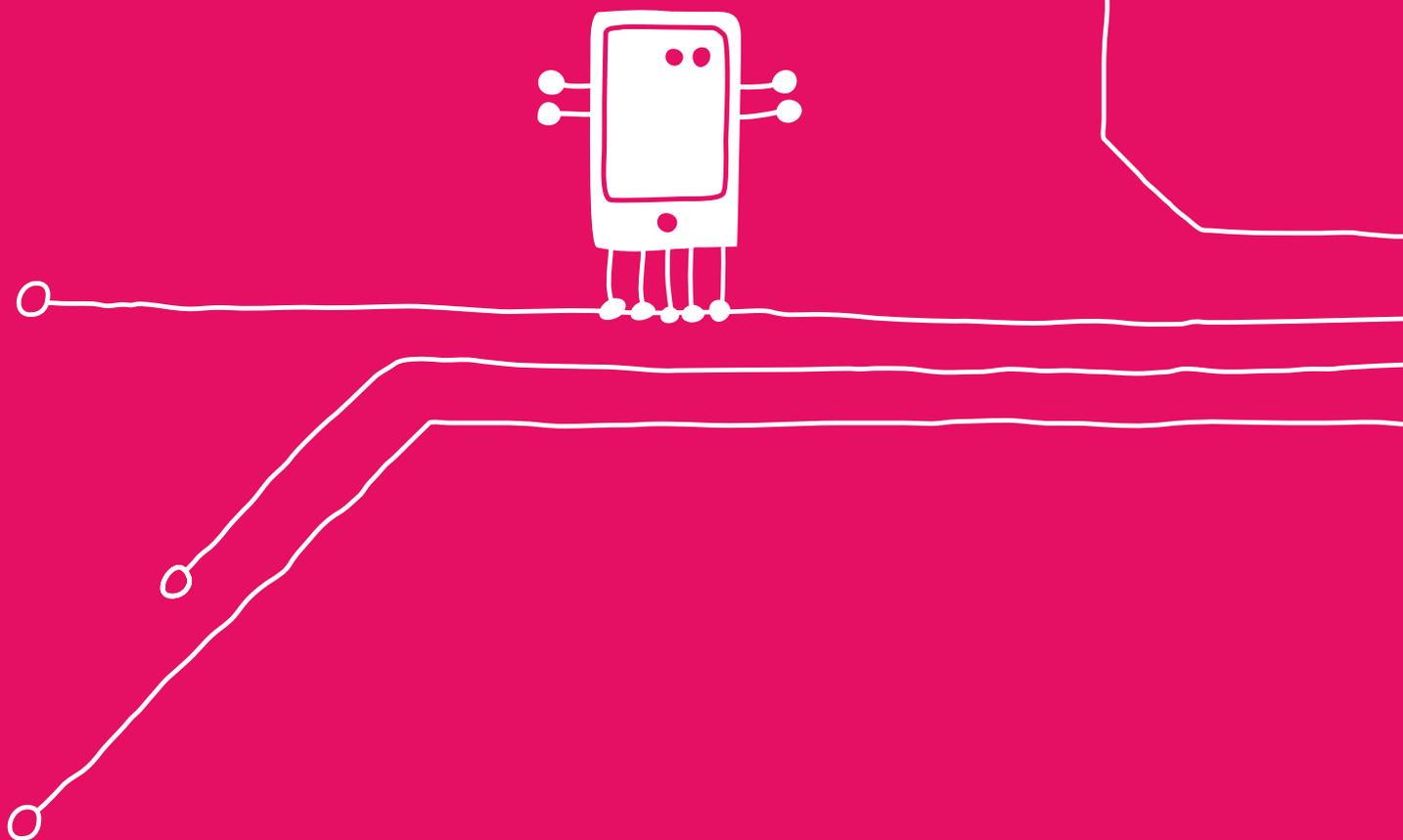
- Explore how to use apps in preschool and primary-school settings.
 - + How might app use differ for children in play versus learning situations?
 - + How should apps and other digital media use be integrated into teacher preparation and classroom design?

conclusion

Popular use of smart phones has exploded in the past few years, and the mobile media revolution is an increasing influence on family communication patterns, starting with very young children. The studies reported here demonstrate that young children are using smart mobile devices: Many have access to them, they like them, and they are good at using them. They may even be ahead of their parents in this regard, as a still significant percentage of adults do not yet see the value of smart mobile device use for their children. In any case, trends suggest that preschool- and elementary-age kids may soon be using smart mobile devices seamlessly — first at home and then perhaps in the classroom of 2015 as a normal part of growing up in a digital age.



Early evidence indicates that children can learn from well-designed educational apps. The implications and insights raised by the related studies reported here are significant ones that should help shape innovation in industry, content development, research design, and practice. The challenge now is how to carefully target pressing educational needs tied to literacy, numeracy, and scientific inquiry in the early years, consider the distinct potential of mobile apps, and confidently respond, “Hey, there is an app for that!” We hope that this report will stimulate innovative work that may soon make such an assertion possible.



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Andrea L. Taylor
Ellen Ann Wartella, PhD

About the authors: Cynthia Chiong received her doctorate degree in developmental psychology from the University of Virginia. During her graduate studies, she was also an Institute of Education Sciences (IES) fellow, where the focus of the program was an interdisciplinary approach to educational research. Cynthia is currently the Director of Research for Sirius Thinking, the creators of *Between the Lions*. Her research interests focus on how the design of educational media can affect young children's learning, the way children interact with educational media, and how parents and teachers use them to teach. Her research has been published in journals such as *Psychological Science*, *Child Development*, *Journal of School Psychology*, and *American Behavioral Scientist*.

Carly Shuler is an Industry Analyst for the Cooney Center and author of *D is for Digital*, *Pockets of Potential*, and *iLearn*. She has an EdM in Technology, Innovation, and Education from Harvard's Graduate School of Education, where she studied how new media and emerging technologies can be used to effectively educate children. Prior to her graduate studies, Carly worked in the toy industry at Spin Master Ltd., where she managed product development and marketing for a number of educational preschool brands, including Aquadoodle, an award-winning toy that encourages creativity, and Word World, a licensed line based on the animated children's series that seeks to increase literacy.

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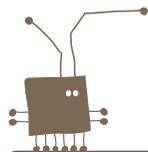


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the Joan Ganz Cooney Center
at Sesame Workshop

1900 Broadway
New York, NY 10023
p: (212) 595-3456 f: (212) 875-7308
cooney.center@sesameworkshop.org
www.joanganzcooneycenter.org

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