U.S. Department of Education

U.S. Department of Health and Human Services

Early Learning and Educational Technology Policy Brief

OCTOBER 2016

U.S. Department of Education
John King
Secretary

Office of Early Learning
Libby Doggett
Deputy Assistant Secretary for Policy and Early Learning

Office of Educational Technology
Joseph South
Director

U.S. Department of Health and Human Services
Sylvia Mathews Burwell
Secretary

Linda K. Smith
Deputy Assistant Secretary for Early Childhood Development

Shannon L.Rudisill
Associate Deputy Assistant Secretary for Early Childhood Development

October 2016

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This policy brief is available on the Department's website at http://tech.ed.gov/earlylearning. Requests for alternate format documents such as Braille or large print should be submitted to the Alternate Format Center by calling 202-260-0852 or by contacting the 504 coordinator via email at om_eeos@ed.gov.

Acknowledgements

This brief was written under the guidance of a team from both the U.S. Department of Education and the U.S. Department of Health and Human Services. From the U.S. Department of Education, Joseph South and Katrina Stevens (Office of Educational Technology), Libby Doggett and Steven Hicks (Office of Early Learning), and Russell Shilling and Melissa Moritz (Office of Innovation and Improvement-STEM) provided leadership. From the U.S. Department of Health and Human Services, Linda K. Smith, Shannon Rudisill, and Amanda Bryans from the Office Early Childhood Development provided leadership.

Joan Lee (Office of Educational Technology) was the author of the brief and led the development and drafting process. Technical assistance was provided by the following people at ED and HHS: Kimberly Burgess, James Collins, Fatima Jibril, James Harnett, Charles Homer, Isaiah Kamrar, Ngozi Lawal, Kathy Lin, Meredith Reynolds, Douglas Steiger, and Jeffrey Polich.

Experts in early learning and technology use provided valuable support. The Departments are grateful to the advice from: Jeanette Betancourt (Sesame Workshop), Preeti Birla (Innovate NYC), Joseph Blatt (Harvard University), Chip Donohue (Erikson Institute), Danielle Ewen (Education Counsel), Ed Green (The Early Learning Collaborative, HITN), Lisa Guernsey (New America), Michael Levine (Joan Ganz Cooney Center), Rosemarie Truglio (Sesame Workshop), and Melina Uncapher (University of California, San Francisco).

The Departments also received support from the American Academy of Pediatrics and are grateful to Dr. Ari Brown, Dr. Dimitri Christakis, Dr. Corinn Cross, Dr. David Hill, Susan Martin, Thomas McPheron, Dr. Jenny Radesky, and Dr. Yolanda Reid-Chassiakos for the feedback on initial drafts and input.

Susan Thomas served as the principal editor for this brief. Graphics were developed by O2 Lab in Washington, D.C.

Vision

The vision of the U.S. Department of Education (ED) and the U.S. Department of Health and Human Services (HHS) (hereafter known as The Departments) is that 1) all young children will have adults in their lives who are well-informed on how to use technology to support learning at various ages; and 2) all young children will have opportunities to learn, explore, play, and communicate through a multitude of approaches, including the use of technology.

This vision is already a reality for some early learners and the adults in their lives. The examples below represent promising ways to help early learners use technology with peers and adults to foster relationships, expand learning, and solve meaningful problems.

- **Supporting interpersonal relationships:** A military family used video chatting software to enable their two daughters aged 2 and 4 to keep in touch almost daily with their father, an Army major, during his deployment in Iraq. The family reported that the connection made his deployment "more bearable" for him and "eased his return home" for the girls because it allowed him to be part of their daily lives.[1]
- **Fostering the development of school readiness skills:** Preschoolers at Austin STEM Academy noticed that the guinea pigs in their class observatory looked cramped inside their cage, so they suggested building a new home. With the help of instructors, the children consulted an application (app) that described guinea pig habitat needs and then collaboratively designed a blueprint for their new guinea pig home. The project helped students develop strong early critical thinking and problem solving skills while executing their plan.[2]
- **Language development and communication:** A teacher vetted and selected a multimedia storytelling app so that a 4-year-old boy in Athens, Georgia who only spoke Chinese was able to create a digital story with a tablet to share details about his home life. The project, complete with photos from home and narration in both English and Chinese, allowed the other students to hear his story in his own words. The digital family story helped him become more integrated into the classroom community and improved his English language skills.[3]
- **Exploration and learning:** A kindergarten classroom in a Southeastern U.S. city used digital cameras, digital microscopes, and drawing software to learn about fossils, bones, and dinosaurs through an archaeological "dig" in their classroom. Sifting through a sand table, the students used the cameras and microscopes to record their experience of discovering plastic bones and dinosaurs. The children then had the choice of creating a multimedia book using drawing software or a handwritten report on their discoveries and what they learned.[4]

TECHNOLOGY AND ASSISTIVE TECHNOLOGY DEVICES

In this document, **technology** refers broadly to both hardware that enables connectivity and devices (including television and handheld devices such as smartphones and tablets), content (including digital media such as apps, games, software and television programming), and assistive technology devices. The term **assistive technology device** stems from the Assistive Technology Act of 1998 and is specifically defined in Section 602(1) of the Individuals with Disabilities Education Act (IDEA) as "any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of a child with a disability. The term does not include a medical device that is surgically implanted or the replacement of such device."

The rapid pace of innovation in technology provides a seemingly endless stream of new learning options for families and early educators. However, not all technology is designed in a way that is appropriate for early learners or leads to meaningful learning, so adults need to be thoughtful about children's technology use. Additionally, there is a growing technology opportunity gap. The goal of the Departments is that all children in every community and at every socioeconomic level have equitable access to appropriate technology in early learning settings and that technology is used responsibly with young children.

Purpose

The purpose of this policy brief is to:

- Provide guiding principles for early educators (including those in home settings), early learning programs, schools, and families on the use of technology by young children to support them in making informed choices for all children.
- Inform the public, families, and early educators on the evidence base used to support these guiding principles.
- Issue a call to action to researchers, technology developers, and state and local leaders to ensure technology is advanced in ways that promote young children's healthy development and learning.

While this brief addresses early learners from birth to 8 years of age, the Departments acknowledge that this is a large age span in the development of a child and what is appropriate for an 8-year-old is likely not appropriate for a toddler or infant. This brief focuses mainly on age-appropriate guidance for children ages 2-8. A special call out box titled, **"What Is Developmentally Appropriate Technology Use for Children age 0-2?,"** on page 11 discusses technology use with children under the age of 2.

The Departments' guiding principles presented in this brief for using technology with young children can help families make informed decisions about their child's interaction with technology, including watching television, playing digital games, using video chats or apps to communicate, or using digital tools to create content. They can guide early educators on how to introduce and use technology in the classroom, community, or home as a tool to support learning. They can also help early educators and policymakers at state and local levels better understand the importance of connectivity and providing appropriate technology for early learners, the importance of training and supporting early educators to best use technology in early learning settings, and the legal requirements for children with disabilities as defined by IDEA and individuals with disabilities as defined by Section 504 of the Rehabilitation Act of 1973 and Title II of the Americans with Disabilities Act.

IDEA, SECTION 504, AND TITLE II

Eligible children with disabilities may receive assistive technology provided as early intervention services under the requirements in Part C of the Individuals with Disabilities Education Act (IDEA); as special education and related services under the requirements in Part B of IDEA; or as special education or related aids and services under the requirements in Section 504 of the Rehabilitation Act of 1973 (Section 504) for school-age children. Section 504 also applies to school-age children who are not IDEA-eligible. Determinations as to whether students with disabilities should receive assistive technology and the specific device or devices to be provided are made on an individual basis by the child's Individualized Education Program (IEP) team, Individualized Family Service Plan (IFSP) team, or Section 504 team, if appropriate.

This brief is not intended to limit the authority of the appropriate team to make individual determinations regarding the assistive technology to be provided to a particular child. In addition, all persons with disabilities, including parents and students, are protected from discrimination on the basis of disability under Section 504 and Title II of the Americans with Disabilities Act. Under these laws, if a covered entity provides technology, the entity must ensure that any technology that is provided is accessible to persons with disabilities.

For more information on the laws that apply to students with disabilities, see the following resources:

- **IDEA:** http://idea.ed.gov
- **Section 504:** http://www.ed.gov/ocr/504faq.html
- **Title II of the ADA:** https://www.ada.gov/t2hlt95.htm
- ED policy documents on accessible technology for students with disabilities:
  - **Joint "Dear Colleague" Letter:** Electronic Book Readers www.ed.gov/ocr/letters/colleague-20100629.html
  - **Frequently Asked Questions About the June 29, 2010 Dear Colleague Letter:** http://www.ed.gov/ocr/docs/dcl-ebook-faq-201105.html

The importance of unstructured and unplugged play

Families and early educators should be aware that technology use should never displace the role of unstructured, unplugged, interactive, and creative play that research shows is the best way children learn. In fact, unstructured playtime is more important for brain development in young children than any type of media use.[5] Children should have exposure to many different types of play, including those where teachers are guiding play, play with peers, and independent play. In early learning settings, play can be intentional, with the teacher thoughtfully creating learning environments, or unstructured such as during recess. During unstructured playtime, children process what they are learning on a daily basis and develop social skills with peers and adults. Technology and media should not take the place of interactions in the real world, including playtime with adults and peers, physical and outdoor activities, and the social interactions and experiences that are essential for a child's development.[6] For these reasons, frequency and duration of technology use are important considerations for families and early educators.

Families should be aware that, as with many other childhood activities and influences, technology use can have both positive and negative effects depending on use.[7] Adults should expect to set limits, encourage a diversity of experiences both digital and unplugged, and keep in mind that research shows that for young children in-person interactions should be fostered.[8]

Guiding Principles for Use of Technology with Early Learners

The Departments recognize that families and early educators have many different options for using technology with early learners. The Departments believe that guidance needs to reflect the reality that families and early educators have access to apps, digital books, games, video chatting software, and a multitude of other interactive technologies that can be used with young children. Even as new technologies emerge, the Departments believe that these principles apply, though guidance may evolve as more research on this topic is published.

The Departments' four guiding principles for use of technology with early learners are as follows:

- **Guiding Principle #1**: Technology—when used appropriately—can be a tool for learning.
- **Guiding Principle #2:** Technology should be used to increase access to learning opportunities for all children.
- **Guiding Principle #3:** Technology may be used to strengthen relationships among parents, families, early educators, and young children.
- **Guiding Principle #4:** Technology is more effective for learning when adults and peers interact or co-view with young children.

Two documents in particular influenced the development of the Departments' guiding principles: *Uses of Technology to Support Early Childhood Practice* and the *2016 National Education Technology Plan* (NETP).

HHS published *Uses of Technology to Support Early Childhood Practice*[9] in March 2015 to examine how technology can be used to support and improve the quality of practice of early childhood practitioners, particularly in their own professional development. The report presented an overview of research related to the use of technology by conducting a literature review and consulting with experts on the topic in four key focus areas: 1) instruction and assessment; 2) parent, family, and community engagement; 3) professional development and informal learning; and 4) facilitators and barriers.

At ED, the Office of Educational Technology released the 2016 NETP, the federal government's flagship educational technology policy document. Titled *Future Ready Learning: Reimagining the Role of Technology in Education*, the plan articulates a vision of equity, active use, and collaborative leadership to make everywhere, all-the-time learning possible for all learners. While acknowledging the continuing need to provide equitable access to technology itself, the plan goes further to call upon all involved in American education to ensure equity of access to transformational learning experiences enabled by technology, including for early learners.[10]

The Departments' four principles state the position of the Departments on this topic and are expanded below.

Guiding Principle #1:

Technology—when used appropriately—can be a tool for learning.

Developmentally appropriate use of technology can help young children grow and learn, especially when families and early educators play an active role. Early learners can use technology to explore new worlds, make believe, and actively engage in fun and challenging activities. They can learn about technology and technology tools and use them to play, solve problems, and role play.

HOW DO YOU DETERMINE WHAT IS DEVELOPMENTALLY APPROPRIATE FOR A CHILD WHEN IT COMES TO TECHNOLOGY?

In *Technology and Interactive Media as Tools in Early Childhood Programs Serving Children from Birth through Age 8*, the National Association for the Education of Young Children (NAEYC) and the Fred Rogers Center state that "appropriate experiences with technology and media allow children to control the medium and the outcome of the experience, to explore the functionality of these tools, and pretend how they might be used in real life.[11]"

Lisa Guernsey, author of *Screen Time: How Electronic Media—From Baby Videos to Educational Software—Affects Your Young Child*, also provides guidance for families and early educators. For example, instead of applying arbitrary, "one-size-fits-all" time limits, families and early educators should determine when and how to use various technologies based on the Three C's: the content, the context, and the needs of the individual child.[12] They should ask themselves following questions:

- **Content**—How does this help children learn, engage, express, imagine, or explore?
- **Context**—What kinds of social interactions (such as conversations with parents or peers) are happening before, during, and after the use of the technology? Does it complement, and not interrupt, children's learning experiences and natural play patterns?
- **The individual child**—What does this child need right now to enhance his or her growth and development? Is this technology an appropriate match with this child's needs, abilities, interests, and development stage?

Appropriate use in formal early learning settings

Early educators should keep in mind the developmental levels of children when using technology for early learning. That is, they first should consider what is best for healthy child development and then consider how technology can help early learners achieve learning outcomes. Technology should never be used for technology's sake. Instead, it should only be used for learning and meeting developmental objectives, which can include being used as a tool during play.

When technology is used in early learning settings, it should be integrated into the learning program and used in rotation with other learning tools such as art materials, writing materials, play materials, and books, and should give early learners an opportunity for self-expression without replacing other classroom learning materials.[13] There are additional considerations for educators when technology is used, such as whether a particular device will displace interactions with teachers or peers or whether a device has features that would distract from learning. Further, early educators should consider the overall use of technology throughout a child's day and week, and adhere to recommended guidelines from the Let's Move initiative, in partnership

with families. Additionally, if a child is eligible for services under IDEA and/or Section 504 and Title II, the student may require specific technology to ensure that the student can access the instructional material.

WHAT ARE SOME DIFFERENCES BETWEEN USING AN E-BOOK AND A PHYSICAL BOOK WITH EARLY LEARNERS?

E-books have the potential to provide learning experiences for children and they also have capabilities that are impossible to deliver in print format. For example:

- A device can hold a complete library of stories and information for children to explore.
- Words and sentences can be highlighted during oral narration.
- Children can elect to have a pre-recorded narrator read the entire text out loud to them.
- Children can experience embedded interactive features within the text.

On the other hand, research has shown that some interactive features may actually impede a young child's comprehension.[14, 15] An example is a feature that allows children to jump around to different points in the story, which can make it difficult for developing readers to follow a sequence of events.

The optimal way for children to experience a physical book or an e-book is with an adult who is actively involved,[16, 17] asking questions that allow children to expand on what they've read to make connections and providing opportunities to check for comprehension. However, the design of some e-books may dampen parents' desires to play that interactive role. Two research studies have shown that when parents read e-books that have features that asked questions, parents were less likely to play that role with their children while reading together.[18, 19] On the positive side, another research study showed that children who read an e-book with a parent remembered content better than children who read an e-book alone, regardless of what the parent was saying during the reading.[20]

When making decisions about incorporating e-books, parents should consider what features are available and when and how they will be used. Bedtime use of e-books may also require additional considerations. For example, currently there is limited research on the impact on sleep when using e-books for bedtime reading, but some research suggests that the backlighting of electronic devices can curtail the amount of time children spend sleeping if a device is used right before bedtime.[21]

Just as with other educational tools, school-aged children should be taught how to correctly handle and care for devices. These skills and the use of technology should generally not be taught as a separate rotation or class, but rather integrated into the learning objective of the lesson.[22] In some cases, however, individualized instruction may be desirable to meet the specific needs of a child. As children grow older, they should continue to build on this basic skill set with lessons in digital citizenship.

WHAT IS DIGITAL CITIZENSHIP?

In the Ed Tech Developer's Guide, released by the Office of Educational Technology in April 2015, digital citizenship is defined as "a set of norms and practices regarding appropriate and responsible technology use… and requires a whole-community approach to thinking critically, behaving safely, and participating responsibly online."[23]

As early learners reach an appropriate age to use technology more independently, they must be taught about cyber safety, including the need to protect and not share personal information on the internet, the goals and influence of advertisements, and the need for caution when clicking on links. These skills are particularly important for older children who may be using a parent's device unsupervised. Early childhood educators and administrators should ensure that the proper filters and firewalls are in place so children cannot access materials that are not approved for a school setting.

Distinctions between active and passive use

To understand how to use technology appropriately with young children, families and early educators should understand the differences between passive and active use of technology. Passive use of technology generally occurs when children are consuming content, such as watching a program on television, a computer, or a handheld device without accompanying reflection, imagination, or participation. Active use occurs when children use technologies such as computers, devices, and apps to engage in meaningful learning or storytelling experiences. Examples include sharing their experiences by documenting them with photos and stories, recording their own music, using video chatting software to communicate with loved ones, or using an app to guide playing a physical game. These types of uses are capable of deeply engaging the child, especially when an adult supports them.

Deep engagement is less likely to occur when a device is used passively. In many circumstances, minimal learning occurs when children use devices merely to consume videos on their own. However, screen time should not be the only factor when considering the value of a child's interaction with technology since high-quality, research-based video content can lead to deep cognitive processing in the minds of young children.[24] As most content does not meet this standard, adults need to recognize that what matters most is whether the child's mind is active and deeply engaged with the content. One way an adult can tell if a child is actively engaging with content is for an adult to watch with them (known as co-viewing) and to guide them to a deeper engagement. Co-viewing and the importance of adult interaction is further discussed in guiding principle #4.

Similarly, adults need to be cautious about assuming that a child using a device in a physically engaging way reflects active learning. While actions such as swiping or pressing on devices may seem to be interactive, if the child does not intentionally learn from the experience, it is not considered to be active use. To be considered active use, the content should enable deep, cognitive processing, and allow intentional, purposeful learning at the child's developmental level.

The Departments further encourage families and early educators to think of ways they can reduce the sedentary nature of most technology use. Technology can encourage and complement physical activity, such as a parent and child using a yoga app together, exploring different varieties of flowers in a neighborhood park while referencing an app to learn about them, or playing console games that encourage adults and children to exercise or dance together.

Additional guidance for families and early educators

Adults should strive to provide balance and moderation when using technology with children. They should set limits that are developmentally appropriate and meet the needs of their children and family. When introducing technology to children, adults should model behaviors such as using technology to promote positive interaction instead of allowing it to interfere with interactions, designating and enforcing face-to-face time that is free of interruptions, and using technology together before allowing children to use it independently.

RESEARCH ON TELEVISION USE

Research on television has shown that the impact of children passively consuming content is associated with adverse effects on their health in terms of weight,[25,26,27] sleep habits,[28, 29] and language development.[30,31,32] One study also showed that fast-paced, cartoon television shows can have an immediate negative impact on executive function skills for four-year-olds.[33] Executive function refers to a set of cognitive and regulation skills involved in goal-directed problem solving, including working memory, inhibitory control, and flexible shifting of attention. These studies have led to previous recommendations from the AAP limiting the amount of time children have spent with screens.

WHAT IS DEVELOPMENTALLY APPROPRIATE TECHNOLOGY USE FOR CHILDREN AGED 0–2?

Research shows that unstructured playtime is particularly important for infants and toddlers because they learn more quickly through interactions with the real world than they do through media use and, at such a young age, they have limited periods of awake time.[34] At this age, children require "hands-on exploration and social interaction with trusted caregivers to develop their cognitive, language, motor, and social-emotional skills."[35]

Research also shows that children aged 0-2 should not watch media or use technology alone. Children age 12-24 months can learn from videos if parents co-view material with them and use the video as a learning tool to build language skills.[36] Some studies have shown that children in this age range can learn from videos, but do not retain information as long as comparison groups who learned the same material using books with their parents did.[37] When video chatting, children under 16 months show no learning gains,[38] though there may be a benefit in promoting bonding when physical distance limits frequent in-person interactions.

Based on this research, the Departments recommend the following:
For children under the age of 2, technology use in early learning settings is discouraged. With families, technology can be used in active ways that promote relationship development, such as using video chatting software to talk to relatives, friends, and families whom they are not able to see on a regular basis. Parents who are interested in using media with their children can start around 18 months with high-quality content, but should always co-view content and use technology with their children. As determined appropriate by the IFSP team under Part C of the IDEA, children with disabilities in this age range may also use technology, for example, an assistive technology device to help them communicate with others, access and participate in different learning opportunities, or help them get their needs met.

For children ages 2-5, families and early educators need to take into account that technology may be used at home and in early learning settings. New recommendations in the AAP's 2016 Media and Young Minds Brief suggest that one hour of technology use is appropriate per day, inclusive of time spent at home and in early learning settings and across devices.[39] HHS supports more limited technology use in early care settings, and more information on their recommendations can be found in *Caring for Our Children: National Health and Safety Performance Standards*.[40] However, time is only one metric that should be considered with technology use for children in this age range. Families and early educators should also consider the quality of the content, the context of use, and opportunities the technology provides to strengthen or develop relationships. At home, parents can use technology to supplement real-world interactions, for instance, by using an app at the zoo or recapping what they experienced while there.

For children ages 6-8 in school settings, technology should be used as a tool for children to explore and become active creators of content. If children have more than one teacher, those teachers should be aware of how much screen time is being used across subject areas and at home. Students should learn to use technology as an integrated part of a diverse curriculum. At home, parents should set limits they feel are appropriate for their children, understanding the differences between passive and active technology use as well as the benefits of using technology with an adult versus solo use. Parents should also be aware of how much technology is being used in the classroom, what is needed for homework, and how this fits into an overall picture of technology use for their child throughout the day. The AAP has created an interactive Family Media Plan Tool on HealthyChildren.org to help parents be thoughtful about media exposure for their children.

Guiding Principle #2:

Technology should be used to increase access to learning opportunities for all children.

When appropriately used by early learners with guidance and modeling by adults, technology can complement or extend learning in ways not easily achieved otherwise. For example, technology can introduce children more directly to cultures and places outside their community. Although children may have access to print resources from libraries, technology can increase the amount of reference information immediately available to them on a given topic and give them the ability to ask questions of people outside of their classroom. Additionally, within a child's own community, technology should be culturally responsive.

Children themselves may be encouraged to take part in creating this content. Technology can help children author their own materials and stories and share their real-life experiences with others, increasing the amount of diverse, culturally relevant, and community-based content in the classroom.

HOW DOES TECHNOLOGY SUPPORT STEM AND EARLY LEARNING?

Technology can be a powerful tool to support learning in science, technology, engineering and mathematics (STEM). There are many resources that use technology to make STEM come to life for young children, allowing access to experiences they wouldn't otherwise have. For example, children can use the panda cams at the Smithsonian National Zoological Park to observe animals that aren't found in their everyday lives, take virtual tours of science museums, and observe cause and effect through simulations and games, without risk of harm.

When combined with social interactions and guidance from parents and early educators, the combination of video and games (transmedia) can be powerful tools at home and in the classroom to promote STEM learning. For example, the Corporation for Public Broadcasting-PBS, a 2010 grantee of ED's Ready to Learn Television program demonstrated significant improvement in 4-year olds' math skills when using the PBS KIDS Transmedia Math Supplement to bolster mathematics instruction.[42] The 2015 Ready to Learn Television program grant application included a competitive priority to support scientific literacy, which has additional potential to support young children in STEM.

The "T" in STEM is often confused with technological devices such as tablets, laptops, and other physical devices or with the broad term "educational technology." Educational technology is content agnostic and describes using technology as a tool to promote learning across disciplines or content areas. The "T" in STEM, however, is intended to introduce children to the underlying concepts of building or creating technology, including computational thinking, which is the basic logic underlying computer science and is beginning to be incorporated into early childhood settings.

WHAT DOES IT MEAN TO BE CULTURALLY RESPONSIVE?

Culturally responsive materials are designed to create learning environments that are conducive to learning for all students, no matter their ethnic, cultural, or linguistic background. In a chapter titled "Technology Tools for Family Engagement: The Role of Diversity," in the book *Family Engagement in the Digital Age: Early Childhood Educators as Media Mentors edited by Chip Donahue*, Kevin Clark suggests that early educators ask themselves the following questions when selecting media:

- Do children see different types of people, characteristics, and attributes?
- Do children hear a variety of sounds, voices, and music?
- Are a variety of situations being depicted (e.g. family structure, lifestyles, power/working relationships?)[41]

It is important that these questions are considered across content, including in apps and other media.

Digital use divide

The 2016 NETP presents research that points to a widening digital use divide, which occurs when some children have the opportunity to use technology actively while others are asked primarily to use it passively. The research showed that children at lower income levels are more likely to complete passive tasks in learning settings while their more affluent peers are more likely to use technology to complete active tasks.[43, 44]

For low-income children who may not have access to devices or the internet at home, early childhood settings provide opportunities to learn how to use these tools more actively. For example, research shows that preschool-aged children from low-income families in an urban Head Start center who received daily access to computers and were supported by an adult mentor displayed more positive attitudes toward learning, improved self-esteem and self-confidence, and increased kindergarten readiness skills than children who had computer access, but did not have support from a mentor.[45] Access to technology for children is necessary in the 21st century but not sufficient. To have beneficial effects, it must be accompanied by strong adult supports.

Children with disabilities

The 2016 NETP discusses equity in the context of connectivity, access, and active experiences, including the accessibility of technology by children with disabilities. These include apps, devices, materials, and environments that support and enable access to content and educational activities for all learners.[46] The Departments support the creation of "born accessible" materials (a play on "born digital," which refers to materials created specifically for digital platforms) that use the principles of Universal Design for Learning and follow industry accessibility standards from the very beginning of the development process.[47] Accessibility is not limited to those with sensory or physical disabilities; it also includes individuals with intellectual or other developmental disabilities.

When used appropriately, technology has the potential to help learners of all ages and abilities fully engage in learning by providing greater access to curriculum and improving learning outcomes.[48] For instance technology may provide children who struggle to communicate with an efficient means of communicating. One example is an app that enables children to point to a picture or a series of pictures and then says the words that correspond to the selected item.

For IDEA-eligible children receiving early intervention services or special education and related services, decisions about assistive technology use would be made by the child's IEP or IFSP) team under IDEA, as appropriate. For children with disabilities who are not eligible for services under the IDEA, children could receive appropriate technology in a preschool program operated by a recipient of Federal financial assistance or in a public preschool program, regardless of receipt of Federal funds. For students enrolled in public elementary schools who are not IDEA-eligible who are entitled to special education or related aids and services under Section 504, these determinations generally would be made by the group that makes the placement and services decisions for that student under Section 504.

UNIVERSAL DESIGN FOR LEARNING

In the Elementary and Secondary Education Act of 1965 (ESEA), reauthorized by the Every Student Succeeds Act (ESSA), Universal Design for Learning (UDL) is defined as "the meaning given the term in **Section 103 of the Higher Education Act of 1965 (20 U.S.C. § 1003)**." In that section of the Higher Education Act of 1965, UDL is defined as "a scientifically valid framework for guiding educational practice that—(a) provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged; and (b) reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient."

The Center for Applied Special Technology (CAST) developed the UDL framework for making a curriculum inclusive of "flexible approaches that can be customized and adjusted for individual needs." The CAST guidelines encourage instructional practices and educational content that embrace the widest possible diversity of learners. The UDL approach encourages the development of tools that consider this diverse range of users in the original design rather than add-on features. To see the guidelines, refer to the **CAST website**.

Recommendations regarding active and passive use for entertainment and learning purposes apply to all children, including those with disabilities. For assistive technology that is necessary for the child to communicate with others or allows them to participate in developmentally appropriate activities, age or time limits should be determined together with the child's IEP or IFSP team.

Dual language learners

For dual language learners, digital resources can support language skills development in the home language and English. For example, students and families can use digital tools to create and share stories in their home language that are culturally relevant for classroom use. Educators can use digital tools to adapt materials with translations in both languages to improve comprehension and communication. In addition, oral language development focused on listening and speaking skills can be enhanced in two or more languages using speech-recording and playback features. When used appropriately and sensitively, technology can help meet the needs of dual language learners as individuals and enhance their learning opportunities.[49]

Guiding Principle #3:

Technology may be used to strengthen relationships among parents, families, early educators, and young children.

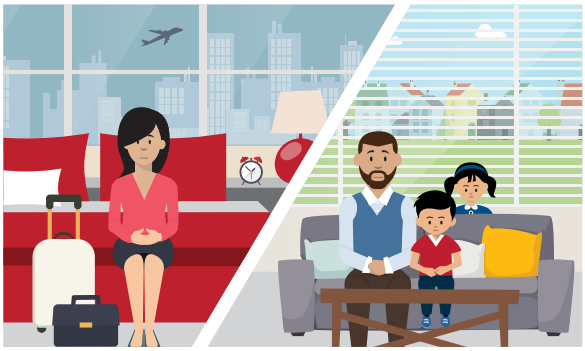
CONNECTIONS BETWEEN HOME AND SCHOOL

In early childhood settings, technology can be used to strengthen relationships between early educators and family members. For example, digital portfolios documenting student work through photos, audio, and video recordings enable teachers to share what children are learning in class with families more often and more informally than is possible in traditional school-based conferences. This allows parents to track their child's progress, provides more opportunities for them to validate their child's efforts and accomplishments, and opens up opportunities for the parents to engage their child about their learning to reinforce or supplement it. In addition to using e-mail, text messages, and social media to make communication between early educators and families easier, technology can also be used to provide information and coaching to parents to reinforce at home what is learned at school. In fact, according to the HHS report, *Uses of Technology to Support Early Childhood Practice,* 40% of parent, family, and community engagement (PFCE) products used video technology to model ideal parent behaviors or coach a parent's behavior. An additional 40% of PFCE products were used to present parents with educational materials.[50] Technology has tremendous potential to strengthen communication and connection between families and early educators to the benefit of children.

STRENGTHENING RELATIONSHIPS

Technology can also be used to enhance relationships between children and adults and between children when distance or other barriers such as health prevent in-person interaction. While video chatting can be done at any age (as interactions tend to be brief and guided by an adult), "new evidence shows that infants and toddlers can attend to and engage in joint attention during video-chat interactions but do so more effectively after approximately 16 months of age and with parental support."[51] Video chatting is not limited to interactions between parents and children or grandparents and children, but is also applicable when children communicate with peers.

TECHNOLOGY CAN FACILITATE SOCIAL INTERACTION



No interaction

Better interaction

Best interaction

While technology has the power to bridge the physical divide between children and loved ones in the ways described, technology should not be used to replace meaningful face-to-face interactions. Precautions should be taken to ensure that technology use does not impede the development of healthy, authentic interactions with adults and peers.

Guiding Principle #4:

Technology is more effective for learning when adults and peers interact or co-view with young children.

Most research on children's media usage shows that children learn more from content when parents or early educators watch and interact with children, encouraging them to make real-world connections to what they are viewing both while they are viewing and afterward.[52]

THE READY TO LEARN TELEVISION PROGRAM

The Ready to Learn Program: 2010-2015 Policy Brief, published in March 2016, summarized ED's Ready to Learn Television program research on the effectiveness of three educational television production organizations.[53] The brief reported on 15 effectiveness/summative research studies with children aged 3-8 using media in informal learning settings (such as after school or child care programs); 7 of the studies focused on learning at home. From the 7 studies that focused on learning at home, positive associations were found between at-home engagement and children's math learning with children whose parents received interventions such as content guides and suggestions for supplemental activities. The studies also found that parents' awareness of children's math learning increased their likeliness to engage in activities and strategies to help their children learn math.[54]

While technology such as tablets and smartphones are designed to be handheld and lend themselves to individualized instead of shared experiences, children may benefit greatly when parents are actively involved while children use such devices. One research study of maternal

interaction with 15-month olds found that the infants are 22 times more likely to transfer learning from a touchscreen to a real object, but only if the interaction with the mother was highly scaffolded with high levels of maternal input and emotional responsiveness.[55]

There are many ways that adult involvement can make learning more effective for young children using technology. Adult guidance that can increase active use of more passive technology includes, but are not limited to, the following:

- Prior to the child viewing content, an adult can talk to child about the content and suggest certain elements to watch for or pay particular attention to;
- An adult can view the content with the child and interact with the child in the moment;
- After a child views the content, an adult can engage the child in an activity that extends learning such as singing a song they learned while viewing the content or connecting the content to the world.

TECHNOLOGY IS MORE EFFECTIVE WHEN USED TOGETHER

Engage | Communicate | Learn | Create

HOW CAN WE PROTECT PRIVACY AND SECURITY FOR YOUNG CHILDREN?

The Children's Online Privacy Protection Act (COPPA) (15 U.S.C. § 6501–6505) governs online collection of personal information by online services such as apps and websites from children under aged 13. For example, before a developer can collect personally identifiable information from a child under 13 verifiable parental consent is required. Any information collected from a child, including photos of the child or a voice recording, must be protected by reasonable security measures. The Federal Trade Commission, which enforces COPPA, has said that school officials can act in the capacity of a parent to provide consent to sign students up for online educational programs at school.

If technology is being used in a school setting, the Family Educational Rights and Privacy Act (FERPA) might also protect the child's privacy online. More information on FERPA is available through the U.S. Department of Education's Privacy Technical Assistance Center: http://ptac.ed.gov/.

Regardless of whether either of these two statutes applies, families and educators should evaluate an app's privacy policies prior to using the app. Assistance on what to review for can be found in the PTAC Model Terms of Service

Advertising and in-app purchases

Beyond ensuring privacy and security, before downloading an app, families, educators, and others who work with young children also need to evaluate whether the app offers in-app purchasing or advertising. Many apps, particularly those that are free, offer advertising or in-app purchases, both of which are generally inappropriate for young children. Many methods of online advertising have the ability to track a user's behavior across multiple sites and services, putting a child's privacy and security at risk. Additionally, parents should also evaluate whether the app includes advertising, particularly age-inappropriate advertising. While adults can sometimes protect from in-app purchases by using appropriate passwords or disabling in-app purchases at the device level, a best practice is to choose software for very young children that avoids in-app purchases and advertising altogether.

Parents and early learning educators should stay up-to-date and informed

Parents and early learning educators who follow the Departments' principles can help ensure that technology is being used intentionally and appropriately to expand a young child's learning and enable experiences and opportunities that previously were not available. However, not all technology is appropriate for young children and not every technology-based experience is good for young children's development. To ensure that technology has a positive impact, adults who use technology with children should continually update their knowledge and equip themselves to make sophisticated decisions on how to best leverage these technology tools to enhance learning and interpersonal relationships for young children. Some sources for information on how to do this include: Common Sense Media, Fred Rogers Center, Joan Ganz Cooney Center, National Association for the Education of Young Children, and Zero to Three.

Call to Action

This brief provides guiding principles and suggestions for families and early learning practitioners on how to use technology with young children. While the brief draws upon the most recent research available, there is still much to be learned when it comes to the impact of early learners' use of technology. The Departments encourage researchers, developers, and administrators to continue to pursue important research questions in this area and to develop policies and products that ensure the best uses of technology in early learning that services the needs of families and early educators. To this end, we offer the following recommendations:

Researchers

The Departments encourage researchers to conduct rigorous studies on the following topics so that additional research-based guidance can be provided to families and early learning educators.

- Longitudinal studies are needed to better understand how young children use and learn with technology and interactive media and its short-and long-term effects. This includes research to understand developmental shifts in children's use of technology at different ages and that maps the trajectory of children's learning and technology use over time, as well as the interaction between technology use and health related behaviors, including diet and physical activity.
- Research is required on how much time children should spend with technology at different stages of development; this research should clearly distinguish between active and passive use and take into account content and context.
- Research is required on the impact of the use of new technologies such as mobile and handheld devices, particularly on the impact on children's cognitive and social development. Some areas of potential research include the impact of the speed of digital games and the effectiveness of new interactive features.
- Research is required on young children's use of emerging technologies such as virtual reality, augmented reality, and digital robots.
- Research should include how parents can best facilitate children's media use.
- Research is needed on the use of technology-based interventions and assessment tools with young dual language learners; differences in access to and use of technology by parents and children and how they associate with children's learning and development; the role of culture and language in the development and use of technology and technology-based interventions and assessments; and how the use of e-books for bedtime stories and children's affects sleep patterns and development.

- Research should be conducted on how early educators can use technology to better provide educational experiences for children. This includes using technology-based assessments to assess children's skills and outcomes and using the data from those assessments to inform classroom interactions and instructional practices.
- Research is needed on how early educators make decisions about what technologies and what content to use and how to train and provide ongoing support for early educators in implementing technologies, including evaluating the impact of technology-based professional development interventions on the interactions and practices of early childhood educators.
- Research is needed on the development and implementation of technology-based interventions or curricula that are designed to address children's school readiness skills (for example, early math, language and literacy, and social behavioral skills).
- Research needs to be conducted to assess the educational claims of media producers that use internal studies to guide families and early educators on their technology purchases. Though over 80,000 apps claim to be educational, there is little research around what works, making it difficult for parents and early educators to know what is quality, appropriate, and effective for each individual child.[56]
- The research process for studying technology should use a variety of methodologies, including rapid, design-based iterative testing. Research in this area can lag behind development of new technologies because of the amount of time it takes to design and implement studies.
- Research is necessary to aid in the development and study of the effectiveness of technology for children with disabilities, including the development of apps to help children access play or communicate. This research needs to include children with a wide range of disabilities, including those with developmental delays.
- Research should include studies on the effectiveness of assistive technology devices that would inform research and development that would lead to improved devices.

Developers

Ideally, media and app developers should work closely with learning scientists and child development experts to develop content that is research-based. They should also work with researchers and practitioners to study efficacy once the content has been released and engage in a continuous improvement cycle to improve efficacy over time. Developers should present findings from research their products and on websites, including the methodology and results used to draw conclusions. Developers who are not aware of the foundations of cognitive science, instructional design, or the learning sciences can miss out on opportunities for high-impact design and ways to systematically build in features from effectiveness data collected from users that can help them improve their product. They should also apply the principles of UDL to make their applications accessible. For more information, developers can read the Ed Tech Developer's Guide or learn about grant opportunities from the Institute for Education Sciences, including grants for educational technology, special education technology, and small business innovation research.

Administrators of early learning programs

Because children from birth to 8 years old can receive care from multiple adults and in more than one setting, there is a need to ensure that information on using technology effectively with early learners is given to anyone who cares for children in this age range. According to *Uses of Technology to Support Early Childhood Practice,* the most common barrier to successful implementation of technology in early childhood classrooms is staff technology literacy. Teachers in early learning settings are particularly in need of training and support, since early childhood programs are often underfunded and professional development on the use of technology is rarely a top priority. Teachers need adequate professional development and access to support services to successfully use technology in the classroom. Administrators can also make families aware of resources to increase home access, including Everyone On, ConnectHOME, and Lifeline.

One recommendation in the *Uses of Technology to Support Early Childhood Practice* report is to incorporate technologies that practitioners are familiar with to ensure that technology is used in a developmentally appropriate way for early learners.[57] While program directors of early learning programs with limited budgets may be reluctant to invest in technology, it is critical that they recognize technology as an important investment they need to make informed decisions. In addition, administrators of early learning programs should consider developing a modernization plan that includes an early learning and technology audit.

WHAT SHOULD BE INCLUDED IN A TECHNOLOGY AUDIT?

A technology audit should include "an assessment of broadband access and the availability of digital tools to support teachers in early learning programs, documentation and promotion of professional development opportunities, a tally of financial commitments made to technology-supported early learning programs, and recommendations for redirecting existing assets from less effective programs"[58]

Conclusion

When evaluating and recommending technology for use with early learners, consideration should be given to how the child is using the technology, including the quality of the content, the context for its use, and the involvement of adults and peers. With the plethora of new technologies and the active ways they can be used, families and early educators should take a more nuanced approach than simply thinking about screen time limits and evaluate the content, context, and their child's development to determine what is appropriate in each circumstance.

Early learning settings should strive to ensure that technology, when used, is applied in ways that promote children's learning and healthy development. In early learning environments, technology should be used to increase accessibility for children with disabilities and dual language learners, and to strengthen relationships with peers and adults.

Whether in early learning settings or at home, appropriate use of technology should support deep cognitive processing and intentional, purposeful learning that promotes the healthy development of children. Equipped with this knowledge, early educators and families are encouraged to use their judgment of what works best for their individual child, understanding the quality of content and context of use matter.

Finally, technology should be used strategically, thoughtfully, and safely by early educators at all times and incorporated along with other valuable classroom materials in early childhood learning environments.

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