CHAPTER 26

Developmental Technologies

Technology and Human Development

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The word *technology* comes from the Greek language, and it is composed by the words *techne*, meaning "art, skill, craft," and *logia*, meaning "study of." The Merriam-Webster Dictionary defines technology as "the practical application of knowledge especially in a particular area" and as "a capability given by the practical application of knowledge." The term can be applied to any specific area, such as medical technology or information technology; however, in this chapter we are applying it to the process of human development. This chapter focuses on how new technologies are having an impact on the way children and youth engage in cognitive, personal, social, emotional, physical, spiritual, and civic development.

We define new technologies as emerging digital tools that involve cutting-edge developments. New technologies today come in various forms and platforms such as computer-mediated software programs, video/audio learning instruments, robotic building kits, electronic toys, handheld and mobile devices, and sensors embedded in everyday objects. New technologies can engage a child playing by herself or can involve multiple children; they can be used as stand-alone devices, connected to the Internet, or integrated into classroom curriculum. New technologies make possible different kinds of learning opportunities, new ways for peer social interactions, and many possibilities for creativity, social, and cognitive development.

Technological devices have changed dramatically in the past 40 years, thanks to less expensive and more powerful batteries, LCDs, touch screens, and increased memory power. Children now have access to cell phones, digital cameras, digital book readers, digital media players, and smart toys. As computers and other technological devices are getting faster, smaller, and cheaper, their use is becoming more widespread, having an impact on most aspects of young people's lives (Resnick, 2002; Shore, 2008).

Young people use computers to communicate with friends, to listen to and exchange music, to meet new people, to share stories with relatives, to organize civic protests, to shop for clothing, to engage in e-mail therapy, and to find romantic partners, among many other uses (Buckingham & Willett, 2006; Ito et al., 2009; Subrahmanyam & Greenfield, 2008). New technologies are changing the developmental landscape for young people (Bers, 2010b). Children born after the early 1980s are considered digital natives, meaning they are a generation of children who will grow up never knowing what life was like before the Internet, cell phones, GPS systems, DVRs, iPads, etc. (Oblinger, 2003; Prensky, 2001; Tapscott, 1998). These digital natives are poised to grow up surrounded by current new digital technologies and emerging innovations we have yet to imagine.

In this chapter, we are looking at technologies as the practical applications and the capabilities and skills resulting from these applications as they can promote or hinder child and youth development. When technologies are used to support or enhance an individual working toward a

developmental milestone, we use the term *developmental technologies*; thus, the major focus of this chapter is the positive impact of new technologies on child and youth development. However, technologies can also be used in ways that hinder development, which will be addressed throughout this chapter. As with other form of cultural activity, the role of technology in human development cannot be studied without understanding the sociocultural context of its usage. Though digital technologies are ubiquitous in our society, it is important to keep in mind that only around 1 billion of the world's 6 billion people actually have access to these technologies (Palfrey & Gasser, 2008). Socioeconomic status, even when controlling for basic Internet access, is a key predictor of how the Internet is integrated into everyday life (Hargittai, 2010).

AN OVERVIEW

In this section, we discuss the history of fears and concerns that have existed in society regarding new technologies. We note the ubiquitous nature of new technologies and point to the role of new technologies in education.

Fears and Concerns

Through the centuries, the invention of all new technologies has been associated with a consistent fear regarding their impact on society, and children in particular. This fear happened with the invention of books, movies, film, radio, and now the Internet and mobile devices. However, one of the differences between the old concerns and the new ones is the interactive nature of digital technologies (Wartella & Jennings, 2000).

In the digital world, children not only consume but can also create content and interact with others (Bers, 2010a, 2010b). These increased interactivities can yield potential benefit but also harm if children are exposed early, and many times without supervision, to the World Wide Web. As children and youth spend many hours connected and looking at a screen for many different needs, some researchers believe that there might be fundamental brain changes occurring due to reading information online and rapid access to information. The dozens of links to click online may be limiting human abilities to read deeply and concentrate (Carr, 2010; Small & Vorgan, 2008; Wolf, 2007).

The American Academy of Pediatrics (1999) recommends no screen time (including television, computers, and handheld devices) before the age of 2; however, some products, such as Your Baby Can Read and Baby Einstein are designed against this recommendation and may prove problematic to child development due to the increased screen time which some researchers fear is impeding on a critical developmental period (American Academy of Pediatrics, 1999; Kaiser, 2005). In addition, the American Academy of Pediatrics (1999) also recommends limited amounts of screen time of "high quality educational" content for children over the age of 2. However, with no government regulations or educator "stamp of approval," parents are forced to rely on marketing and advertising to distinguish "good quality" (Kaiser, 2005). Parents and teachers fear that with digital media, through the computer or the mobile devices, it is difficult to monitor and protect children from accessing negative advertising, violent, or sexual content. Older adults are not the only ones who have concerns around cell phone use; 85% of teachers surveyed by the Sesame Workshop in 2008 believe cell phones have no place in schools. This response was consistent even among teachers in their early 20s, who had, themselves, grown up with cell phones (Shuler, 2009a). The free, wide-ranging, always-on accessibility provided by tools such as the Internet mean access to a world of information, which is a powerful tool for knowledge. However, this largely unregulated access also means access to misinformation, pornographic and violent content, and communication with potentially dangerous people. Unlike television, there is less control and moderation over online content (Belvins & Anton, 2008), and those who use the Internet must be able to critically evaluate the information found online (American Association of School Librarians, 1998).

However, despite these concerns, digital technology use is widespread. Children today, on average, spend more time with digital media than engaged in any other activity other than sleeping (Roberts & Foehr, 2008). In just a few decades (the World Wide Web debuted in 1991) billions of people worldwide have invented and adopted digital technologies—hundreds of years faster than the printing press. Furthermore, no generation has yet lived their whole lives in this digital culture (Palfrey & Gasser, 2008). The children born in the 1990s are the first generation of children with access to new technologies, such as smart phones and YouTube, from birth. They have their e-mail and social networking programs, such as MySpace, Facebook, and Twitter, all in their pockets. The class of 2012 is the first group to come to cognitive maturity with the new digital technologies of today (Buckleitner, 2009). Young children are coming of age surrounded by new technologies that will be prominent forces in their lives

(I. Berson & Berson, 2010). A large body of interdisciplinary research on technology and early childhood has been conducted in the past three decades. Efforts focused on the impact of technology on children's cognitive and academic development (Clements, 2002; Fletcher-Flinn and Gravatt, 1995) and socioemotional development (Crook, 1998; Medvin, Reed, Behr, and Spargo, 2003; Muller and Perlmutter, 1985; Shade, Nida, Lipinski, & Watson, 1986; Wang & Ching, 2003). Digital natives' social interactions are fundamentally changing due to the use of digital technologies. They do not know a time when it was common practice to send a handwritten note rather than an e-mail or call someone up for a date, rather than texting or Facebook-messaging them. To the digital natives, the "real" world and the "online" world are one and the same (Palfrey & Gasser, 2008).

Children spend almost as much time with digital technologies as they do learning in school, leading to an opportunity to leverage these technologies (Shuler, 2007). Thus, we should ask ourselves not only what kinds of technologies young people are using, how often, and in what context, but most importantly, what are young children doing with these technologies. Are the children using the technologies in a way that is consistent with developmentally appropriate practice? Are the technologies supporting the children to engage in developmental tasks appropriated for their age?

The Ubiquitous Nature of New Technologies

Whether children are formally introduced to new technologies through the adults in their lives or just encounter them in their surroundings, they are a large part of children's lives and, therefore, important to study. Currently, 75% of all households have broadband Internet access (Pew Research Center [Pew], 2010a) and around 84% of households have some access to the Internet (Kaiser, 2010). Individual technological device access, however, varies by age.

In a large-scale study (Rideout, Vandewater, & Wartella, 2003), parents reported children under the age of 6 spending, on average, 2 hours per day with screen media, which is the same amount as they reported their child played outside and almost three times as much times the child spent reading or being read to. In addition, 93% of children ages 6 to 7 live in a home with a cell phone (Sesame, 2007). Of children in kindergarten through 2nd grade, 19% have access to cell phones with Internet connectivity (Project Tomorrow, 2009), 32% have access to an mp3 player, 53% have access to a desktop computer (Project Tomorrow, 2009), and 31% have access to a laptop (Project Tomorrow, 2009). In turn, 27% of 5- to 6-year-olds use these computers for an average of 50 minutes per day, using Skype to chat with grandparents, watching movies and TV shows, and playing games, to name a few examples.

For children and youth 8 to 18 years old, device ownership has increased dramatically in the past 5 years. Of 8- to 18-year-olds, 76% own an mp3 player (up from 18% in 2004), 66% own a cell phone (up from 39% in 2004), and 29% own a laptop (up from 12% in 2004) (Kaiser, 2010). For 18- to 34-year-olds, 95% own a cell phone, 57% own a desktop, 70% own a laptop, 74% own an mp3 player, 63% own a game console, 5% own an e-reader, 5% own a tablet computer, and 1% did not own any of the devices (Zickuhr, 2011).

A gap in computer access has developed, however, between African American, Latino American, rural households, and Caucasian households. This phenomena, often called the *digital divide*, refers to the difference in access to new technologies across different socioeconomic, cultural, and geographic groups in America. While 77% of Caucasian adults accessed the Internet in 2010, only 65% of Latino and 66% of African American adults went online (Pew, 2011). This difference could be due to the rate of broadband Internet connections in homes. Only 45% of Latino households, 50% of rural households, and 52% of African American households had broadband access in their homes, compared to 65% of Caucasian households. In addition, in 2010, 85% of Caucasian adults owned a cell phone, compared to 79% of African American adults and 76% of Latino adults. Controlling for factors such as level of education and income, however, the usage differences disappeared, meaning, the divide appears to have more to do with socioeconomic status than with ethnicity (Pew, 2011).

U.S. Census reports back up this hypothesis. Census data has shown computer ownership for children ages 3 to 17 is correlated with household income. In 2003, 60% of homes with a $20,000 per year income had a computer versus 90% of homes with an income of $60,000 or more. Furthermore, children from higher income households were more than twice as likely as children from the lowest income households to use a computer to complete homework assignments (Roberts & Foehr, 2008). Increasingly, Internet connectivity for these groups, and people across the globe, comes in the form of mobile technologies (Shuler, 2009a). In the United States in 2010, despite differences in cell phone ownership among these groups, 41% of African Americans, 31% of Latinos, and 29% of

Caucasians accessed the Internet from their mobile phone (Pew, 2011).

The U.S Government understands the need to decrease the digital divide. The National Broadband Plan, which began under the Clinton administration and continues under President Obama, would make high-speed Internet available to 98% of Americans. This plan would give rural areas access to the Internet, enabling rural businesses to reach customers, giving families and students access to the resources the World Wide Web provides, and enabling law enforcement to access state-of-the-art communication tools (www.broadband.gov/plan). However, some researchers argue that simply providing access is not enough; it is also important to understand the social context of use (Palfrey & Gasser, 2008; Zillien & Hargittai, 2009).

One large study of children (Jackson et al., 2008) found African American boys were the least intensive users of computers and the Internet; however, both African American and Caucasian boys were the most intense users of videos games. In contrast, African American females were the most intense users of the Internet, and females, particularly African American females, were the most intense users of cell phones. This study also found African American children, both males and females, were more likely to search for religious/spiritual information online than any other group.

For adults, the most popular activities online are e-mail, using a search engine, and looking up health information (Pew, 2010b). For teens, online blogging has actually decreased in popularity (14% in 2010 versus 28% in 2006), while blogging for adults has remained steady at around 10% (Pew, 2010b). For those who access the Internet, 73% of teens and 47% of adults use social networking sites. Popularity of these sites varies by age and race. While young adults and older adults have almost equal use of Facebook (71% vs. 75%), younger adults are much more likely to have a MySpace page (66% vs. 36%) (Pew, 2010b). However, this is for the general population. Researchers have begun to look closer at the user makeup of both Facebook and MySpace. Although they have roughly equal unique visits in 2009, Facebook tended to attract users with higher socioeconomic status and more Caucasian users than MySpace (Boyd, 2009).

In 2009, 8% of Internet users aged 12 to 17 used Twitter, which is the same for virtual worlds for this age group. This use is much less common than text messaging, which 66% of teens this age participate in, or searching for news and political information online, an activity in which 62% of 12- to 17-year-olds participate (Pew, 2010b).

In 2010, according to a study of 1,200 households by the Entertainment Software Association [ESA], 67% of American households played video games; 64% of parents believed that games were a positive part of their children's lives, and 48% of parents played videogames with their kids at least once per week (ESA, 2010). The term *video games*, as it is used here, refers to software supported by any type of computer, console, mobile or virtual platform that involves interaction with a user interface to generate visual feedback on any display by manipulating an input device, such as a game controller, joystick, keyboard, or mouse.

Games are goal-directed and competitive activities conducted within a framework of agreed rules. This ample definition makes room for different genres of games: ludic games, in which players win by taking action and developing strategies; narrative games, in which players solve conflicts by choosing different paths of action; and simulations, in which players can observe emerging behavior patterns to understand how a particular system functions in different circumstances. Playing games might involve racing, solving puzzles, doing sports, engaging in action and adventure, playing with rhythm and music, developing strategies, participating in simulations, fighting, first-person shooting, or roleplaying. As of 2009, the best-selling video games were sport games (19.6%) and action games (19.5%), followed by family entertainment (15.3 %) and shooter games (12.2%) (ESA, 2010). The top games sold for families were the Super Mario Brothers®, several Wii games such as Wii Play® and Wii Sports®, The Sims, and World of Warcraft (ESA, 2010). Some of the most popular games for children are music games such as Guitar Hero® and Rock Band®.

A 2010 nationally representative survey of 2,002 3rd- through 12th-grade students done by the Kaiser Family Foundation on children's media use found a significant increase in video gaming over the past 10 years, from an average of 26 minutes daily in 1999 to 49 minutes in 2004 and 73 minutes in 2009. According to the Kaiser report (2010), this increase appears to be largely a function of the growing use of handheld devices for game playing. On any given day, 60% of young people play video games and spend an average of 1 hour and 13 minutes at it. Video game playing peaks among 11- to 14-year-olds, especially for console playing. The Kaiser report found that just as children begin to make the transition into adolescence, their media use explodes (Kaiser, 2010).

There remains a substantial difference between boys and girls in console video game playing, with boys spending an average of almost an hour a day playing and

girls just under 15 minutes. However, contrary to the public perception that media use displaces physical activity, young people who are the heaviest media users report spending similar amounts of time exercising or being as physically active as other young people their age who are not heavy media users. While levels of physical activity do vary by age and gender, they do not vary by time spent using media (Kaiser, 2010).

Only a few years ago gaming was mostly viewed in the best-case scenario as a waste of time, and most commonly as a risky activity that might lead to antisocial behavior, aggression and violence, as well as reinforced gender stereotypes (Grüsser, Thalemann, & Griffiths, 2007; National Institute on Media and the Family, 2008). More recently, a growing body of research is starting to focus on "serious games" that might have a positive impact in young people (Squire and The Games-to-Research Team, 2003). For example, there is an increasing interest and expertise in developing serious computer games for promoting health (Kato, Cole, Bradlyn, & Pollock, 2008; Lieberman, 2001), education (Gee, 2007) and civic engagement (Bers, 2010b)

The 2008 Pew Internet & American Life Project's report found that 44% of youth play games that teach them about a problem in society, while 52% play games that engage them in thinking about moral and ethical issues. The report also suggests that youth who have these kinds of civic gaming experiences are more likely to be civically engaged in the offline world, and are also more likely to go online to get information about current events, try to persuade others how to vote in an election, become committed to civic participation, and raise money for charity.

Although public debate often frames video games as either good or bad, research shows that the context in which the video games are played and the content of the video games matter more than the amount of play time. Some video games might promote prosocial behavior and cognitive problem solving, while others might hinder it. Video games offer the opportunity to bring civic education back to life by engaging young people in simulations of political processes and immersing them in experiences in which making civic-based decisions is highly rewarded (Bers, 2010b). For example, researchers such as Barab and Squire (2004) have studied the positive learning impact of playing the historical simulation game Civilization. Although video games are popular, virtual worlds are becoming the most rapidly growing third places for children in elementary school. In a 2008 report published by the Association of Virtual Worlds, approximately 110 virtual worlds are categorized for kids, 115 for tweens, and 140 for teens (Association of Virtual Worlds, 2008). As of the second quarter of 2008, the largest virtual world for adults (over age 20) had 13 million registered users, while the largest for children had 90 million users (KZERO Research, 2008). Virtual worlds such as Neopets (www.neopets.com) are designed for children 6 to 12 years old. They can create their own Neopet by choosing its species, gender, personality, set up his or her own shop, feed them, and look after them, as well as communicate with others, play games, and create their own Web pages. Children can also submit content for the weekly electronic newspaper called *The Neopian Times* and participate in a peer-based Neopets community. Children create artifacts and master new skills. As of August 10, 2008, 237,138,604 Neopets had been created.

The eMarketer report found that 24% of the 34.3 million U.S. child and teen Internet users visited virtual worlds once a month in 2007; this number was up to 34% in 2008 (Williamson, 2008). As an example of the increasing popularity of virtual worlds for children, the site Webkinz increased its visits by 1,141% in a year (Prescott, 2007), from less than 1 million to over 6 million (Tiwari, 2007). Club Penguin doubled in size, from 1.9 million to 4.7 million visitors (Shore, 2008). This popularity, however, is related to commercial endeavors. For example, Club Penguin was acquired by Disney, the popular Webkinz animals come with a code needed to enter the virtual world, and the Bratz fashion dolls are sold with a USB key necklace so the child can unlock the Be-Bratz.com virtual world (Beals & Bers, 2009).

Cell phone use is quickly becoming ubiquitous. More than half the world's population owns a cell phone. Children under 12 are the fastest-growing group of mobile technology users (Shuler, 2009a). Between 2005 and 2008, mobile device ownership among children ages 4 to 14 doubled (NPD Group, 2008). Cell phones are cheaper, easy to transport, and easier to repair than traditional computers, which has led to their rapid growth in countries outside the United States. Whereas Americans tend to own multiple devices, many other countries use cell phones exclusively for their Internet access (World Economic Forum, 2010).

With cell phones come apps (mobile applications). Almost half of the 100 best-selling apps for smartphones (47%) in 2009 were designed for preschool and elementary aged children; by April of 2009, there were already 21,000 app games for young children compared to just

a couple hundred for Nintendo DS or Playstation PSP (Shuler, 2009b). Thirty-five percent of apps are aimed at preschool aged children and, of the top 25 apps, over half are designed for the preschool age group (Shuler, 2009a). The most popular areas are early literacy, foreign language, and math, and the apps cost between 99 cents and $2.99. The low cost of these apps and the widespread availability of mobile devices make apps a key area of development for educational material in the coming years (Shuler, 2009a; Shuler, 2009b).

Popular apps for adults are entertainment based (games, food, sports, travel) and provide information (news, directions, weather); however, only 35% of the U.S. adult population has a cell phone with apps (44% of 18–29 year olds). Cell phone users are more likely to take a picture (76%), send text messages (72%), access the Internet (38%), or send e-mail (34%) (Pew, 2010c).

New Technologies in Education

During the last 50 years, the role that computers and other computer-based technologies play in education has grown dramatically. Koschmann (1996), borrowing from Kuhn's notion of scientific paradigms, identified four major paradigms in the evolution of the realm of educational technology. Each of these paradigms contains different pedagogical and methodological approaches to conceive and integrate computer-based technology in the teaching and learning process. However, early promises within each paradigm regarding educational technology's potential to reshape and reform the educational system still remain unfulfilled.

The earliest paradigm in educational technology was called computer-assisted instruction (CAI). Koschmann (1996) marked the arrival of this paradigm with IBM's release of the program Coursewriter I (Suppes & Macken, 1978) in 1960. This program allowed educators to create digital instructional aids—even if the educators had little knowledge of programming. These applications filled the specific needs of the classroom as identified either by the teachers or by the designers of the CAI applications. In essence, CAI programs allowed educators to extend themselves by using computer software as an aid to teach children through programmed instruction (Koschmann, 1996).

The basis of the CAI paradigm rested on the concept that the role of a teacher was "to acquire formal knowledge, find efficient ways of sharing it, and determine whether pupils have learned what was taught." (Cuban, 1993) Most of the educational technologies designed with the CAI paradigm served as a new medium for the presentation and the delivery of information to students in the form of drill and practice. Within the CAI paradigm, developers of new educational technology wore the lenses of behaviorism and believed the effectiveness of a technology was situated in its instructional efficacy (Koschman, 1996).

In the early 1970s, the paradigm of intelligent tutoring systems (ITS) emerged in the CAI-dominated field of educational technology. The shift resulted from researchers in the field of artificial intelligence migrating into the developing world of educational technology (Wegner, 1987); a shift which brought a more cognitive approach to the behaviorist-dominated field. Information processing theory, the foundation of artificial intelligence, held that problem solving was a method of determining three things: (1) the initial state of the learner, (2) the goal state for the learner, and (3) the steps or operations required to move the learner from the initial state to the goal state (Koschmann, 1996). Just as a skilled educator could modify a lesson plan to fit the needs of an individual student during a one-on-one session, ITS researchers aimed at creating educational software that adapted itself to the user. Unlike static CAI applications, ITS educational software incorporated an interactive component, with each student receiving a different type of instruction based on skill level and ability. As the foundation of the ITS paradigm, designers believed that a high level of instructional competence was tantamount to the successful use of an educational technology.

The third paradigm, which Koschman (1996) identifies as the Logo-as-Latin paradigm, is firmly based in the *constructionist* theory of learning developed by pioneer Seymour Papert. To remind readers of the Piagetian roots of his philosophy, Papert coined the term "constructionism," replacing the "tiv" of "construct*iv*ism" with the "tion" to stress the importance of constructions in the world, most specifically in the computer screen, to support the construction of knowledge in our heads. Papert was a mathematician and an expert in artificial intelligence who worked with Piaget and early in the 1960s believed in the potential of the computer for helping children learn new things in new ways (Papert, 1980). At the time, given that computers were big expensive machines that required advanced mathematical skills, it wasn't so clear that Papert's vision would one day be realized. However, in 1967, based at the MIT Artificial Intelligence Laboratory, he led the team that developed the first programming language for children, Logo, to immerse them

in the joy of math land. Logo, a child-friendly version of the programming language LISP, allowed children to manipulate a turtle on the computer screen to follow their instructions and draw geometrical shapes. In the process, they explored in a fun way concepts of geometry, variables, and recursion, while thinking about their own ways of learning.

Constructionists assert that computers are powerful educational technologies when used as tools for supporting the design, the construction, and the programming of personally and epistemologically meaningful projects (Bers, 2008; Resnick, Bruckman, & Martin, 1996). Constructionism is situated in the intellectual trajectory started in the 1960s by the MIT Logo Group, under the direction of Seymour Papert, based first at the Artificial Intelligence Laboratory at MIT and later at the MIT Media Laboratory. Although the Logo Group members held many different research agendas and goals, the collective vision of the group rested primarily on at least four major pillars.

First, the group believed in the constructionist approach to education. Based on Piaget's (1928) constructivism, Papert's theory of constructionism emphasizes the need for technological environments to help children learn by doing, by actively inquiring and by playing. The interaction with the technological materials around them provides children with the opportunity to design and make meaningful projects to share with a community.

Second, the group understood the importance of objects for supporting the development of concrete ways of thinking and learning about abstract phenomena. In this context, computers acquired a salient role as powerful tools to design, create, and manipulate objects in both the real and the virtual world. The group envisioned this technology existing not only in the form of current desktop computers, but also as tiny computers embedded in LEGO® bricks that could be programmed to move and respond to stimulus gathered by touch or light sensors (Bers, Ponte, Juelich, Viera, & Schenker, 2002; Martin, Mikhak, Resnick, Silverman, & Berg, 2000).

Third, the group valued the notion that powerful ideas empower the individual. Powerful ideas afforded individuals new ways of thinking, new ways of putting knowledge to use, and new ways of making personal and epistemological connections with other domains of knowledge (Papert, 2000). Constructionists envisioned the computer as a powerful carrier of new ideas and particularly as an agent of educational change. Computers allowed users to take on different roles in the educational setting, moving past the traditional position of teacher as the producer of information and student as the consumer of information.

Fourth, the group embraced the premium of self-reflection. The best learning experiences occur when individuals are encouraged to explore their own thinking process and their intellectual and emotional relationship to knowledge, as well as the personal history that affects the learning experience. Constructionism viewed the programming of a computer as a powerful way to gain new insights into how the mind works and learns. Following the constructionist tradition, several programming languages for children have been developed over the years (Bers & Horn, 2010).

For example, one of the most successful ones is Scratch, a free graphical programming language also developed by researchers at MIT (Resnick et al., 2009). Since the launch of Scratch in 2007, more than 2 million people have downloaded the software. There is a vibrant online community (http://scratch.mit.edu), where students around the world share more than 1,500 new Scratch projects every day. With Scratch, students can program their own interactive stories, games, animations, and simulations. By snapping together graphical programming blocks in Scratch, children can create a story with characters that dance, sing, and interact with one another, or they can create an interactive birthday card for a friend. In the process, children learn important literacy and mathematical concepts, and they develop valuable problem-solving skills (Resnick, 2007b).

Papert's constructionism became widespread in the world of education in 1980 with the publication of his pioneering book *Mindstorms: Children, Computers and Powerful Ideas*. In *Mindstorms*, Papert (1980) advocated for providing children with an opportunity to become computer programmers as a way to learn about mathematics and, more importantly, to learn about learning. Papert argued that Logo, or the language of the turtle, was an easy and natural way to engage students in programming. Logo allowed students to actively create artifacts in a process of discovery-based learning—a process directly aligned with the cognitive constructivist model of learning (Papert, 1980). Although Papert was one of the key researchers involved in the first implementations of Logo, the benefits of programming, in Papert's view, would extend far beyond the world of Logo. Through the process of designing and debugging computer programs, students would develop a metacognitive approach towards problem-solving and learning.

The fourth and most recently developed paradigm, computer supported collaborative learning (CSCL), shifts the view of the process of cognition as residing within the head of one individual to the view that cognition

is situated within a particular community of learning or practice (Lave & Wenger, 1991). Therefore, educational technologies designed within this paradigm take seriously the need to provide tools for community building and community scaffolding of learning. The contributions from the fields of sociology, anthropology, and linguistics, along with the work done by neo-Piagetians and social constructivists, created the school of thought that constructed education as essentially a social process (Ernest, 1995). Additionally, the Vygotskian theory of *cultural-historical psychology* (van der Veer & Valsiner, 1991) and the theories of situated cognition resulted in the use of collaborative learning as the underlying theory of instruction for the CSCL paradigm (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991; Rogoff, 1994). This pedagogical switch occurred concurrently with the fast-growing uses of the Internet in education and the development of different virtual learning communities.

The four paradigms identified above summarize the state of the art of educational technology and the different approaches taken with regard to theories of learning, pedagogical stances, research questions, and notions of what constitutes evidence of success. Despite all four paradigms proposing, each in its own distinct way, the advent of computers as major agents of educational reform, new technologies entered the classrooms without necessarily producing the expected outcomes. Too quickly the technological tools became "oversold and underused" (Cuban, 2001). While these tools have the potential to enhance learning, Papert (1987) reminds us of the dangers of falling into the technocentric fallacy, the assumption that technology *by itself* can produce changes. New tools encompass only one of the many elements of the social and cultural context in which learning occurs. It is naïve to expect the entire system to change with the introduction of a new, singular element.

The technocentric fallacy tainted the past of educational technology and continues to saturate the present. For example, research found that, despite the large investment nationwide in new equipment, most of the computers "end up being souped-up typewriters" used in unimaginative ways (Cuban, 2001). Teachers are poorly prepared to effectively integrate technology into curriculum or to rethink curriculum in light of emerging technologies. These problems are due in part to a technocentric approach that puts too much emphasis on the actual technology and too little on the conditions where the technology will be used. Making it possible for educators and children to use computers expressively and in creative ways involves not just the deployment or development of new tools, but also a framework to provide social support for learning and new supporting structures at both the micro and macro levels of the educational system (Bers, 2008).

POSITIVE TECHNOLOGICAL DEVELOPMENT

We now focus on the positive uses of technologies for child and youth development. Following the positive technological development (PTD) framework (Bers, 2010a, 2010b, 2012), this section organizes the different kinds of technology-mediated behaviors that young people engage in throughout their lives. PTD is a framework that guides the design of technologically rich educational programs for children and teenagers; however, in this chapter it will be used to elucidate the role that technology can play in supporting positive youth development. The following sections focus on six behaviors that are supported by the use of new technologies and provide examples of how those play out differently throughout the developmental span. As technologies constantly change, there is a need of a framework to conceptualize what is unique about the potential of developmental technologies to engage children and youth in positive behaviors. These technology-mediated behaviors are:

- *Content creation*. Through programming languages or computer applications that engage users in working with text, video, audio, graphics, animations. Through the process of creating digital content, children also develop technological fluency by learning how to solve problems in the technological world.
- *Creativity*. The ability to transcend traditional ideas, rules, patterns, relationships, or interpretations and to create and imagine original new ideas, forms and methods using new technologies. Most constructionist tools that support content creation also support creativity.
- *Choices of conduct*. The opportunity to make choices about our behaviors and actions in the digital world and experience its consequences helps us shape a moral compass that guides the use of technology in responsible ways.
- *Communication*. The process of interchanging thoughts, opinions, or information by using technologies. New developments on social media promote new ways of communication.
- *Collaboration*. The opportunity to work with others and to willingly cooperate towards a shared task. Most technologies that support collaboration also provide ways for people to connect and communicate.

- *Community building*. An active stance towards using technology to enhance the community and the quality of relationships amongst the people of that community.

Content Creation

The notion that children can create digital content was first advanced by Papert's constructionism in the late 1970s (Papert, 1980). Constructionism claims that children learn better when making their own projects, constructing their own ideas, and designing their own solutions to problems. Therefore, researchers have developed a variety of computational tools to support and augment the playful design of "objects to think with" (Kafai & Resnick, 1996).

Early on, constructionism focused exclusively on using programming languages as one of the most expressive ways to create digital content. Following the Logo tradition, authoring systems and programming environments, both software and hardware, invite children to become designers and programmers of personally and epistemologically meaningful projects (Resnick et al., 1996). While Logo grew from Papert's love of mathematics, other constructionist programming systems engage children in learning about complex systems (Resnick, 1994); encourage peer learning and collaboration in virtual communities (Bruckman, 1998); promote storytelling skills and the exploration of cultural identity and moral values (Bers, 1998, 2001); and engage children in engineering by making their own robots (Bers, 2008; Bers et al., 2002; Martin et al., 2000; Rogers & Portsmore, 2004).

Most recently, the Scratch programming environment was developed by Mitchel Resnick and his Lifelong Kindergarten group at the MIT Media Lab. Scratch makes it easy to create interactive stories, games, and simulations by snapping together digital programming elements or blocks, as one would snap together LEGO® bricks or puzzle pieces. These projects can then be shared with an active online community consisting of more than 400,000 registered members. In the process of creating and sharing projects, young people learn core computational concepts, while also learning important strategies for designing, problem solving, and collaborating (Resnick et al., 2009).

Digital Literacies

While the constructionist tradition puts programming at the center of the children's content creation, a different group of researchers and practitioners, also concerned with providing opportunities for children to create content, focuses on new digital literacies (Buckingham, 2003; Buckingham & Willett, 2006; Coiro, Knobel, Lankshear, & Leu, 2008). This approach is an extension of the media literacy work started in the United States in the early 20th century with the study of film as an active process of consumption, rather than a passive one (National Association for Media Literacy Education [NAMLE], 2009).

Through the process of content creation, children develop *competence* regarding 21st-century skills such as digital literacy (Ba, Tally, & Tsikalas, 2002; Karlstrom, Cerratto-Pargman, & Knutsson, 2008; McMillan, 1996). The term *21st-century literacy* means connecting digital dots across mediums, including areas yet to be developed (Jones-Kavalier & Flannigan, 2008) and gaining skills in areas beyond the traditional subjects of reading, writing, and arithmetic. The 21st-century skills include literacies in media, information, and communication technologies; in global awareness; and in finance, business, entrepreneurship and civic engagement (Wang et al., 2010).

Scholars of new digital literacies suggest that with the advances of social media applications, knowledge of computer programming is no longer necessary. Youth can engage in other forms of content creation practices, such as instant messaging, blogging, making a Web site, creating and sharing music videos, podcasting and videocasting, working with images and photo sharing, participating in online discussions, e-mailing, using online chat, and creating and sharing digital mashups (see Black, 2008; Coiro, 2003; Gee, 2007; Jenkins, 2006; Kist, 2007; Lankshear & Knobel, 2006).

The definition of *digital literacy* also varies. Digital literacy has been described as a broad range of topics of understanding, using several different labels: *computer literacy*, *information literacy*, even *comperacy*, (McMillan, 1996) a term based on Papert's *letteracy* (Karlstrom et al., 2008). Digital literacy has also been defined as the habits children develop to use digital technology for entertainment, socialization, fun, and education (Ba, Tally, & Tsikalas, 2002) or as a survival skill that includes more than just the ability to use digital technologies correctly. Eshet-Alkalai's framework also includes cognitive and emotional components of digital literacy (Aviram & Eshet-Alkalai, 2006; Eshet-Alkalai, 2004; Eshet, 2005), in particular those used for communication and collaboration.

Use of digital tools for content creation varies by age. The most powerful way in which children can use new technologies is to create personally meaningful projects. In the same way that young children use paintbrushes and clay to make art projects, new technologies provide a new

medium to add interactivity to their creations. Children and youth of all ages use digital cameras and voice recorders to create their own movies, stories, and slide shows (Ching, Wang, & Kedem, 2006). Young children can take advantage of new touch-screen interfaces, which are more user-friendly for little fingers (and for universal access for those with disabilities) than a keyboard and mouse (Holzinger, 2003). And children can use one of the many drawing and paint apps now available for touch-screen tablet computers and phones.

Although young children are not expected to be developmentally ready to engage with sophisticated programming tools, research has shown that, when presented with developmentally appropriate interfaces, children as young as 4 years old can use different technologies to make their own projects come alive (Bers, 2008; Bers & Horn, 2010, Bers et al., 2006; Johnson, 2003). Children are not merely consuming information technology; they take an active role in creating, manipulating, and disseminating information (Berson, 2003).

Older children and youth, as they gain autonomy with digital devices and develop the use of language, start accessing digital media that requires the use of language to create content. In addition, these children and youth may use the resource of the Internet to teach themselves how to create new digital content to share online; they are personally motivated to learn in order to express themselves online in forms of Web sites, blogs, or just changing the color scheme on their profiles (Livingston & Bovill, 2001). Two-thirds of teens who are online have engaged in some form of content creation (Lenhart, Madden, Macgill, & Smith, 2007). YouTube is flooded with videos of children and teens showing off their talents—whether it be music, acting, comedy, remixing, or how-to videos. There are over 6 billion videos on YouTube. Teens aged 15 to 19 make up 17% of the viewers, and 17% of these teens generate their own content (Chau, 2010). Youth also create blogs around thousands of topics and contribute to communities centered on their passions. Reports have claimed up to 52% of all blogs are maintained by teens aged 13 to 19, while others report 39% to 40% of blogs are maintained by children and youth under the age of 20 (Huffaker & Calvert, 2006).

One example of teen-generated content is fan fiction, where youth expand on existing stories by creating their own stories using popular characters (Jenkins, 2006), such as those from Jane Austen novels, *Harry Potter*, and *Star Trek* (Black, 2008). However, this form of content creation is producing its own 21st-century problems, with arguments over the legality of using intellectual property for purposes of writing fan fiction (Jenkins, 2006) or creating "remixes" of existing content (using words, photos, videos, etc.) (Diakopoulous, Luther, Medynskiy, & Essa, 2007; Palfrey & Gasser, 2008). Content creation is also happening in mobile phone devices, as well, with tools like Google App Inventor (http://appinventor.googlelabs.com) that enable children, youth, and adults to create their own apps.

Content creation has a dark side, however. While, historically, there has been concern over youth exposure to online content generated by others (e.g. pornographic images), the popularity of social networks, blogs, and sites like YouTube have now made it possible for youth to create their own negative and problematic content (Boyd, Ryan, & Leavitt, 2011). This content ranges from the distribution of gang fight videos on YouTube to the creation of social networks around self-injurious behaviors such as anorexia and cutting (Boyd et al., 2011).

While gang fights and self-injurious behaviors have been unfortunate components of youth subculture for years, there is concern around making this content easily accessible on the Internet (Wilson, Peebles, Hardy, & Litt, 2006). On one hand, the Internet makes it easier to find this problematic content. On the other hand, the Internet can become a resource for helpful information and a way to reach out to teens with these issues. While most regulation at this point focuses on censoring this type of content online, it is important to understand and treat the underlying causes of this behavior (Boyd, Ryan, & Leavitt, 2011).

Creativity

New technologies that offer opportunities to create content, make projects, and develop new skills also promote creativity. The creativity supported by these technologies, and that the PTD framework refers to, has a "little c"—it is everyday creativity and refers to everyone's potential to create and imagine in original ways, as opposed to Creativity with a "big C" of significant geniuses such as Einstein or Mozart (Sawyer, 2006).

Despite early worries that computers might stifle creativity (Cordes & Miller, 2000; Oppenheimer, 2003), research has found that when used well, open-ended constructionist type of software can actually help creativity to bloom (Clements & Sarama, 2003; Resnick, 2007). Mitchel Resnick presents a vision of how children might use computers in a creative way, "more like paintbrushes and less like televisions, opening new opportunities for

children to playfully explore, experiment, design, and invent" (Resnick, 2006).

Computers can be programmed so they can be anything to anyone, taking on a "thousand forms" for a "thousand functions" and appeal to a "thousand tastes" (Papert, 1980). This is the power of digital technology as an expressive tool. New technologies that integrate multimedia tools allow children to generate new ideas and express them in innovative ways. Using basic computer programs such as Microsoft® Paint or PowerPoint afford children opportunities to draw and manipulate objects and pictures. For example, when a 4-year-old uses KidPix to create a story, animates the characters with motion and music, and then presents a slideshow to her parents, or when a 5-year-old uses the CHERP (Bers and Horn, 2010) robotic programming language to make animals that can dance and move around in search of food, technology is opening a door to creativity (Bers, 2008; Johnson, 2003). By combining recyclables and traditional art materials with technological components, young children can take a robotic base and turn it into anything they want; from a monster truck to a kitty cat to a flower for an interactive garden (Bers, 2008; Bers et al., 2002; Rusk, Resnick, Berg, & Pezalla-Granlund, 2008). Robots are not just already-made creatures such as Wall-E and R2D2; robotics can be a creative play space for storytelling and self-expression.

Information and communication technologies can also incite creativity (I. I. Berson & Berson, 2010). Remixing audio, video, photographs, and text; writing fan fiction: recording movies, skits, and movies; writing blogs; creating Web sites and podcasts; and developing apps are all different ways in which new technologies are used to express creativity (Diakopoulous et al., 2007; Jenkins, 2006; Palfrey & Gasser, 2008).

Collaboration

Over the last 20 years there has been a great amount of research looking at how computers support collaborative work and collaborative learning (Grudin, 1994). The low cost and nearly instantaneous sharing of ideas, knowledge, and skills facilitated by the Internet has made collaborative processes dramatically easier. The nonhierarchical structure of the technology also allows for new forms of self-organization and leadership to emerge through these collaborations. Collaboration can happen across the ocean or with the neighbor next door; with people we already know, or with those who share a niche interest and meet online for the sole purpose of working together. In technical terms, collaboration can be co-located or geographically distributed, and individuals can collaborate synchronously (at the same time) or asynchronously (not at the same time).

A broad range of tools enable adults and youth to work together in all of these different ways: social networking, instant messaging, team spaces, Web sharing, blogs, wikis, and audio and video conferencing.

Research has shown that computers might promote new forms of collaboration among young children, such as helping and instructing behaviors, discussion, and cooperation (New & Cochran, 2007). Children engage more frequently at turn taking, cooperative play, and language use at a computer than when using puzzles and blocks (Genishi, McCollum, Strand, & Hamilton, 1985). Children also prefer to work in teams rather than individually when using computers. Furthermore, computers allow for collaboration via e-mail, electronic field trips, and video conferencing with other classrooms, social interactions that were previously not possible due to physical location (National Association for the Education of Young Children [NAEYC], 1996).

For young children who are in a developmental process of learning how to work with others, the design features of the technology might promote social and prosocial development. Classic developmental theorists such as Piaget (1928) and Vygotsky (1978) both discussed the influence of children on one another in order to further develop cognitively. Early childhood is a time of egocentrism. Collaboration with other children while using technology might help to foster interactions between peers who may otherwise be focused on their own thoughts and might also engage in partnerships that expand the child's zone of proximal development (Vygotsky, 1978). For example, a child who is better skilled at using the mouse or browsing the Web might work together with a child who had less exposure to it; a child who has used a digital camera at home might show another child which button to press; and children may show each other their favorite smartphone apps and instruct each other on initial play instructions. Research shows that there is more spontaneous peer teaching and helping at a computer screen than during other classroom activities (Clements & Nastasi, 1992).

New technologies also have the benefit of being smaller, from netbooks to iPhones. Computers no longer fill up entire rooms! This is beneficial for a child to collaborate with others. A piece of technological equipment can be easily picked up and brought across the room to a friend, teacher, or parent. This also gives the child the opportunity to move her body; there is no need to just sit at a computer. Children can make their own songs and

videos to dance to, or act out the actions of their robots. Children can carry the laptop to show off their work to anyone around them or can climb on top of Dad's lap to explore an iPad app together. The mobility of new technologies lends itself to interactions and a new phenomenon commonly referred to as the pass-back effect (Chiong & Shuler, 2010), which refers to the parent and child sharing in use of a technological device by passing it back and forth to each other.

For older children, youth, and adults, online collaboration has contributed to development and culture in a variety of ways. Wikipedia is probably the most notable example of both creativity and community contribution (Palfrey & Gasser, 2008), which contains more than 6 million articles. On Wikipedia, everyday people, who are not necessarily "experts," contribute content in order to define terms, people, places, and any concept imaginable.

Virtual worlds and massively multiplayer online games (MMOGs) are also mediums in which people of all ages collaborate through play and engage in online play, creating content for these worlds while collaborating in missions, quests, and games (Palfrey & Gasser, 2008; Steinkuehler, 2004). Examples include Second Life, World of Warcraft, and EverQuest. Major companies, such as IBM, even use Second Life as a way for global employees to interact and conduct business (Morrison, 2009).

The Internet is also being used for formal as well as informal educational collaborations. Over the past 6 years, online higher education has grown faster than standard higher education enrollments, with 4.6 million students taking at least one online course in the fall of 2008 (Allen & Seaman, 2009). With a growth rate of enrollment steadily increasing each year (17% in 2008) (Allen & Seaman, 2009) collaboration in online course environments may prove to be an important skill in the coming years. Furthermore, with an economic recession, more and more high schools are turning to online courses in order to remediate students or provide advanced placement courses that only a few students wish to take (Harrison, 2011).

Communication

Humans are meaning-making individuals. Communication is the process by which meaning is assigned and conveyed in an attempt to create shared understanding. New technologies support different forms of communication (e.g. text, voice, sound, pictures, and videos) through synchronous and asynchronous methods of connecting with one another. Although communication in the online world and social media applications involve some risks, they also create enormous possibilities for sharing ideas, thoughts, and feelings and for forming new social relationships and maintaining old ones.

Technologies that effectively facilitate social interaction also promote language and literacy development. Activities around technologies that support interactions among peers by encouraging peer learning, peer teaching, and cooperation inevitably become venues for language-rich exchanges. At the computer, for example, research has shown that children speak twice as many words per minute than at other nontechnology-related play activities, such as Play-Doh® and building blocks (New & Cochran, 2007), and speak to their peers nine times more than when working on traditional puzzles (Muller & Perlmutter, 1985).

With products such as Skype, children are able to communicate face-to-face with their grandparents and loved ones. This can potentially eliminate the problems that arise when children, having not yet grasped object permanence (Piaget, 1954), try to engage in non-face-to-face communication. With wikis, Web sites, Google groups, and dozens of photo-sharing programs, children's work and pictures from the day can be posted online on password-protected pages for parents to view, thus bringing the classroom to the parents and providing the parent and child many specific discussion points beyond "what did you do in school today?"

While even stand-alone drill and practice computer software can help children read and strengthen their vocabulary recall, the impact of technology is greatest with regard to language development when it is also used to facilitate peer interaction rather than as a replacement for teachers or tutors (New & Cochran, 2007). Research shows that when children are using computers, they are more likely to ask other children for advice and help, even if an adult is present, thus increasing socialization (Wartella & Jennings, 2000). Even in situations where each child has an individual computer or their own piece of digital equipment to work with, children still choose to form groups (Druin, 1998). Children learn from each other and build communication skills by sharing, discussing, and asking questions about the new technologies they are using. They begin to move past parallel play to engage with the technology and each other. In addition, as children begin to explore virtual worlds, they utilize conversational scripts to continue learning about conversational patterns and communicating with others—the parent sitting next to them and the child across the globe.

Wireless communication allows a new generation of teenagers to meet online anytime and anywhere. However, today's teens struggle with issues of identity as much as past generations. Adolescence is a time to form a sense of individuality; to become aware of personal strengths and weaknesses. According to Erickson, adolescents experience *identity vs. role confusion* (Erikson, 1963, 1982). As they transition from childhood to adulthood, they need to explore the question "Who am I?" while pondering the multiple roles they could play in the adult world. Adolescents know that the decisions they make now might have an impact in their future. They want to take their place in society, either by finding more or less conventional roles or by challenging established ways. At the same time, they need to find a sense of purpose, a stable and generalized intention to accomplish something that is at once personally meaningful and of consequence to the world (Damon, Menon, & Bronk, 2003).

Adolescence is characterized by the tension between differentiation and identification: the need to find boundaries between self and others and the need for integration into a major whole consisting of family, culture, and society. Erikson talks about adolescence as a psychological moratorium, a "time out" when one can suspend decisions concerning long-term commitments and gain new experiences, encounter adventures, and experiment with multiple roles.

Sherry Turkle, a psychoanalytically trained psychologist and sociologist, a professor at MIT, and a pioneer in studying people's personal relationships with technology, applied Erikson's concept of moratorium to the study of how adolescents use online environments as a "social laboratory for experimenting with the constructions and re-constructions of self that characterize postmodern life" (Turkle, 1995). The pioneering work of Turkle has shown that technology serves to explore concepts of self as adolescents "cycle through" their own identities through playful experimentation.

Virtual worlds, among other online environments, may serve as spaces for moratorium. For example, the Habbo world (www.habbo.com) is popular among adolescents. Habbo uses the metaphor of a hotel in which youth can "meet new and existing friends, play games and simply have fun. It is a richly colorful, multi-dimensional virtual community and game environment to which [sic] users join by creating a fully customized online character called a Habbo" (Beals, 2010). Users can design their avatars and their rooms and use furniture that can be purchased from a catalogue. There is a code of conduct, called the "Habbo Way," that includes rules to which users should adhere, including, for example, not giving out passwords, not using hate speech, not telling people information about their location in real life, and not acting out violent acts.

According to the 2010 Pew and American Life Project report (2010b), 93% of teens ages 12 to 17 go online. Once there, they do different things. Nearly three quarters (73%) of online teens visit social network sites. The older online teens, ages 14 to 17 (82%), use online social networks more than younger teens ages 12 and 13; 8% of online teens visit virtual worlds like Gaia, Second Life or Habbo Hotel; 62% of online teens get news about current events and politics online; 48% bought books, clothing, or music online; 31% of online teens get health, dieting, or physical fitness information from the Internet; and 17% gather information online about topics that are hard to discuss with others, such as drug use and sexual health (Pew Research, 2010b).

Online communication is also an avenue for exploring social aspects of youth culture in a new digital form. One example, which exists in the offline world as well, is navigating relationships. This can be both a positive and negative experience. Connecting with friends, classmates, and family members one does not see often has been made easier with the invention of e-mail and social networks. Teens can use the Internet as a place of growth (Turkle, 1995), a way to practice skills like flirting without risking face-to-face embarrassment. Youth with particular interests can find solace in groups online communicating over shared mutual interests. Gay and lesbian youth learn they are not alone (Maczewksi, 2002). Teens also learn how to create and monitor their own social presence and self-identity; however, this can create a problems when a teen tries to balance his/her "coolness" for friends with acceptability for parents, college admissions counselors, and future employers (Boyd, 2007).

Sherry Turkle writes extensively about relationships in the digital age, which, she concludes, are leading to anxiety. Teens, due to the anonymity online and the lack of face-to-face interactions with others, create an environment in which they have a much easier time writing negative criticism of each other online. In addition, teens report being afraid of who is on the other end of a chat or a text message, and teens are more and more likely to feel like they cannot turn off their digital communications, afraid they will miss an important text, call, or Facebook message. Teens are also growing up in a world, because of digital technology, where they no longer believe in privacy (Turkle, 2011).

Cyberbullying is a negative aspect of youth communication online that has received attention lately with suicide

deaths (e.g., Megan Meier, Phoebe Prince) blamed on bullying and harassment online. This has led to legal action around cyberbullying laws and criminal prosecution of the bullies. Forty-three percent of teens have been bullied online, and this is most prevalent among 15- to 16-year-old girls (National Crime Prevention Council [NCPC], 2007). Cyberbullying is particularly harmful because it lacks the face-to-face communication needed for empathy and, in a way, rationalizes behavior because it seems less "real" (Palfrey & Gasser, 2008). Cyberbullying takes place not just online but also through text messages and can be further exacerbated by photos taken with digital cameras on cell phones and the ability to manipulate photos with photo editing software (Li, 2006). In addition, due to free speech laws, it is sometimes difficult to patrol negative speech online (Li, 2006).

Community Building

New technologies can facilitate behaviors such as community building that lead to contribution to society in the form of community service, activism, and advocacy (Bers, 2012). For example, current research shows the many opportunities for civic engagement beyond geographic boundaries offered by new technologies. Researchers contend that the Internet can be a venue for helping young people develop a sense of volunteerism and activism, for engaging in new forms of civic activities such as online petitioning and civic dialogues, and for promoting traditional types of civic activities such as voting, as well as to experience the challenges of democratic participation (Bers, 2008, 2010; Blumler & Coleman, 2001; Cassell, 2002; Cassell, Huffaker, Tversky, & Ferriman, 2006; Earl & Schussman, 2008; Montgomery, 2008; Montgomery, Gottlieb-Robles, & Larson, 2004; Rheingold, 2008).

The 2008 Pew Internet & American Life Project's report found that 44% of youth play games that teach them about a problem in society, while 52% play games that cause them to think about moral and ethical issues (Lenhart et al., 2008). The report also suggests that youth who have these kinds of civic gaming experiences are more likely to be civically engaged in the offline world, and are also more likely to go online to get information about current events, try to persuade others how to vote in an election, become committed to civic participation, and raise money for charity.

The election of Obama has been mentioned as one of the first examples of large-scale use of digital media, including blogging, videos, social networks, and text messaging, for a cause; the campaign used technology for relationship building, spreading information, and organizing offline rallies and gatherings (Harfoush, 2009). These tools have also been used in global politics. Facebook, Twitter, and social networks in general have been mentioned as resources for arranging gatherings and protests against former Egyptian President Mubarak and former Libyan President Gadhafi. Both governments shut down the Internet in early 2011, in an apparent effort to stop community organization happening on these sites (Chen, 2011).

People also use social networking sites and the Internet as a place to donate to charities and causes with Web sites such as Kiva, which allows people all over the world to donate money towards third-world business startups (www.kiva.org) or new social media sites such as Help Attack (www.helpattack.com) in which users donate money to charity for each Facebook update or Tweet (Twitter message), in addition to donating to traditional charities. Texting campaigns, where you text a number and automatically charge a donation to your cell phone bill, have recently gained popularity. Online petition signing is also a faster and easier way to gain signatures for a cause. It seems that the power of digital technologies and community building facilitate offline traditional means of action (e.g., protests) while creating a new medium for donations and information dissemination (Van Laer & Van Aelst, 2010).

CHOICES OF CONDUCT IN DIGITAL COMMUNITIES

The open-ended and decentralized nature of new technologies gives freedom to children to make authentic choices and to experience consequences. The process of making choices is an important aspect for building a strong sense of character (Bers, 2012). Of course, the freedom to choose their choices will be determined by the age of the child and her developmental needs, as well as the comfort zone of the adult in charge.

From a moral development standpoint, early childhood is a time of egocentrism and an early development of perspective taking. It is around this time that children begin to understand the concept of fairness (Colby & Kohlberg, 1987). New technologies may support this process by providing children with the opportunity to experiment with "what if" questions and potential consequences, and to provoke examination of values and exploration of *character traits.* Most explorations of the moral and ethical domain though new technologies

happen later on, when children are avid users of the Internet and might face cyberbullying (Li, 2006, 2007) and temptations of piracy (Chiou, Huang, & Lee, 2005; Logsdon, Thompson, & Reid, 1994). However, it is never too early to begin teaching and modeling appropriate cyber-safety and "netiquette" to young children (M. Berson & Berson, 2004; Shea, 1994; Straker, Pollock, & Burgess-Limerick, 2006). Virtual communities designed for young children, such as Panwapa (www.panwapa.org) and Disney's Club Penguin (www.clubpenguin.com) do have safety features built in, such as preset chat scripts. These begin to provide models for appropriate behavior. Web sites such as Webkinz (www.webkinz.com) provide an opportunity for children to learn about taking care of pets and also integrate a social networking component. In addition, Webkinz integrates a physical component (stuffed animal) with the virtual world. However, sites such as Webkinz have been criticized for promoting consumerism, consumptionism, and competition (Dellinger-Pate & Conforti, 2010).

As previously mentioned, there are some legal issues around licensing and copyright for youth engaged in digital remixing or mash-ups. One way to combat this issue is by using and distributing media under a creative commons license (www.creativecommons.org). People who use the content produced under a creative commons license are using that content legally, since the creators of the content have chosen to provide their content free for anyone's use, so long as credit is given to the original content creators.

Also previously mentioned was the area of bullying. This is a huge moral conflict for youth online. The government has started an antibullying initiative and has partnered with the MIT Media Lab and the social network site Formspring to create tools to detect cyberbullying and migrate the content elsewhere when it does occur. In addition, Facebook will be launching a reporting system for inappropriate content, and the National Education Association has initiated an antibullying campaign called "Bully-Free: It Starts with Me," among other federal programs (see White House, 2011).

Most youth online break the law regularly, and they may or may not even know it. Teens rarely pay for music; they download it for free. Teens also watch TV and movies online, which are not always there legally. It started in 2008 with Napster, an easy-to-use P2P (peer-to-peer) file-sharing network. At its peak, 30 million people were using Napster—40% of whom were college students (Palfrey & Gasser, 2008). However, the music upload by users onto Napster to share was done so illegally. Napster was sued by the record companies and shut down, but that did not stop the P2P networks. They are easy to use and popular, and dozens exist today. A survey of college students in 2003 found 72% believe downloading copyrighted material was acceptable (Palfrey & Gasser, 2008).

Digital technologies are powerful tools and uncharted territories. It imperative that parents, educators, and society teach children and youth how to behave appropriately online, make them aware of the consequences of their behaviors, teach them to critically evaluate the difference between accurate and inaccurate information, and to understand the importance of laws surrounding illegal use and download of photos, TV shows, movies, and music. By teaching children and youth to use new technologies appropriately and be good digital citizens, we can, as a society, harness the power of these new technologies to their full potential.

CONCLUSIONS

Children are exposed to new technologies before ever making it to their preschool classroom. In the early days of personal computing, there was lively debate over the developmental appropriateness of technology. Today, however, the pressing question is "How are these technologies having an impact on child and youth development?" The answers appear to be mixed.

New technologies lend themselves well to fostering development in key areas such as socioemotional development, identity development, the development of language, and cognition—if used appropriately. The power of digital tools, especially the Internet, has made widespread, global communication possible along the same networks that one can use to communicate with the neighbors or classmates from school.

But how do we know what is appropriate and not? The PTD framework suggests that the best uses of technologies to support positive development put the child in the role of producers, rather than consumers. This framework advances the notion that technologies should engage young users in creating digital content, creativity, choices of conduct, communication, collaboration, and community building. As new technologies are constantly evolving, it is the kind of activities and behaviors they support that we should focus on. These should be aligned with supporting developmental milestones, as opposed to hindering them. This is where more research is needed in the field.

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