Chapter 1
Virtual Worlds: Young Children Using the Internet

Ithel Jones and Young Park

Abstract There has been a dramatic increase in the number of young children using digital media. Children are regularly using the internet to play, communicate, and explore. Educators and researchers are beginning to examine the social and cognitive implications of children's use of interactive media and the internet. Socio-cultural and ecological systems theories offer a perspective that can support our understanding of internet use and young children's cognitive development. This chapter examines three popular internet applications: virtual worlds, virtual field trips, and tele-collaborative projects. Drawing on the ecological systems and socio-cultural theories, implications for children's development are considered.

Keywords Cognitive development · Digital media · Early childhood · Internet · Socio-cultural theories · Technology · Tele-collaboration · Virtual worlds · Virtual field trip

An Online World

Megan is a bright 8-year-old girl from a middle-class family. She lives in a media-rich house with her parents and younger brother. She is an avid reader, and she loves writing stories. She also loves her pet cat, as well as her collection of soft toys and dolls. One of her favorite activities is playing on the computer in her parents' home office. Her daily engagement with technology usually includes going on the internet to visit sites such as Webkins, Club Penguin, and Nickelodeon's Petpet Park.

From the moment Megan was born, images of her have been posted online. Her digital life began when her proud parents uploaded prenatal sonogram scans to the internet followed by regular photos and other information. As Megan's digital profile, or footprint, increased, so did her experiences with interactive technologies. As an

I. Jones (✉)
Florida State University, Tallahassee, USA
e-mail: ijones@admin.fsu.edu

Y. Park
Pusan National University, Pusan, South Korea

K. L. Heider, M. Renck Jalongo (eds.), *Young Children and Families in the Information Age,* Educating the Young Child 10, DOI 10.1007/978-94-017-9184-7_1,

active 2-year-old, Megan often begged her mother to take her to the playground. But, instead of heading to the local community park, her mother would settle with Megan in a cozy chair and visit the virtual world of Elmo's Playground on their iPad. Scrolling through family photos on her mother's handheld device would often relieve Megan from the boredom of long car journeys. Then, after a long and busy day, the favorite part of her bedtime routine was to share and talk about a picture book on an e-reader.

As a preschooler, Megan enjoyed the challenges of the interactive programs at the computer station. During center time, she and her friend would chat and giggle as they worked together using the SMART Table drawing application. Then, by the time she was in kindergarten, Megan was a frequent visitor to the virtual world of Club Penguin. Having shaped her online presence through the creation and modification of an avatar, Megan played games, communicated, and interacted with other online faces. In this virtual world, she could dress up, purchase virtual goods, and even care for a virtual pet.

Changing Childhood

Children like Megan have more access to all kinds of electronic media and online activities than ever before. Changes in media use, and widespread internet use, have drastically altered childhood experiences. For young children, electronic media are part of the landscape and contexts of their lives. The ubiquity of the internet and new online technologies, in particular, permeates all aspects of children's lives. The internet encompasses a diverse, interactive space that blurs the boundaries between the real and imaginary, or virtual world, in ways that we never could have envisioned. One of the most compelling aspects of the internet, however, is its interactivity. Using the internet, children can practice their skills, test their knowledge, or contribute their work using one of the many interactive sites available on the Web.

This chapter examines the ways young children can use the internet to support their learning and enhance their problem-solving skills. First, we explore the nature and extent of young children's use of digital media in the U.S. Next, we discuss children's online access and internet use. In doing so, we consider the social impact of the internet as well as critical dimensions of media technology and the internet that influence young children's learning. Specifically, we examine how using the internet can enrich children's experiences and consider theoretical perspectives concerning how the internet might influence children's cognitive development. Then, finally, we examine three popular online applications including virtual worlds, virtual field trips, and tele-collaborative projects.

Young Children Using the Internet

According to recent research findings, young children are spending more time using digital media than ever before (Common Sense Media 2011; Gutnick et al. 2011). The various digital media used by children include computers, handheld and console

video game players, cell phones, iPods, and iPad-style tablet devices. In a recent study, the Common Sense Media group (2011) reported that more than half of all children have home access to mobile devices such as smartphones, video iPods, or tablet devices such as an iPad. In addition, more than two-thirds of families with young children have computers, typically with an internet connection (Gutnick et al. 2011). While children's exposure to digital media has significantly increased, so have the capabilities of the various electronic devices. Thus, activities are not restricted to any one type of media. Television, for example, can be streamed via the internet on a desktop computer, iPad, or a smartphone. How and when young children use various digital media, however, is largely determined by their parents or caregivers.

It seems that most parents support and encourage children's use of digital devices. In the United Kingdom, for example, households with young children are more likely to be connected to the internet (Ofcom 2007), and ever-younger children are regularly going online. It was recently reported that almost a third (29%) of all parents in the United States have downloaded "apps" to their mobile devices for their children to use. Thus, increasing numbers of children are using such apps on mobile devices, including 10% of 0–1-year-olds, 39% of 2–4-year-olds, and 53% of 5–8-year-olds (Common Sense Media Group 2011).

Such use of mobile digital devices is matched by extensive use of computers by children under 8 years of age. More than half of 2–4-year-old children have used a computer and 90% of 5–8-year-olds (Common Sense Media 2011). It is further reported that young children are regularly using computers, most on a weekly basis and many on a daily basis. A recent trend in computer use is the popularity of portable devices. Since 2005, for example, ownership of desktop computers in the United States has declined by 18%, while ownership of laptops has increased to 60% of families (Gutnick et al. 2011). It seems, therefore, that families and children like to use portable electronic media.

Given that children's access to an ever-increasing inventory of electronic devices has increased significantly, it is hardly surprising that they are spending more and more time with media. Indeed, use of all types of media has increased in the last decade and, by the time children are 8 years old, they are spending more than 5 hours a day using media (Gutnick et al. 2011). While television continues to dominate children's media use (Common Sense Media 2011), young children also regularly consume other media, particularly as they mature. Contemporary children from affluent families living in economically-developed countries seem to have an increasing appetite for smartphones, tablet devices, and video consoles, and most are using these technologies to access the internet. Moreover, those children who do go online are doing so several times a week, with usage increasing with age (Gutnick et al. 2011). In short, the internet is rapidly becoming embedded in children's everyday lives.

From 2000 to 2002, internet use among American 6–8-year-old children doubled. In 2003, it was reported that 91% of children from 3 years old to 12th grade use computers, and 59% use the internet (De Bell and Chapman 2006). Approximately 23% of children in nursery school use the internet and 50% by third grade (De Bell and Chapman 2006). Such widespread internet use by young children raises many questions concerning access, as well as the nature and quality of use. In addition, practitioners and parents have voiced concern about the appropriateness of technology use by young children. According to Simon and Memeth (2012), these include concerns that:

- children spend too much time with technology and that it will dominate their activities
- infants and toddlers are being forced to use technology
- children will be exposed to inappropriate content and inappropriate marketing

Similarly, early childhood educators fear that using technology will lead to negative effects on children's imagination and creativity and their socio-emotional development (Cordes and Miller 1999). In addition, there is some concern that children are less active when they use digital media and that this could contribute to childhood obesity and other health problems (Strasburger et al. 2011).

Despite these concerns, young children are going online; and they are doing so at younger and younger ages. Professional organizations such as the National Association for the Education of Young Children (NAEYC), however, recognize that "technology and interactive media are here to stay" (NAEYC 2012, p. 2). In their most recent position statement concerning the use of digital media in early childhood programs, the NAEYC paved the way for early childhood educators to embrace digital media, albeit with some degree of caution. Although they voiced concern about conflicting evidence on the value of technology in children's development, they adopted the position that "technology and interactive media are tools that can promote effective learning and development when they are used intentionally by early childhood educators" (NAEYC 2012, p. 5). What, then, are the benefits of the internet and digital media for young children? In the following paragraphs we discuss the internet and analyze components that may be pertinent to children's learning and development.

Essentially, the internet is a system of interconnected computer networks. The internet encompasses communication from one-to-many, one-to-one, and many-to-many. Since its widespread use beginning in the 1990s, the internet had a significant cultural impact including increases in communication using email and interactive video calls, the world wide web with forums and blogs, as well as social networking and online commerce. In fact, there is hardly any aspect of the lives of individuals living in developed countries that has not been transformed by the power of the internet including entertainment (e.g., video and audio), education (e.g., online courses), electronic business, telecommuting, crowd sourcing, politics, and philanthropy.

In considering internet use by young children, perhaps what is more important is, not so much the range of computer connections, but its social and cognitive affordances. That is, the social and cognitive actions that are made possible and enhanced through the use of computer technologies. These affordances include communication, connectivity, access to information and, most importantly perhaps, interactivity. Simply put, the internet can be viewed as a cognitive tool. The internet allows information to be instantly available to everyone. At the same time, it allows for input and response from the user. It is this interactive aspect that potentially leads to social and cognitive outcomes for young children. Indeed, there is increasing evidence that use of the internet is associated with positive social and cognitive benefits for children (Greenfield and Yan 2006; Johnson 2006; Young 2007).

There is a small, yet growing, body of research concerning the social and cognitive effects of internet use with young children. In a study of children in a Head Start program, Fish et al. (2008) found that children who had home computer access scored significantly higher on a standardized cognitive development test. Similarly, Jackson et al. (2006) reported that children who had used the internet had higher scores on reading tests and higher grades in comparison to students who had limited internet access. There is also some evidence that internet use during the preschool years may be associated with school readiness (Li and Atkins 2004).

In other studies, researchers reported that internet use could lead to positive outcomes in the area of literacy development (Hisrich and Blanchard 2009; Jackson et al. 2006). This is because much of the internet is text based and, in using the internet, children are exposed to a print-rich environment. Moreover, when using the internet, children are engaging with information in a variety of ways (Burnett and Wilkinson 2005). The digital texts of the internet are considered distinct from traditional print texts (Leu et al. 2004; Snyder 2002), thereby requiring different skills. It is hardly surprising, therefore, that there is increasing emphasis in the literature on multimodal texts and exploration of children's reading of digital texts (Primary National Strategy 2004).

The limited research concerning the cognitive and social effects of internet use on young children is matched by an emerging focus on a theoretical description of internet use and cognitive development. As a new field of inquiry, developing a theoretical framework is important in order to understand how "children and adolescents live in a new, massive, and complex virtual universe, even as they carry on their lives in the real world" (Greenfield and Yan 2006, p. 391).

Toward a Theory of Internet Use and Cognitive Development

Young children and the internet is a relatively new field of inquiry in developmental psychology (Greenfield and Yan 2006). It is also an area of study that is of considerable interest to educators as well as policy makers. Much has been written about the internet's potential to shape children's learning at home as well as in school (Livingstone 2009). While many experts claim that digital media and using the internet can have a positive effect on children's cognitive development (Johnson 2012; Kirkorian and Anderson 2009), research in this area is sparse. There is, therefore, a need to develop theoretical models or frameworks to guide our understanding of the potential effects of the internet on children's learning and their cognitive development. Given the complex nature of the internet, developing theoretical models is particularly challenging.

Typically, in examining children's cognitive development, researchers consider the influence of social contexts, activities, or concrete artifacts. The internet, however, is a complex virtual universe with immense capabilities. Yan (2006) noted that the internet is essentially a hybrid of artifacts and social and mental systems.

In other words, the internet includes objects, such as tablets and screens, opportunities to communicate with others, and a complex virtual world (Yan 2006). Yet, for the most part, the internet lacks concrete artifacts, and while the social interactions can be real-time and face-to-face, it is often in a virtual space. At the same time, the internet is an interactive space that requires input and response from the user. For the purposes of considering a theoretical model, it is useful to consider the internet as a cultural tool that children use in their daily lives.

Contemporary theories of child development assume that individual attributes of the child, biological factors, and environmental experiences, individually and collectively, shape children's cognitive growth. Bronfenbrenner's (1979) ecological systems succeeds in capturing environmental influences on cognitive development by situating children at the center of multiple levels of the environment, labeled as systems theory (e.g., microsystem, mesosystem). These systems are organized as five nested layers, each influencing the other, thereby producing direct and indirect influences on development. Bronfenbrenner (1979) primarily focuses on the social contexts in which children live and the people who influence their development. Viewed this way, development occurs in increasingly-complex reciprocal interactions between the individual and the environment. Understanding cognitive development, therefore, requires considering all factors (e.g., environmental, family, political, social, etc.) and how they interact. Recently, researchers (Johnson and Puplampu 2008; Johnson 2010) proposed that children's internet use is a component of Bronfenbrenner's microsystem, or the child's immediate environment. Described as the "ecological techno sub-system" (Johnson 2010, p. 178), it includes interaction with "non living elements of communication, information, and recreation technologies" (Johnson 2010, p. 178). This view seems to be consistent with Bronfenbrenner's (1979) position that the child is not a passive recipient of experiences in the various settings, or contexts, but someone who reciprocally interacts with others and helps to construct the settings. Clearly, this type of interaction occurs when young children use the internet for various tasks.

While embedding children's internet use within the microsystem is appealing, it fails to capture the role of culture and community in learning. Vygotsky's (1978) sociocultural perspective on cognitive development is based on the simple, yet powerful, idea that development is a product of culture. His theory presents the radical idea that thought and intelligence are the product of history and culture. Culture creates mental tools that transform cognitive processes. Then, the internalizing of these processes leads to the development of higher-order psychological processes. In other words, the internalized processes shape our thinking. According to Vygotsky, acquisition of mental tools occurs through meaningful participation in authentic, social activities, and the Zone of Proximal Development (ZPD) describes how we learn from others as we participate in social activity. "Human learning presupposes a specific social nature and a process by which children grow into the intellectual life of those around them" (Vygotsky 1978, p. 88).

The internet can be considered a particularly powerful and sophisticated cultural tool that can influence cognitive development. Yet, arguably, using the internet takes children away from the social activity that plays such a pivotal role in Vygotsky's

sociocultural theory. Since interactivity is a hallmark of the internet, a reasonable assumption is that it can succeed in creating and maintaining social activity in a unique way.

In the following section, we consider the application of Bronfenbrenner's (1979) ecological systems theory and Vygotsky's (1978) sociocultural theory in the context of three increasingly-popular internet activities: virtual worlds, virtual field trips, and tele-collaborative projects.

Virtual Worlds

The popularity of virtual world web sites such as *Club Penguin* (http://www.clubpenguin.com), *Webkins* (http://www.webkins.com), *Whyville* (http://www.whyville.net), and *SqwishLand* (http://www.sqwishland.com) is staggering, to say the least. It is reported that *Club Penguin,* a game-themed world for children from 6 to 14 years old, has more than 150 million registered members. One of the newer virtual worlds, called *SqwishLand,* was launched in 2010, and it had 9000 registered users in just 10 days. As one of the more popular virtual spaces, the world of *Webkins* receives upward of 40 million logins every month.

Virtual worlds are three-dimensional environments that allow children to engage in various activities such as playing games, communicating with others, dressing up, or purchasing virtual goods. Players assume the persona of an avatar by shaping its appearance, such as hair and skin color, furnishing their online home, and caring for virtual pets. Users can easily navigate their avatar through various spaces (e.g., rooms, islands, neighborhoods) using text or following signs and icons. Most of the virtual worlds have their own currency that players can earn by participating in various activities and then use to purchase virtual goods. Social interaction is a key part of virtual worlds whereby users can use preselected words or phrases or enter their own words. Beyond interacting and communicating with other avatars, users can play games and attend parties or social events, often based on holiday themes. User motivation and interest is maintained by way of regular updates using blogs, or virtual newspapers.

These digital virtual worlds have been compared to children's school playgrounds (Meyers 2009) in that they include "play, group norms, reward structures, and socialization opportunities" (p. 51). It is claimed that such online environments create opportunities for education, socialization, and creativity (Hew and Cheung 2010). Much of children's activity in a virtual world is similar to their play (Marsh 2010) in that they are allowed to engage in pretend play, fantasy, and creating narratives. Beyond play, virtual worlds allow children to engage in new literacies (Meyers 2009) through participation in a discourse community. Users also engage in problem solving by making observations and decisions and drawing appropriate conclusions (Meyers 2009).

From a theoretical perspective, children's engagement in virtual worlds is clearly situated in Bronfenbrenner's (1979) microsystem. At the same time, the virtual

world seems to create a conduit into the larger social network of the exosystem in which the child does not directly participate. This seems to function much like the "techno sub-system" described by Johnson and Pumplampu (2008). Then, from a Vygotskian perspective, the virtual worlds described here are the newest cultural tools and, as such, they influence children's thinking and learning. Potentially, these tools also elicit and develop new and different cognitive skills. Despite the "virtual" nature of the experience, from a cognitive developmental perspective, the child's participation constitutes an authentic social experience. This is because both the real and virtual contexts share similar interactive and cognitive elements.

Virtual Field Trips

Much like the virtual worlds of *Club Penguin* and *Webkinz,* the virtual field trip (VFT) takes children on an educational excursion from the safe confines of their classrooms. Teachers use the VFT to provide learning experiences beyond what children would typically be provided (Cox and Su 2004). Typically, the VFT consists of multimedia presentations created by teachers, themselves, or accessed through web sites such as S*cholastic* or *PBS Kids*. Organizing traditional field trips can be challenging for teachers because they have to deal with issues such as expense, safety, liability, transportation, and time constraints. The VFT, on the other hand, allows teachers to focus on the educational content. VFTs are particularly appealing to preschool or kindergarten teachers because of the difficulties of arranging field trips for younger children.

Using digital media, the VFT offers children rich educational experiences within the classroom. For example, children can experience other communities, they can interact with experts and other individuals, and even observe real-time events that may pose significant risks in the real world (e.g., observing wild animals up close). Unlike the virtual worlds where children are individual participants, the VFT offers classroom-based experiences. The VFT is embedded in the curriculum and might include use of online texts and images, streamed video, audio clips, and video conferences. In short, the VFT immerses children in an environment they would not otherwise have access to.

For younger children, the VFT provides a suitable alternative to first-hand experiences and a fun and engaging way for children to learn new concepts. Like the virtual worlds, the VFT positively shapes the child's microsystem by allowing the child to engage in new and different experiences. Since the experiences of the VFT shape the socio-cultural environment, Vygotsky's theory is also relevant here. Vygotsky's sociocultural perspective emphasizes the situatedness of thinking and speaking in the context of activity (Wertsch et al. 1995). For teachers, the VFT brings rich experiences into the supportive, interactive space of the classroom. For children, the VFT provides real-world experiences because most of the interactions, though spatially and temporally separated, are real-time and face-to-face. In turn, such experiences allow children, as social learners, to actively construct meaning

about how the world works. Furthermore, engagement with more experienced others and direct observation of real-time events encourages children to reflect on the meaning of their interactions. This reflection potentially involves careful consideration, analysis of information, and in turn, critical thinking.

Tele-collaborative Projects

Many early childhood teachers are also extending the classroom boundaries by utilizing tele-collaborative projects. Using the internet, teachers and students are connecting with others around the world using email, listservs, discussion boards, and other platforms. According to Harris (1998), there are three categories of tele-collaborative activities: interpersonal exchanges, information collection and analysis, and problem solving. Each of these categories includes five to seven activities that can support children's learning. For example, interpersonal exchanges include electronic communication with individuals and with groups, keypals, and electronic appearances. Information collection and analysis includes creating databases, publishing, and data analysis. Problem-solving activities include information searches, simulations, or social action projects; all of which can potentially promote critical thinking.

For young children who are immersed in the interactive digital age of television, interactive computers, and video games, the tele-collaborative project is simply an extension of what they are experiencing at home. Such projects can provide direct social encounters that enrich and support children's learning. Moreover, such use is supported by Vygotskian theory (1978), which suggests that children can achieve much more when they are engaged in collective activities. As social learners, children actively construct meaning (Rushton and Larkin 2001), and their learning is embedded within social contexts (Tudge and Rogoff 1989). Tele-collaboration can potentially create and enhance such social contexts, whereby the dialectic relationship of interaction and context leads to the social construction of shared understanding. Also, as with the VFT, tele-collaborative activites can alter and shape the child's micro- and meso-system (Bronfenbrenner 1979). This is because the activities modify and shape the child's immediate environment in positive ways.

Summary and Conclusions

In conclusion, increasing numbers of young children in the United States are becoming regular consumers of digital media. They are accessing the internet at home and becoming regular players in virtual worlds such as *Club Penguin* or *Petpet*. Similarly, at school, the internet is being harnessed to enhance children's educational experiences using multi-media applications and approaches such as virtual field trips or tele-collaborative projects. While the virtual world of *Club Penguin*

is an imaginary world with some resemblance of real-life events and activities, the school-based virtual field trips are real-life events accessed virtually.

The multiple uses and applications available through and via the internet can have positive consequences for children's learning and development. Educators, researchers, and policymakers are in agreement that there are social and cognitive effects of internet use by young children. Yet, to date, the research concerning the effects of internet use on cognitive development is sparse. Furthermore, the development of theoretical frameworks for understanding the effect of digital media on children's development is still in its infancy. Clearly, there is a pressing need for research examining the psychological and educational consequences of children's widespread and extensive use of internet activities.

Most theories of cognitive development were developed prior to the widespread use of digital media. As such, they fail to take into account the significant influence of children's extensive exposure to a wide range of internet-based activities such as virtual worlds and online communication. Two theoretical perspectives, Bronfenbrenner's ecological systems theory and Vygotsky's sociocultural theory, seem applicable and relevant in considering the internet's effect on children's cognitive development. By drawing on such theories, we can begin to understand how children's engagement in online worlds can shape their learning and development. We can also further our understanding of how children's experiences with digital media and the internet can be built upon and enhanced in early childhood settings.

References

Bronfenbrenner, U. (1979). *The ecology of human behavior: Experiments by nature and design*. Cambridge, MA: Harvard University Press.

Burnett, C., & Wilkinson, J. (2005). Holy lemons! Learning from children' uses of the internet in out-of-school contexts. *Literacy, 39,* 158–165.

Common Sense Media. (2011). *Zero to eight: Children's media use in America*. New York, NY: Common Sense Media.

Cordes, C., & Miller, E. (1999). *Fool's gold: A critical look at computers in childhood*. New York: Alliance for Childhood.

Cox, E. S., & Su, T. (2004). Integrating student learning with practitioner experience via virtual field trips. *Journal of Educational Media, 29,* 113–123.

DeBell, M., & Chapman, C. (2006). *Computer and internet use by students in 2003 (NCES 2006–065). U.S. Department of Education*. Washington, DC: National Center for Education Statistics.

Fish, A. M., Li, X., McCarrick, K., Butler, S. T., Stanton, B., & Brumitt, G. A. (2008). Early childhood computer experience and cognitive development among urban low-income preschoolers. *Journal of Educational Computing Research, 38,* 97–113.

Greenfield, P., & Yan, Z. (2006). Children, adolescents, and the internet: A new field of inquiry in developmental psychology. *Developmental Psychology, 42,* 291–394.

Gutnick, A. L., Robb, M., Takeuchi, L., & Kotler, J. (2011). *Always connected: The new digital media habits of young children*. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop.

Harris, J. (1998). *Virtual architecture: Designing and directing curriculum-based telecollaboration*. Eugene, OR: International Society for Technology in Education.

Hew, K. F., & Cheung, W. S. (2010). Use of three-dimensional (3-D) immersive virtual worlds in K-12 and higher education settings: A review of the research. *British Journal of Educational Technology, 41,* 33–55.

Hisrich, K., & Blanchard, J. (2009). Digital media and emergent literacy. *Computers in the Schools, 26,* 240.

Jackson, L. A., Von Eye, A., Biocca, F. A., Barbatsis, G., Zhao, Y., & Fitzgerald, H. E. (2006). Does home internet use influence the academic performance of low income children? *Developmental Psychology, 42,* 429–435.

Johnson, G. M. (2006). Internet use and cognitive development: A theoretical framework. *E-learning, 4,* 433–441.

Johnson, G. M. (2010). Internet use and child development: Validation of the ecological techno-subsystem. *Educational Technology and Society, 13,* 176–185.

Johnson, G. (2012). The ecology of internet use during middle childhood: Physical, social, emotional and cognitive development. In T. Amiel & B. Wilson (Eds.), *Proceedings of world conference on educational multimedia, hypermedia and telecommunications* (pp. 1311–1316). Chesapeake, VA: AACE.

Johnson, G. M., & Puplampu, P. (2008). A conceptual framework for understanding the effects of the internet on child development: The ecological techno-subsystem. *Canadian Journal of Learning and Technology, 34,* 19–28.

Kirkorian, H. L., & Anderson, D. R. (2009) Learning from educational media. In S. L. Calvert & B. J. Wilson (Eds.), The handbook of children, media, and development (pp. 188–213). Oxford, UK: Blackwell. doi:10.1002/9781444302752.ch9.

Leu, D. J., Kinzer, C. K., Coiro, J., & McCammock, D. W. (2004). *Toward a theory of new literacies emerging from the internet and other information and communication technologies*. Paper presented at the International Reading Conference, Reno, NV.

Li, X., & Atkins, M. S. (2004). Early childhood computer experience and cognitive and motor development. *Pediatrics, 113,* 1715–1722.

Livingstone, S. (2009). *Children and the internet*. Malden, MA: Polity Press.

Marsh, J. (2010). Young children's play in online virtual worlds. *Journal of Early Childhood Research, 8,* 23–39.

Meyers, E. M. (2009). Virtual worlds, real learning. *School Library Monthly, 3,* 50–52.

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

Ofcom. (2007). *Ofcom's submission to the Byron Review. Annex 5: The evidence base. The views of children, young people, and parents*. London, UK: Office of Communications.

Primary National Strategy. (2004). *Learning and teaching using ICT*. London, UK: DfES Publications.

Rushton, S., & Larkin, E. (2001). Shaping the learning environment: Connecting developmentally appropriate practices to brain research. *Early Childhood Education Journal, 29,* 25–33.

Simon, F. S., & Memeth, K. (2012). *Digital decisions: Choosing technology tools for early childhood*. Lewisville, NC: Gryphon.

Snyder, I. (2002). Communication, imagination, critique-literacy communication for the electronic age. In I. Snyder (Ed.), *Silicon literacies: Communication innovation and education in the electronic age* (pp. 173–183). London, UK: Routledge (Falmer Press).

Strasburger, V. C., Jordan, A. B., & Donnerstein, E. (2011). Health effects of media and television on children and adolescents. *Pediatrics, 125,* 756–767.

Tudge, J., & Rogoff, B. (1989). Peer influences on cognitive development: Piagetian and Vygotskian perspectives. In M. H. Bornstein & J. S. Bruner (Eds.), *Interaction in human development: Crosscurrents in contemporary psychology* (pp. 17–40). Hillsdale, NJ: Erlbaum.

Vygotsky, L. (1978). *Mind in society. The development of higher mental processes*. Cambridge, MA: Harvard University Press.

Wertsch, J., Hagstrom, F., & Kikas, E. (1995). Voices of thinking and speaking. In L. Martin, K. Nelson, & E. Tobach (Eds.), *Sociocultural psychology: Theory and practice of doing and knowing* (pp. 276–290). New York: Cambridge University Press.

Yan, Z. (2006). What influences children's and adolescents' understanding of the complexity of the internet? *Developmental Psychology, 42*(3), 418–428. doi:10.1037/0012–1649.42.3.418.

Young, K. (2007). Toward a model for the study of children's internet use. *Computers in Human Behavior, 24,* 173–184.