

The logo for the Education Development Center (EDC), consisting of the letters 'EDC' in a bold, green, sans-serif font inside a white square.

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Integrating Technology Into Exemplary Preschool Settings

A Report on the Apple and ConnectED Initiative

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Table of Contents

Study in Brief	1
Key Findings	2
Introduction	4
Research Approach	7
Findings	11
Future Considerations	27
References	30

Study in Brief

How can early childhood educators harness the affordances of 1:1 devices to support and enhance play-based learning in America's preschool classrooms? To date, most early learning environments, particularly those in low-income communities, have not had access to digital resources or the technology infrastructure to enable their use. Yet thanks to a host of federal, state, and corporate initiatives, this is beginning to change. One such example is the Apple and ConnectED initiative, which committed \$100 million to support the implementation of 1:1 devices in 114 high-needs schools across the country. Apple's investment provides a rich opportunity, not simply to redress problems of preschool access, but also to increase our understanding of the productive roles that technologies can play in preschool teaching and learning. Preschool children are not just smaller versions of elementary school-age students; they are differentiated by critical development milestones that have yet to be reached and that require distinct ways of engaging with digital tools, focal content, teachers, and peers.

This report presents findings from a yearlong investigation of the Apple and ConnectED initiative in 10 exemplary preschool classrooms. Conducted by EDC's Center for Children and Technology, this is a sub-study of SRI International's six-year program of research on the Apple and ConnectED initiative. The goal of this work was to document and describe technology integration in the context of well-supported, child-centered early learning settings. By working with a small set of exemplary preschool programs, we present a portrait of what is possible when technology integration is paired with what we know to be important conditions for success: strong leadership, robust technological infrastructure, child-centric orientation to instruction, and sustained professional support. By focusing on the implementation of the Apple and ConnectED initiative in optimal conditions, this work establishes evidence of promise and highlights promising practices for using tablets to support and elevate high-quality teaching and learning in preschool settings.

Key Findings

The Preschool Classroom and the Apple and ConnectED Initiative

- Apple devices fit naturally into the play-based ecology of the 10 preschool classrooms in this study. Most children were familiar with the simple, tactile gestures needed to navigate the devices, and they quickly learned how to use features such as the camera and AirDrop.
- The portability of iPads provided opportunities for teachers to extend and augment learning opportunities outside of the classroom. For example, children in one school used the iPad to document what they learned on field trips.
- With a little help from their teacher, children engaged with media-mixing apps to produce their own content using multiple modes of communication, such as sound, text, and video. Teachers noted that the multi-modal features of iPads foster play, encourage deeper engagement with content, and allow children to more effectively communicate their understanding.
- Teachers with more experience using Apple devices tended to give children access to the iPad during choice time, which encouraged more spontaneous and social use. These teachers established guidelines at the start of the year to teach children how to safely handle the iPad.
- Teachers at all four schools used the Apple devices to support their instructional routines, enhance playful learning and social interactions, provide a showcase for children's learning, and create a new channel to communicate with parents.

The Child-Oriented Preschool Teacher and the Apple and ConnectED Initiative

- The initiative transformed the way teachers used technology in their teaching without crowding out the existing play-based approach to learning that characterized the 10 preschool classrooms in this study.
- Even in optimal settings, integrating technology into teaching and learning takes time. As the 10 teachers in this study gained experience and participated in professional learning opportunities, they became more adept at leveraging the affordances of the devices to provide learning activities that would not have been possible without the technology.

- Teachers took on different roles when facilitating children's use of technology. Those teachers with the most experience using the Apple devices moved thoughtfully and flexibly across these roles, based on their learning goals and children's needs.

The Preschool Child and the Apple and ConnectED Initiative

- Teachers described children's use of the iPad as a social experience, providing new opportunities for children to communicate with each other and their teacher. Teachers reported that children often collaborated with classmates on developing a shared product, such as an interactive book.
- The multi-modal affordances of the devices and educational apps allowed children in the 10 classrooms to experience multiple layers of the same content at the same time, which teachers saw as enhancing and possibly accelerating literacy development.
- Teachers mediated children's use of the devices as a tool for information consumption in ways that promoted critical thinking and personalized learning. In classrooms where teachers had more experience using the Apple devices, children typically had more opportunities to interact with technology as producers of information (e.g., create videos about books), which may promote all aspects of deeper learning.
- Teachers at all four schools observed that using the production features of the iPad increased children's ownership of their learning and promoted social-emotional development.

The School and the Apple and ConnectED Initiative

- The robust technological infrastructure put into place through the Apple and ConnectED initiative enabled the four schools to bypass technology and Internet problems that typically act as barriers to implementation.
- All four school leaders appreciated following a multi-phase approach to rollout, which allowed teachers to become familiar with the devices before introducing them into their teaching.
- The 17 days of professional learning offered by the Apple and ConnectED initiative during the first year of implementation supported teachers in using technology in more innovative ways over time. Teachers and leaders at all four schools stressed the need for additional support and reported using professional learning communities and instructional coaches to sustain teacher learning.

Introduction

In 2013, President Obama launched the ConnectED initiative with the vision of providing next-generation broadband and high-speed wireless Internet to 99 percent of students across the country. Apple committed \$100 million to the initiative, equipping 114 high-needs schools nationwide¹ with 1:1 devices, infrastructure upgrades and support, and teacher professional learning. Through this investment, Apple seeks to improve academic achievement, increase student engagement, support deeper learning, and encourage innovative ways of teaching with technology to promote student-centered learning. The Apple and ConnectED initiative is one of many public-private partnerships committed to supporting schools in using technology to transform teaching and learning.

Framework

Although federal programs such as E-rate and Title I have succeeded in narrowing the gap in technology access between high-poverty and low-poverty schools (Warschauer & Matuchniak, 2010), research continues to document significant differences in how schools use technology. Higher-income schools tend to use technology to bolster student-centered learning experiences that are responsive to individual student needs; in the most innovative schools, teachers leverage the unique features of technology to transform activities and provide learning experiences that would not otherwise be possible. In contrast, the use of technology in lower-income schools is more likely to follow a teacher-directed education model that privileges drill-and-practice over deeper learning (Singleton et al., 2018).

In response to these trends, Apple developed a robust approach for supporting the integration of 1:1 devices, which they implemented in 114 high-needs schools. Critical to this approach was the recognition that the type of change necessary to successfully integrate technology into teaching is a multi-step process that requires time and regular support. Thus, in addition to providing the devices themselves, Apple offered personalized professional learning, technological infrastructure and support, and flexible pathways to implementation based on local contexts and the goals of individual schools.

Apple's full suite of resources and supports includes the following:

- ➔ **Equipment.** Every school receives an iPad for each student, a MacBook Air and iPad for each teacher, and an Apple TV for each classroom.
- ➔ **Infrastructure.** Apple and its partners provide Wi-Fi and the necessary infrastructure upgrades.

¹ In order to qualify to participate in the Apple and ConnectED initiative, 96 percent or more of a school's population must be eligible for free or reduced-price lunch.

- **Support team.** The ConnectED support team provides assistance with change management and implementation. The team includes the following positions:
 - **Apple Development Executive:** Supports school leaders in visioning, instructional planning, and change management
 - **Apple Professional Learning Specialist:** Provides 17 days of professional learning, using a coaching and mentoring model to support individual school and teacher needs and to demonstrate age-appropriate uses of the Apple devices
 - **Project Manager:** Coordinates the support team and manages the implementation process
 - **Project Engineer:** Provides technology support
- **Tech support.** ConnectED Project Engineers offer coaching for school IT professionals and assist with issues related to hardware, operating systems, and wireless infrastructure.
- **Learning resources.** Through Apple's App Store, Apple Books, and iTunes, schools have access to an extensive range of educational resources and apps.

Technology in Early Learning Settings

Although research on touch screen technologies in early childhood settings is limited in scope, a small but growing body of literature shows that when used in child-centered and developmentally appropriate ways, technology can support learning and engagement

(Blackwell, 2013; Fantozzi, Johnson, & Scherfen, 2018a; Lu, Ottenbreit-Leftwich, Ding, & Glazewski, 2017; Neumann, & Neumann, 2017; Rowe & Miller, 2016). The intuitive nature of the touch screen interface makes these devices particularly suitable for use with young children. In fact, most children, including those from lower-SES households, come to school with some level of familiarity with navigating touch screen devices.



Yet, teachers, administrators, and parents continue to express ambivalence and concern toward using technology in preschool settings. In particular, they worry that technology will crowd out the play-based experiences that characterize early childhood learning

environments. In recognition of the technology-saturated environments that surround young children, the American Academy of Pediatrics (AAP) released a policy statement describing the healthy use and potential educational benefits of technology and media for young children (AAP, 2016). Drawing on research related to television, videos, and mobile/interactive technologies, the AAP statement addresses the benefits of media and technology related to young children's cognition, literacy, and social outcomes. To realize these benefits, however,

AAP stresses that caregivers must select educational and age-appropriate resources and must actively mediate and support children's use of media and technology. AAP's recommendations echo those outlined in the joint position statement on the use of technology and media issued by the National Association for the Education of Young Children (NAEYC) and the Fred Rogers Center (NAEYC & Fred Rogers Center, 2012).

As part of the Apple and ConnectED initiative, Apple Professional Learning Specialists worked with teachers and administrators to identify age-appropriate media and apps, and to model and support teacher-mediated experiences that promote learning without crowding out play and other hands-on activities.

Technology Integration

An important consideration of technology use in classrooms across all grade levels is how teachers are able to leverage the particular affordances of technology to enhance and transform learning opportunities. Puentedura's (2013) SAMR model has emerged as a popular framework for classifying the depth of technology integration. The SAMR model describes four levels of technology integration: substitution, augmentation, modification, and redefinition. In the first two levels (substitution and augmentation), teachers use technologies to *enhance* the learning experience, changing the way students engage in learning. In the second two levels (modification and redefinition), teachers use technologies to *transform* the learning experience, changing the learning activity itself. The Apple and ConnectED initiative hypothesizes that as teachers gain experience teaching with technology, their use will become more innovative, shifting the role of technology from enhancing to transforming instruction.

Research Approach

This qualitative study documents and describes the implementation of the Apple and ConnectED initiative in 10 well-supported, child-centered early learning settings. As part of SRI's larger program of research, the goal of this work was to examine teacher perceptions of the initiative and to describe promising practices and innovative uses of Apple technologies with preschool-age children in exemplary settings. EDC's Center for Children and Technology conducted this study between February 2018 and February 2019 with teachers from four schools that Apple identified as exemplary in their implementation of the Apple and ConnectED initiative. Building on SRI's wider evaluation efforts, this study addressed three research questions:

- 1 What are promising practices for integrating tablets into early learning?
- 2 What teaching practices help children make meaning from mediated experiences?
- 3 What features of digital tools promote academic readiness and the social interactions that we know are critical to early learning?

To address these questions, the research team collected qualitative data from multiple sources, including Apple Development Executives,² school leaders, and preschool teachers, and through a variety of methods, including interviews, focus groups, and virtual tours.

Sample

To select schools, the research team employed purposive sampling, working with Apple to identify schools that had demonstrated strong implementation of the Apple and ConnectED initiative. Following the interviews with Apple Development Executives, the research team established district permission to approach each school. Researchers then recruited preschool leaders by email or phone. After conducting telephone interviews with these leaders, the team worked with them to identify and recruit teacher participants. Ten preschool teachers participated in the focus groups, eight of whom also participated in the virtual tours and follow-up interviews.

² Apple Development Executives are experienced educators and leaders who work closely with schools to support strategic planning and instructional leadership.

The final sample included 4 schools, 4 school leaders, 10 teachers, and 2 Apple Development Executives. All preschools served high-needs communities, with 96 percent or more of the students qualifying for free or reduced-price lunch. One school served only children receiving special education services. Table 1 provides an overview of each participating school.

Table 1. Sample Characteristics

	School 1	School 2	School 3	School 4
SCHOOL BACKGROUND				
Location	Rural town in the Southeast	Small city in the Southwest	Midsize city in the Southeast	Small city in the South
Grade Levels	Pre-K to 8	Pre-K to 3	Pre-K	Pre-K to 5
Years using ConnectED Devices	2.5 years	2.5 years	2.5 years	2.5 years
Months or years using ConnectED devices in preschool	5 months	5 months	2.5 years	2.5 years
Number of teachers interviewed	1	2	2	3
STUDENT DEMOGRAPHICS				
% Black	71	1	97	0
% Hispanic	0	94	2	98
% White	24	3	0	2
% Other	5	1	0	0

Importantly, all teachers in our sample followed a student-centered and play-based approach to teaching and learning. Although each school was in its third year of implementing the Apple and ConnectED initiative at the time of the study, teachers at two schools (School 1 and School 2 in Table 1) were in their first year of using the devices. Thus, when we interviewed these teachers, they had only been teaching with technology for five months, and neither school had used technology with preschool children prior to the Apple and ConnectED initiative.

In contrast, preschool teachers in School 3 and School 4 were in their third year of using technology with their students. Both schools had received the Apple Distinguished School designation, which indicated that the schools demonstrated innovative uses of Apple technology. Multiple teachers in School 3 were also part of the Apple Distinguished Educator program, further indicating fluency in using technology. The instructional coach at School 4, who was deeply involved in supporting implementation, was also participating in the Apple Distinguished Educator program. Prior to the ConnectED initiative, teachers in some of the upper elementary school classrooms in School 4 were already using technology in their teaching, but technology was not being used in preschool classrooms. In the year prior to implementing ConnectED, School 3 introduced five iPads into each preschool classroom.

Methods

The research team collected data through semi-structured interviews with Apple Development Executives ($N = 4$) and school leaders ($N = 4$), four focus groups with preschool teachers ($N = 10$), and combined virtual classroom tours and interviews with a subset of the preschool teachers from the focus groups ($N = 8$). Table 2 presents an overview of data collection methods and key topics covered.

Table 2. Data Collection Methods and Key Topics

Participants	N	Method	Key Topics
Apple Development Executives	4	30-minute telephone interview	<ul style="list-style-type: none"> • Instructional uses of technology promoted by ConnectED • Onboarding and professional learning
School leaders	4	60-minute telephone interview	<ul style="list-style-type: none"> • Planning, onboarding, and professional learning • Leader perceptions of ConnectED • Leader strategies for implementation
Preschool teachers	10	30- to 60-minute virtual focus group, using WebEx software	<ul style="list-style-type: none"> • Critical professional learning practices • Promising practices for integrating technology
Preschool teachers	8	30- to 45-minute virtual classroom tour and interview, using FaceTime, Webex or RingCentral software	<ul style="list-style-type: none"> • Physical contexts of technology use in the preschool classroom • Promising practices for integrating technology

The research team recorded all interviews and focus groups, which were then transcribed for analysis. Researchers designed interview and focus group protocols sequentially, allowing the data collected with participants from one group to inform the content of the interview or focus group with the following group. The team conducted interviews with Apple Development Executives and preschool leaders over the phone. Following the focus groups, the research team conducted virtual classroom tours, where teachers gave researchers a “tour” of their classrooms using an app such as FaceTime. During these tours, teachers described where and how children used the Apple devices and explained how they facilitated children’s use of the technology. Researchers conducted the virtual classroom tours when children were not in the classroom.

Analytical Approach

Researchers used Dedoose qualitative analysis software to analyze data, following the principles of thematic analysis as outlined by Braun and Clarke (2006). Researchers familiarized themselves with the data by reading and re-reading the transcriptions; generated initial codes and applied them across the data set; searched for, reviewed, and defined themes; and produced a report of the findings. The researchers engaged in an iterative process, discussing findings with one another and returning to the data regularly. To ensure consistent use of codes, researchers double-coded a subset of the transcripts, discussing and resolving differences in codes.

Findings

By focusing our study on how a small number of teachers in well-supported schools incorporated Apple devices into their classrooms, we were able to surface promising practices for using technology with young children to support learning. The teachers in this study placed great value on the Apple and ConnectED initiative and believed that it had equipped them with a new set of tools that elevated their teaching and extended learning opportunities. We know from previous work that teachers are likely to integrate technology in ways that align with their existing pedagogical philosophies. Prior to their participation in the Apple and ConnectED initiative, the teachers in this study followed child-centered approaches to teaching that prioritize play-based learning experiences. This existing orientation to teaching meant that these teachers were well-positioned to harness the new digital tools in playful ways that supported their learning goals. Moreover, at the helm of these schools were strong leaders who had demonstrated a commitment to the initiative; teachers at all four schools named their leaders as instrumental in ushering a schoolwide shift to teaching with technology.

In this section, we present what we learned about how preschool teachers in well-supported schools introduce and facilitate technology to promote social interaction, academic readiness, deeper learning, and social-emotional development. We group these findings into four areas:

- 1 How the Apple devices fit into the ecology of the preschool classroom
- 2 How preschool teachers experienced the Apple and ConnectED initiative, and how they facilitated technology to support learning
- 3 How preschool children interacted with the devices
- 4 How the Apple and ConnectED initiative was implemented at the school level

We conclude this section with a discussion of promising practices that emerged from this work.

The ConnectED Preschool Classroom

Teachers valued the unique features and affordances of the Apple devices. They viewed the iPad as a developmentally appropriate tool that playfully enhances their preschool classrooms, offering new formats for children to engage in learning.

Unlike their desktop counterparts, the iPad is lightweight and portable, enabling an easy integration within and beyond the classroom and supporting play and social interaction. This portability allowed teachers to extend and augment learning opportunities outside of the classroom—for example, children in one school used the iPad to document what they learned on field trips. The physical manipulation of the touch screen is intuitive and appealing to these young and tactile learners who tend to explore the world around them through touch. Teachers explained that most children came to school having already encountered touch screen devices and were able to quickly master the navigation and use the photography, video-recording, and audio-recording features of the iPad. And with a little help, children in several classrooms used media-mixing apps to produce their own content that incorporated multiple modes of communication, such as sound, text, and video. Teachers called out these multi-modal features as fostering play, encouraging deeper engagement with content, and permitting children to more effectively communicate their understanding. As one teacher noted:



It's not hindering them to show what they learn because they can say it, they can draw it, they can choose their colors and their writing tools. It's just opened the door, not letting barriers hinder them to show what they're learning.

This and similar comments suggest that children's digital products gave teachers insight into children's knowledge and skills that was more authentic and accurate than what children produce without technology.

Although there is no single model for how teachers tailored their use of Apple devices to fit the ecology of preschool classrooms, teachers in their third year of the Apple and ConnectED initiative tended to support children's use of the iPad during choice time, which allowed for more spontaneous use and deeper integration.

Each classroom in this study had areas for whole-group and small-group activities, as well as comfortable spots for children to be on their own. The configuration of the learning centers in each classroom prioritized social interaction and play, which reflected each teacher's child-centered approach to teaching. How each teacher situated the technology within and across these spaces, however, varied. All teachers reported projecting content from their Apple TV or MacBook Air during whole-group activities, most often to introduce or reinforce content or to model an upcoming activity. Similarly, all teachers shared examples of using the iPad during

small-group activities, primarily to individualize the same learning opportunity. A teacher in one classroom created a new “tech learning center” that children could visit during choice time.

The most notable difference across the eight classrooms that participated in the classroom tour was the level of access that children had to the devices. In some classrooms, children could only use the iPad at specific times and in designated areas. This was more common in first-year ConnectED classrooms; in most third-year ConnectED classrooms, children were able to carry the iPad freely throughout the space. Children in the third-year classrooms were also more likely to have access to the iPad during choice time, which allowed for more spontaneous and social use. For example, teachers in these classrooms reported that children often used the iPad to take photos of something they were working on, which they shared with the teacher and each other.

All 10 teachers grappled with what level of access to grant their children. Teachers in the third year of the Apple and ConnectED initiative purposefully devised systems that allowed for hands-on experiences.

At the start of the Apple and ConnectED initiative, all teachers said they felt concerned about young children handling such expensive devices. Worry about breakage persisted in first-year ConnectED classrooms, where children tended to have limited access to devices. In one classroom, this concern related to lacking sturdy covers for the iPad. In contrast, teachers in third-year ConnectED classrooms were more comfortable and allowed children to hold and



move around with the devices. These teachers noted that they dedicated time at the beginning of the school year to prepare children to use the devices responsibly. Teachers at one school used memorable, child-friendly phrases, such as “Hold it with two hands in a hug,” to remind children to be careful. In another school, each classroom had a poster that illustrated how to hold the iPad, along with reminders for activities such as washing and drying their hands. Teachers in these classrooms said that children were generally quite responsible with the iPad. However, there were some exceptions; for example, two of the special education teachers explained that students who struggle with emotional issues may need closer supervision when using the iPad.

Teachers employed the Apple devices in a multitude of ways, streamlining their existing instructional activities and providing new pathways for playful learning, movement, and communication.

Teachers described a range of ways in which they used the Apple devices to support their instructional routines, enhance playful learning and social interactions, and create pathways to showcase learning and communicate with parents:

- **Teacher's helper.** Teachers perceived the Apple devices as increasing the efficiency of their normal instructional routines. Projecting content from the MacBook Air or Apple TV provided an easy way for teachers to scaffold and model upcoming activities and to promote movement, for example, by having children do yoga and dance videos. Teachers explained that having access to Apple 1:1 devices also created new opportunities for on-the-fly formative assessment and differentiation. Similarly, being able to assign each child a learning activity based on their individual needs and preferences personalized each child's learning experience. Teachers also appreciated having real-time access to nearly unlimited information and resources that afforded more authentic interactions with content that would otherwise be unavailable to children. As one preschool director noted:



Before ConnectED, if the class is talking about different geographic locations or landscapes, the teacher would have approached this more traditionally, using a book to show deserts, oceans, etc. Now the students can open maps of different areas on the iPad and bring them to life. They can see and hear the waves. It really provides students with more of an authentic learning environment. Or, if they're talking about zoo animals, they're able to hear the sounds, touch animals, move them around. Our nearest zoo is two hours away. They wouldn't normally be able to do that.

- **Learning catalyst and partner in play.** Teachers in this study described harnessing the devices to enhance existing activities, introduce new learning goals, and support social emotional development and deeper learning. All but one teacher shared examples of children using the devices in playful ways. In classrooms where children had open access to the devices, the iPad often acted as a tool to document activities during choice time. For example, children used the iPad to record themselves singing a song or to photograph their art projects, which they then shared with their teachers, parents, and friends using AirDrop. The iPad also served as a tool in guided play, during which the teacher designed a playful and flexible learning experience that the child or group of children had autonomy in leading.
- **Showcase for learning.** Teachers and children alike used the camera and recording features of the iPad to document their teaching and learning. Children loved sharing their photos, and teachers attributed increases in children's self-esteem and ownership of learning to the production features of the iPad. Photos and recordings served as anchors for student-teacher conversations, which teachers observed as encouraging children to reflect on their learning. And, as discussed earlier, teachers reported that the child-friendly and multi-modal features of the iPad enabled children to more accurately and authentically represent their knowledge and skills. A few teachers created portfolios of learning for individual children to document and share their progress with children, parents, and school leaders.

- **School-home liaison.** All but one teacher used Apple devices to share student work with parents, which, they reported, boosted children's self-esteem and strengthened the school-home relationship. Teachers also noted that sharing children's work widened parents' understanding of what their child was able to comprehend and produce. Indeed, parents were often surprised and delighted by the level and quality of their child's learning. As one teacher shared:



Parents can see what [their children] did. And they love that. . . . Yesterday, we did this weaving on paper plates. So I took the video, and I put the picture on the Class DoJo, and the mom was like, "Oh, my gosh, look at my baby!" She couldn't believe that her child was doing this.

A few teachers also shared examples of parents using this information to reinforce and extend children's learning outside of school.

The ConnectED Preschool Teacher

The Apple and ConnectED initiative transformed the way these 10 teachers used technology to support teaching and learning without crowding out the play-based experiences that characterize child-centered preschool classrooms.

For teachers in all but one of the four schools, using touch screen devices with children was an entirely new experience. Although most teachers had a laptop and projector before ConnectED, they used these devices mostly for lesson planning and communicating with other teachers and school leaders. Teachers said that introducing technology into their classrooms gave children new learning experiences, but they stressed that technology was just one tool in their repertoire, and they welcomed Apple devices to the extent that they supported play and learning goals. As one teacher noted:



Instruction and curriculum come first, and then we'll find a piece of technology to add onto it. We don't teach the apps, never. We never teach the app. It's like, "Hey, I need to teach my idea." Or, "I need to teach sequencing" or "I need to teach addition." And then we just say, "Okay, how does this app fit into it?" or "How can I use this to teach my curriculum?"

This perspective likely reflected the child-centered orientation to instruction that the teachers in this study followed before the Apple and ConnectED initiative, as well as the guidance that Apple Learning Specialists provided in selecting educational and age-appropriate content and modeling how to actively support children's use of the Apple devices.

With time and continued professional support, teachers became more adept at leveraging the affordances of Apple devices to design learning opportunities that would not be possible without technology.

Shifting teachers' instructional uses of technology was an ongoing process driven primarily by ConnectED professional learning, communities of practices within individual schools, and school leaders. Teachers with more experience implementing ConnectED typically had greater fluency in leveraging the devices to transform learning experiences, although this was not always the case. Teachers in three schools—including in two first-year ConnectED classrooms—used the iPad to engage children in simple coding activities, which promoted computational thinking, critical thinking, and real-world engagement. Without the benefit of the iPad, children would likely not have been exposed to this content.

Teachers in all schools shared examples of using technology on all four levels of the SAMR technology integration scale (substitution, augmentation, modification, and redefinition). In most cases, teachers used the iPad to augment (level 2) and modify (level 3) their instruction; however, we also heard multiple examples of teachers using the devices to redefine (level 4) children's learning experiences. For example, in three of the schools, children collaborated with their teachers and each other to retell or create their own stories using authoring and storytelling apps, such as Book Creator, which uses text, word, video, and pictures. We know from previous research that this type of collaborative literacy play supports teamwork and emergent literacy and connects digital learning activities to hands-on experiences that help children see themselves as authors (Beschorner & Hutchison, 2013; Fantozzi, Johnson, & Scherfen, 2018b; Wohlwend, 2015).

When facilitating use of the 1:1 devices, teachers with the most experience using Apple devices moved thoughtfully and flexibly across five main roles to support children in creating and making meaning of their experiences.

When it came to supporting children's use of technology, preschool teachers in the Apple and ConnectED initiative took on several roles to ensure that use of the iPad deepened the learning experience. Building on research the team previously conducted, which focused on another public educational technology initiative (Education Development Center, Inc., & SRI International, 2011), our analysis surfaced five main roles the ConnectED teacher is likely to take on when supporting children's technology use:

- ➔ **Presenter.** The ConnectED presenter uses Apple devices during structured, whole-group activities to present or reinforce content, model upcoming activities, and engage children in movement such as dance and yoga. When in this role, instruction may look teacher-centered, but it is almost always in service of learner-directed or play-based activities.

- **Sherpa.** The ConnectED sherpa oversees intentional and guided interactions with the iPad. Teachers describe sitting with a child or small group of children, following closely along to scaffold and ask questions that help children make meaning of an activity. These close and sustained interactions provide opportunities for teachers to assess students' understanding, allowing teachers to shift the learning experience based on children's needs. In most cases, the sherpa is intentional in selecting an activity or game based on their instructional goals and knowledge of individual children's needs. At the beginning of the year, teachers may also play this role to help children navigate between and within apps and to establish class norms for handling the iPad.
- **Pop-up guide.** The ConnectED pop-up guide facilitates from an intentional distance, periodically "popping in" to talk about the content, problem-solve, or simply express enthusiasm about a child's work. As with the sherpa role, these conversations allow teachers to probe what students understand and to identify when students can benefit from additional scaffolding or new challenges. A teacher's role may shift from pop-up guide to sherpa if a child is especially confused or bored. Likewise, teachers may shift to the role of presenter if they discover that several students are experiencing a similar challenge.
- **Creative assistant.** The ConnectED creative assistant devises and facilitates opportunities for children to direct their own learning through creation. For example, a teacher may ask children to use digital media to retell the story of Humpty Dumpty. Children have autonomy in how they choose to complete the activity, and the teacher's role is typically to assist children in collecting and managing the different pieces of the project. The digital products that result from these activities provide children and teachers with a valuable anchor to reflect on the stages and processes of learning.
- **Journalist.** The ConnectED journalist digitally captures children's learning and then shares it with children, parents, and school leaders. Teachers report this as a source of pride for children and an effective way to communicate what children are learning with parents. Some teachers create a portfolio of each child's work over time, which allows them to document and share children's progress.

When selecting apps, teachers reported choosing those that were developmentally appropriate; however, choosing from over 200,000 apps can be overwhelming, especially for teachers new to the Apple and ConnectED initiative.

When selecting digital activities, teachers looked for apps that were age-appropriate, supported their instructional goals, and were easy to use. During the first year of implementation, Apple Professional Learning Specialists worked with teachers to identify educational apps with age-appropriate content. As teachers became more comfortable using the Apple devices they sought more open-ended apps and programs (e.g., Book Creator) with features students

could manipulate to create content and collaborate with others. Teachers in their third year of the Apple and ConnectED initiative also sought apps and activities that promoted collaboration and creation and allowed children to direct their own learning. These practices aligned closely with the AAP (2016) and the NAEYC and Fred Rogers Center (2012) position statements, which provide guidelines for healthy and developmentally appropriate use of technology and digital media with young children.

Although teachers used appropriate selection criteria, finding the right app remained a challenge. With over 200,000 educational apps to choose from, ConnectED teachers were tasked with an endless menu of options. Mentor (2015) fittingly calls this dilemma “app attack,” and Hirsh-Pasek and colleagues (2015) maintain that very few educational apps have been vetted for use with young children.

With limited information on the educational value of apps, finding the right ones can overwhelm teachers, especially those newer to ConnectED. One teacher explained, “When we first got the iPads, anything cute we saw, we wanted. We were just downloading stuff like crazy.” After some time, the teachers in this school began to meet as a group to discuss apps and activities that met their classroom contexts and learning goals. Although most school leaders recommended a few apps to use, they also gave teachers autonomy in finding and selecting apps and activities. Most teachers said that they typically scanned the app store and tested apps that looked promising. As schools progressed in the Apple and ConnectED initiative, some began to implement more formal mechanisms for selecting apps. For example, one school had a core team that reviewed any app for which the school intended to purchase multiple licenses.

At one school, introducing 1:1 technologies has re-engaged teachers in their work, inspiring collaboration and providing new opportunities for growth.

One goal of the Apple and ConnectED initiative was to increase teachers' job satisfaction and commitment to the profession. Teachers at one school discussed their heightened engagement and job satisfaction as one impact of using the technology. One teacher commented:



It has made me a better teacher, and I'm growing each and every day. You know, sometimes you get to a point where you are bored with what you're doing and everything becomes mundane . . . Now each day is exciting. I've actually learned to love teaching again.

The leader at this school also observed this renewed engagement:

My teachers are excited because it just makes it fun. Teaching and learning is just not stagnant. They're able to be creative, and the pride that my teachers have with delivering these effective lessons has blown my mind. I mean, it's amazing, the transformation here in our school.

The ConnectED Preschool Student

Teachers described children’s use of the iPad as a social experience that offered new opportunities for social interaction with friends and teachers.

Using the iPad fostered social interactions; teachers observed that even when working on their own, children were very likely to interact with each other when using the iPad. Teachers noted that the children served as important resources for one another and that they enjoyed collaborating and helping each other solve problems that emerged when using the iPad. One teacher commented:



“Mostly they each have their own iPad but they’re very close to each other to help each other. If kids struggle, then they’re like ready to jump and help. They love helping each other.” Moreover, multiple teachers observed that shyer students tended to be more comfortable sharing ideas and interacting with classmates when using the iPad: “You would think they’d go over in the corner by themselves. No. It’s totally the opposite. They become more social. They want to share. They want to talk. They want to explain. So it actually brings people together.”

Teachers believed the technology provided new pathways for learning and shared examples of how using the Apple devices supported children’s academic readiness.

When school leaders introduced the Apple and ConnectED initiative, some teachers had initial misgivings about using technology with young children. After using the Apple devices, however, teachers unanimously agreed that participating in the initiative offered children learning opportunities that would not otherwise be available to them. One special education teacher remarked: “technology has opened a lot of doors for my children... we’ve learned different apps, different ways to communicate, different ways to show our work, different ways to learn. I mean there’s so much... technology has made it a lot easier.” Teachers and leaders also perceived the devices as supporting academic readiness. Multiple teachers noted that growth in children’s literacy skills was stronger than in previous years. They attributed this to the multi-modal and personalized affordances of educational apps, which allowed children to interact with audio and visual representations of letters at their own pace.

The Apple devices served as an information source for children in all classrooms. Teachers mediated children’s interactions to promote critical thinking and personalized learning.

When using Apple devices during whole-group or small-group instruction, children most often engaged with the iPad to support information consumption, such as watching a video about the solar system or practicing sight words on a literacy app. Literature in the education

technology field frequently casts information consumption as a passive experience, where students have limited ownership of their learning. Standing opposite to consumption is production, which literature characterizes as active learning experiences, where children construct knowledge through the act of creation. For the classrooms in this study, however, there was far more nuance than the consumption-production dichotomy suggests. When children used technology as a source of information, teachers actively engaged them in sensemaking and critical thinking. For example, a teacher might sit next to a child and ask open-ended questions to help the child relate what they are learning to what they already know. Importantly, teachers also mediated children's experience by selecting apps and activities that aligned with children's interests and learning needs, using Apple devices to differentiate their instruction and support personalized learning.

Children in third-year ConnectED classrooms were more likely to also have opportunities to interact with technology as producers of information, providing opportunities to engage in deeper learning.

A central goal of the Apple and ConnectED initiative was to promote *deeper learning*, a set of higher-order thinking skills and dispositions characterized by five dimensions: (1) teamwork, (2) communication and creation, (3) critical thinking, (4) personalized learning, and (5) real-world engagement. Apple's theory of change rests on the hypothesis that as teachers gain experience using technology, they will provide more opportunities for children to engage more deeply along these dimensions (Singleton et al., 2018). Our results support this conjecture. As we described in the previous paragraph, using technology as a source of information can promote critical thinking and personalized learning. In examples where children use the devices as producers of information, they may have opportunities to engage in all elements of deeper learning.

- **Teamwork.** Teachers gave children opportunities to work together on creating a shared product. For example, after learning the words to "Humpty Dumpty," one teacher worked with a group of children to produce an iMovie of the rhyme. The children recorded themselves reciting each line and worked with each other and the teacher to add music and special effects. Other teachers described examples of children working together to create interactive books using open-content composing apps, such as Book Creator. Examples of teamwork were present in all classrooms, although examples of children working on a shared product were more common in classrooms where teachers had more experience with the Apple and ConnectED initiative.
- **Communication and creation.** As demonstrated by the examples of collaboration above, students used the iPad to produce artifacts of their learning, most often related to literacy. Children often worked with classmates on a shared task, for example, retelling a story using video, sound effects, and narration.

Flewitt (2012) and others argue that by layering these different modes of communication, children deepen their understanding of a story and also provide teachers with new insight into what they understand. Notably, one special education teacher remarked that the affordances of the iPad provided her nonverbal children with ways to communicate that would not be possible without the iPad: “They’d want to show you what they’re learning and maybe they can’t speak. You know, there are some that aren’t verbal, but they can show you the picture . . . So the accessibility also is unbelievable.” Similarly, the iPad created new pathways for children to share their work with their teachers and each other. As noted earlier, teachers shared examples of children taking pictures of their work and using the AirDrop feature on the iPad to send photos and videos in real time to their teachers and friends.

- **Critical thinking.** Teachers used the iPad to promote children’s critical-thinking skills, providing learning opportunities for children to apply what they had learned to new situations. For example, after learning about different shapes, children in one school went on a shape scavenger hunt, using the iPad to capture real-world examples of the shapes they learned about. Children in several classrooms used apps such as ScratchJr and Code-a-pillar to complete simple coding activities, which required children to approach problem-solving through an iterative design process. Teacher facilitation of these learning experiences was an important component of encouraging critical thinking.
- **Personalized learning.** As described throughout our findings, teachers used the Apple devices to personalize learning by selecting apps and activities based on what they knew about children’s interests and instructional needs. Nearly all teachers mentioned this as a strength of having 1:1 devices. The iPad also offered children choices for how they wanted to complete an activity. For example, children in one class could choose between retelling a story through journaling or by recording themselves.
- **Real-world engagement.** Having access to Apple devices provided opportunities for children to engage in more authentic learning experiences, in some cases extending the learning experience beyond the classroom walls. For example, one teacher used FaceTime to connect with a bilingual teacher at another ConnectED school. Children from both classrooms sang songs and spoke to each other in English and Spanish. Teachers also used the devices to connect children to experiences they would not otherwise have. For example, some teachers described having children use Google Earth to learn about animals in different parts of the world. Children were able to zoom in on the map, and view pictures and videos of the animals they were learning about. Finally, a few teachers believed that children were gaining real-world experiences by using the iPad and developing digital literacy skills.

Teachers observed that children were more engaged when using the iPad and that being able to produce digital artifacts increased children's ownership of learning and supported social emotional development.

Children enjoyed the novelty of using the iPad, whether it was for completing an app-based task or taking a photo of an art project. Teachers noticed that children were generally more engaged on a learning task when using the iPad, and that using the iPad to produce their own work increased children's self-esteem and ownership of learning. One teacher said, "They feel like they're a part of something. They really enjoyed it and seeing the final product. They see, 'Okay, we put this work in, and this is what we came out with,' and they take pride in that." Teachers who used the production features of the iPad noted that being able to easily create, revise, and recreate digital products increased children's self-confidence and encouraged them to take more risks. Finally, multiple teachers noted that using the iPad encouraged shy and more reluctant learners to participate.

One said:



We have very shy students in our class who don't speak a lot in front of other people, but when they're being recorded, they love sharing what they learned, and then we can all listen to them, and they feel like they're contributing a lot.

The ConnectED Preschool

Robust technological infrastructure provided through the Apple and ConnectED initiative allowed for mostly seamless use of devices throughout schools.

As part of ConnectED, Apple equipped schools with wireless Internet and necessary upgrades to existing physical infrastructures. Apple also offered training for IT staff and provided technical support as needed. Although infrastructure was not a focus of this study, these elements of the initiative emerged as essential for successful implementation, allowing schools to mostly bypass tech issues that research identified as barriers to implementation. Although a few teachers mentioned that their wireless connections were spotty at times, none said that it was a persistent problem or that it altered how often or for what purposes they used the devices.

School leaders believed that participating in the Apple and ConnectED initiative began to transform teaching and enhance learning activities in their schools; however, leaders recognized that technology integration takes time and saw opportunities for teachers to expand their use of technology.

Directors from each school expressed deep appreciation for the opportunity to be part of the Apple and ConnectED initiative, and all discussed how access to 1:1 technology transformed

what teachers and children were able to do. Highlighting the production features of the devices, one director noted, “I think it’s transformed the way the students produce and show you what they learned.”

Leaders stressed that technology integration was a multi-year process. In looking to the future, school leaders expressed their intention to continue supporting teachers in learning new ways to use the devices to transform teaching and learning: “I don’t want to say that we’ve met every goal, because every year we have to set new goals for ourselves.”

School leaders reported that following a multi-phase approach to rollout was key to preparing for implementation, providing time for teachers to familiarize themselves with the devices and opportunities to discuss how to fit technology into their child-centered approach.

One of Apple’s core beliefs is that successful integration of technology requires regular support and time. The school leaders in this study stressed the importance of meeting teachers where they were in terms of their knowledge of technology and their comfort in using it as an instructional tool. Each school rolled out the devices with the teachers well before introducing them into the classrooms. During this initial phase, preschool teachers gained familiarity with navigating the devices and using different features, such as the camera and AirDrop. One school pilot-tested the devices with a small set of classrooms at the end of the school year, which leaders said helped them anticipate and plan for the challenges of a full rollout. Teachers in all schools regarded their leaders’ commitment to ConnectED and their multi-phase approach to implementation as essential to successful integration.

Teachers and leaders believed that Apple and the ConnectED initiative professional learning prepared them to use Apple devices and that the scaffolded approach supported them in using the technology in more innovative ways over time.

During the first year of implementation, the Apple and ConnectED initiative provided every school with 17 days of professional learning with an Apple Learning Specialist. Teachers noted that this was critical to implementation, and their comments suggested that having access to the Apple Learning Specialist allowed them to experiment with new practices and uses throughout the first year. At the very beginning, schools and the ConnectED team provided basic support, such as how to turn on the iPad and use its basic features. As teacher familiarity and comfort with the iPad grew, the professional learning turned to supporting integration. Teachers in their third year of implementation described how, over time, they began to extend how they used the devices, taking better advantage of features such as producing videos and mixing content.



In the beginning it was all about how to use the iPad—here’s the home button, here’s the camera. As we went through the process and the PD, we were really able to learn about leveraging tech in the classroom.

Teachers and leaders stressed that the most helpful part was being able to work directly with an Apple Learning Specialist to tailor the professional learning to address their individual instructional goals and needs. In one school, the Apple Geniuses from a nearby Apple store held workshops to help teachers learn new uses of the devices, such as KeyNote or moviemaking.

Sustaining professional learning beyond the 17 days provided through the Apple and ConnectED initiative was key; schools turned to communities of practices and instructional coaches to support continued instructional growth and innovation.

As we know from research and our own work, in order to be effective, professional development must be sustained over time and embedded in teachers' practices. Teachers and leaders recognized that the Apple and ConnectED initiative provided this during the first year, but expressed the need for additional support during the second and third years of the initiative as teachers became better equipped to use the technology in more innovative ways. After the first year of implementation, teachers formed both formal and informal communities of practice to sustain their professional growth. One school had a dedicated instructional coach who was an Apple Distinguished Educator and who worked with teachers to help them conceptualize and implement new ways of using the technology. Another school had a core group of teacher leaders who tried out new activities before introducing them to the larger group during weekly professional development meetings.

The Apple Leadership Conference connected leaders and teachers from the larger network of ConnectED schools, providing important opportunities to share experiences and best practices.

Each year, school leaders and teacher representatives had the opportunity to attend the Apple Leadership and Learning Academy. Leaders from three schools discussed the value of these meetings. According to one school leader:



It really helped me lead the development of visions for the school and how to follow through and carry out putting them into action. Really great for me in going through ConnectED. I got to meet amazing educators, and we really built a community where we were able to share and learn from others who are as enthusiastic as we are.

Teachers also discussed the value of connecting with and learning from teachers at other ConnectED schools. One teacher reported learning new activities that she was able to directly implement in her teaching. Although leaders and teachers placed great value on this conference, a few wished there were more opportunities to network with other ConnectED schools.

Discussion of Promising Practices

The central goal of this work was to describe promising practices for integrating technology into early learning settings to promote deeper learning, academic readiness, and social-emotional development. By working with preschool teachers in four schools that have been successful in their implementation of the Apple and ConnectED initiative, we have established preliminary evidence of what developmentally appropriate use of technology looks like under optimal conditions.

Teachers with the most experience using technology in their teaching tended to be most fluent in leveraging the unique affordances of touch screen devices to support play, learning goals, and social interactions. Their examples and reflections surfaced multiple promising approaches to implementing and supporting technology use in the preschool classroom:

- ✓ Teachers used technology to support play, not replace it. The teachers in this study stressed that they used technology to support their current child-centered practices. The strongest teachers provided children with open access to the devices during choice time, which allowed for spontaneous and playful use.
- ✓ Teachers used technology to document learning, creating new opportunities for children to demonstrate their understanding and reflect on their work. Children delighted in sharing photos and videos of their work with their teacher and their friends. Teachers reported that these products gave them new insight into children's understanding and that they used children's photos and videos as anchors to encourage student reflection and help them make meaning of their work. Teachers observed that sharing work gave children more ownership of their learning and boosted their self-esteem. Some teachers also shared this work with parents and caregivers, strengthening the school-home relationship.
- ✓ Teachers used technology to personalize learning based on their knowledge of children's understanding and preferences. Teachers took advantage of educational apps to individualize instruction, assigning children tasks based on their preferences and where they were in their learning.
- ✓ Teachers collaborated with children and fostered children's collaboration with each other to produce artifacts of learning. Teachers also created opportunities for children to produce their own digital products. Children took the lead during these activities, with teachers stepping in when needed. These learning experiences supported deeper learning—specifically, teamwork, communication and creation, and real-world engagement.

- ✓ When facilitating children's use of technology, teachers moved flexibly and fluidly across different roles based on the activity, learning goals, and children's needs. Skilled teachers took on different roles to model, scaffold, guide, and document children's learning activities. When children used technology as an information source, teachers actively engaged them in conversations to support sensemaking and critical thinking. When children used technology as producers of learning, teachers provided space for children to direct their own experiences, providing guidance as needed. These activities promoted social-emotional development and provided opportunities for children to engage in multiple aspects of deeper learning.
 - ✓ Teachers worked with their colleagues to select apps and activities that were developmentally appropriate and easy to use, and that supported their instructional goals. In selecting apps and activities to use with their children, teachers used criteria that aligned with those in the NAEYC and Fred Rogers Center (2012) joint position statement. Although teachers often selected apps based on their own reviews, they also collaborated with their colleagues and relied on the recommendations of teacher leaders.
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Future Considerations

Drawing from our findings, we present a set of recommendations to guide different stakeholder groups in supporting the adoption of digital technologies in future preschool settings.

Apple and ConnectED Team

- ✓ Consider extending professional learning opportunities into the second and third years of implementation. Teachers and leaders noted that the professional learning was instrumental in preparing teachers to use the devices and begin to experiment with different ways of using them as tools for teaching and learning. As teachers entered their second and third year of implementation, they were ready and willing to explore more innovative uses of the devices. Teachers and leaders alike expressed a desire for additional professional learning opportunities from the Apple and ConnectED team.
- ✓ Provide additional opportunities and channels for ConnectED initiative schools to connect with each other. Teachers and school leaders valued the opportunities they had to connect with and share ideas and best practices with other ConnectED schools and would like more opportunities to network with like-minded educators.
- ✓ Continue documenting promising practices. Underscoring Apple's conjecture that innovative integration of technology takes time, teachers and school leaders stressed that their use of the devices is a work in progress. Even teachers in their third year of implementation noted their intention to continue experimenting with new uses of technology. As schools continue along the trajectory of innovation, it will be valuable to continue capturing these process and practices, possibly generating a long-term road map for schools planning to integrate 1:1 devices.
- ✓ To help school leaders and teachers set realistic goals for implementation, add *teacher familiarity and comfort with using technology* to the initial tech assessment. The Apple and ConnectED initiative may also consider developing implementation guides for schools based on their existing technology infrastructure and experience using technology with young children. It is important that these guides be open-ended and flexible enough to meet the context and goals of individual schools.

School Leaders

- ✓ Recognize and address teachers' ambivalence and concern around using technology in preschool settings. Teachers could benefit from examples that demonstrate the value of technology in supporting play and social interactions.
 - ✓ Provide time for teachers to participate in communities of practice, and set up channels for teachers to share ideas, reflect on best practices, and develop collective expertise. Consider supplementing these communities and channels with dedicated instructional coaches who can work with individual teachers to align technology use to learning goals. These coaches can also onboard teachers who are new to the school and/or to using technology in their teaching.
 - ✓ Recognize that introducing technology into instruction is a process, and meet teachers where they are in terms of their comfort with and knowledge of technology. Before introducing technology into classrooms, give teachers time to become familiar with the devices. Once teachers are comfortable using the devices, turn to pedagogical approaches to using technology, along with specific activities teachers can immediately use in their teaching.
 - ✓ Ensure that the school has the necessary infrastructure and reliable Internet access. Previous research lists unreliable Internet access as a major barrier to using technology on a regular basis. By providing infrastructure and tech support, the Apple and ConnectED team allowed schools to mostly bypass this barrier.
 - ✓ Provide support for selecting apps and activities. Although the teachers in this study said they chose educational apps using developmentally appropriate criteria, the sheer volume of available apps made finding the right one a challenge. Consider providing teachers with a list of apps and a rubric to assess the value and appropriateness of individual apps.
 - ✓ Help teachers devise child-friendly protocols for handling the devices responsibly. Teachers' concerns over the safety of the devices emerged as an initial barrier to use and one that persisted in multiple classrooms. Teachers who overcame this perceived barrier created rules that children could relate to (e.g., "Carry with two hands and a hug").
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Teachers

- ✓ Provide children with greater access to the devices, especially during choice time. Children enjoy using the devices to take photos and videos of their activities and then sharing them with their teachers and friends. Teachers observed that this was both a source of pride for the children and a new way for them to demonstrate their understanding. Teachers can also use these artifacts to help children reflect on and deepen their learning experiences.
- ✓ Share children's digital products with parents. By inviting parents to see their children's work, teachers can strengthen the school-home connection and create opportunities for parents to build on what children are learning in school.
- ✓ Take advantage of the unique features of technology to encourage child-directed creation. With a little help from their teacher and classmates, children can use digital authoring tools to create interactive learning products.
- ✓ Leverage the multi-modal affordances of the devices and educational apps. Teachers in this study observed that providing different ways for children to experience the same content enhanced their understanding, while also attending to children's different learning styles.

Researchers

- ✓ Although teachers provided anecdotal evidence of technology supporting—and, in some cases, accelerating—learning, future research that explores this hypothesis in a more systematic and rigorous way will produce richer data and findings.
 - ✓ This study relied on teacher descriptions and perceptions of how they use technology. Future work ought to include classroom observations to better understand what implementation looks like in real time.
 - ✓ This work focused on implementation of 1:1 devices in highly supported, child-centered preschool settings. Future research might consider what implementation looks like in a wider variety of settings. In particular, what does implementation look like in classrooms that follow a more teacher-directed approach? What barriers do these teachers encounter? What types of professional learning opportunities support integration that is also child-centered and play-based?
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