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Young children's Internet use at home and school: Patterns and profiles

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Abstract

Thirty-eight children in first and second grade completed a 10-item rating scale on Internet use at home and school. Results suggested that, in general, more children used the Internet at school than at home but home-based use was more often perceived as enjoyable. Three patterns of Internet use emerged suggesting three types of young users: *home-based users* demonstrated extensive, comprehensive, and enjoyable use of the Internet at home coupled with limited and less enjoyable Internet use at school; *school-oriented information seekers* reported mainly visiting websites, both at home and at school, but school access was preferred; and *school-oriented communicators* indicated primarily using email, both at home and at school, but school use was preferred. Implications for Internet literacy in young school children are discussed.

Keywords

child development, child internet use, ecological techno-subsystem, home-based users, internet literacy, school-oriented communicators, school-oriented users

Forty percent of Australian children aged four to six years have been online for at least two years (Nielsen//NetRatings Internet and Technology Report, 2005). Approximately 20 percent of Canadian nine-year-old children access the Internet through their own personal computer (Media Awareness Network, 2006). According to the Corporation for Public Broadcasting (2002), the prevalence of Internet use among American six- to eight-year-old children doubled between 2000 and 2002 (from 27% to 60%, across all locations, at least one a week). The Office of Communications (2007) reported that 7 percent of British 10-year-olds have a webcam (a camera designed to transmit video over the Internet). All trends indicate that the number of children accessing the Internet and the amount of time they spend online are steadily increasing.

Public anxiety surrounding the digital divide (Burnett and Wilkinson, 2005; Livingstone and Helpsper, 2007), increasingly complex school Internet literacy curriculum (Johnson, 2007a; Takahira et al., 2007), and social policy initiatives directed at enhancing childhood Internet access (Jackson et al., 2006; Sandvig, 2003) reveal the extent to which Internet use is perceived as developmentally appropriate (if not required). 'Throughout history, the development and widespread

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use of new technologies has impacted human cognition and social structures' (Young, 2007, p. 173). Indeed, there is mounting evidence that using the Internet provides children with cognitive and social advantages (Greenfield and Yan, 2006).

Internet use and child development

The Internet provides children with opportunities to communicate, access information, and engage in interactive play. Theoretically, such uses of the Internet stimulate cognitive and social development (Johnson, 2006; Young, 2007). Meta-analysis confirms a positive relationship between Internet use during childhood and school achievement (Cavanaugh et al., 2004). Jackson and colleagues (2006) provided low income children with home-based Internet access and continuously recorded time online. 'Findings indicated that children who used the Internet more had higher scores on standardized tests of reading achievement and higher grade point averages 6 months, 1 year, and 16 months later than did children who used the Internet less (p. 429). Fuchs and Wößmann (2005) reported, having controlled for socioeconomic status, 'a negative relationship between home computer availability and academic achievement, but a positive relationship between home computer use for Internet communication' (p. 581). Johnson et al. (2007) compared children whose parents did and did not report specific patterns of childhood online behavior at home. Reportedly, at-home online learning and communicating (but not playing and browsing) were associated with advanced child development in expressive language and metacognitive planning.

Related to online learning and communicating, children commonly use the Internet to visit websites (Media Awareness Network, 2006; Office of Communications, 2007). The Internet, although rich in graphic display, is primarily a text-based medium; 'the more a child uses the Internet, the more he/she reads' (Jackson et al., 2007: 188). Librarians refer to the Internet as a 'lifeline for children' and note that 'the Web keeps getting bigger and better for youngsters, with more helpful and enjoyable sites popping up every day' (McDermott, 2000: 36). From a developmental perspective, visiting websites stimulates cognitive processes involved in interpreting text and images (Johnson, 2006). Metacognitive functions such as planning, search strategies, and evaluation of information are exercised when visiting websites (Tarpley, 2001).

In addition to visiting websites, children commonly report using the Internet to play games (Media Awareness Network, 2006; Office of Communications, 2007). Van Deventer and White (2002) observed proficient 10- and 11-year-old video gamers and noted extremely high levels of self-monitoring, pattern recognition, and visual memory. DeBell and Chapman (2006) concluded that Internet use promotes cognitive development in children, 'specifically in the area of visual intelligence, where certain computer activities – particularly games – may enhance the ability to monitor several visual stimuli at once, to read diagrams, recognize icons, and visualize spatial relationships' (p. 3). In a comprehensive review of the literature of the time (when interactive digital games were less sophisticated), Subrahmanyam et al. (2000) concluded that 'children who play computer games can improve their visual intelligence' (p. 128).

It should be noted, however, that playing video games has also been linked to childhood distractibility, over-arousal, hostility, and aggression (Anderson et al., 2007). Based on naturalistic observation in a day care setting, Bacigalupa (2005) concluded that when children played video games, 'their interactions with others were disjointed, rushed, and ineffective' (p. 25). Focus group interviews with children revealed the perception of over-arousal and loss of awareness of surroundings during video game playing (Funk et al., 2006). Funk et al. (2003) compared aggression and empathy in children who played a violent or non-violent video game for 60 minutes. Exposure

to the violent video game was associated with desensitization as reflected in lower empathy scores. Based on survey data from a large group of eight- to 10-year-old children and their parents, Walsh et al. (2006) reported that two-thirds of parents claimed that they placed limits on their children's video gaming; one-third of children indicted corresponding perception.

Childhood Internet use (i.e. communicating, visiting websites, and playing games) occurs in context, specifically, in the case of young children, home and school environments. Kerawalla and Crook (2002) noted that parents took few steps to orchestrate the content of young children's online activities and rarely became directly involved in those activities. Cho and Cheon (2005) surveyed families and found that parents' perceived control, obtained through shared web activities and family cohesion, reduced children's exposure to negative Internet content. Lee and Chae (2007) reported a positive relationship between parental mediation techniques (website recommendation and Internet co-use) and children's educational attainment.

In comparing home-based and school-based computer activity, Murphy and Beggs (2003) observed that, at home, children choose their own activities, have ample time for exploration, and learn incidentally. In contrast, at school, teachers control activities, computer time is limited, and learning is directed. Based on detailed interviews and repeated observation of six children (three boys and three girls), Burnett and Wilkinson (2005) concluded that creative problem solving was evident in home-based, but not necessarily school-based, use of the Internet. The paths of influence between Internet use at home and school (i.e. communicating, visiting websites, and playing games) and child development (e.g. cognition and social skills) appear complex; a theoretical framework is required.

Ecological systems theory and the techno-subsystem

Ecological systems theory (Bronfenbrenner, 1979, 1989) provides a comprehensive framework for organizing environmental influences on development by situating the child within a series of relationships affected by multiple levels of the surrounding environment. Bronfenbrenner organized the contexts of child development into five nested environmental systems, with bi-directional influence within and between systems. The *microsystem* refers to immediate environments and includes, most notably for young children, home and school interactions. The *mesosystem* comprises connections between immediate environments (e.g. parent–teacher interactions). The *exosystem* includes environmental settings that indirectly affect the child (e.g. a parent's workplace). The *macrosystem* reflects overarching social ideologies and cultural values (e.g. the rights of children). The *chronosystem* highlights the effect of time (e.g. life transitions) on all systems and all developmental processes. Bronfenbrenner (2005) expanded ecological systems theory to reflect the *bioecology*, that is, the child's biology (e.g. neurological potential and genetic predispositions) is conceptualized as a dimension of the microsystem.

Bronfenbrenner (1989) described human development as 'the progressive, mutual accommodation, throughout the life course, between an active, growing human being, and the changing properties of the immediate settings in which the developing person lives, as this process is affected by the relations between these settings, and by the larger contexts in which the settings are embedded' (p. 188). Cognitive theorist Jerome Bruner (2005) recently reiterated his seminal assumption that 'our minds appropriate ways of representing the world from using and relating to the codes or rules of available technology' (p. x). A socio-cultural orientation to child development presupposes that 'through participation in activities that require cognitive and communicative functions, children are drawn into the use of these functions in ways that nurture and scaffold them' (Vygotsky, 1986: 6–7).

Ecological systems theory (Bronfenbrenner, 1979) emerged prior to the Internet revolution and the developmental impact of then available technology (e.g. television) was conceptually situated in the child's microsystem. In theoretical response to dramatic increase in childhood use of digital technologies, Johnson and Puplampu (2008) proposed the *ecological techno-subsystem*, a dimension of the microsystem. As illustrated in Figure 1, the techno-subsystem includes child interaction with both living (e.g. peers) and non-living (e.g. hardware) element of communication, information, and recreation technologies in immediate or direct environments. From a cognitive-developmental perspective, using increasingly complex cultural tools (e.g. Internet technologies) requires and facilitates increasingly complex cognitive processes (Nickerson, 2005). From a socio-cultural perspective, human tools (e.g. email) mediate and define social processes (e.g. communication; Thorne, 2003).

Based on survey data, the Corporation for Public Broadcasting (2002) reported that patterns of home Internet use during childhood vary as a function of age. Nine- to 12-year-old children, for example, most commonly use the Internet at home, in order of frequency, to 1) visit websites for

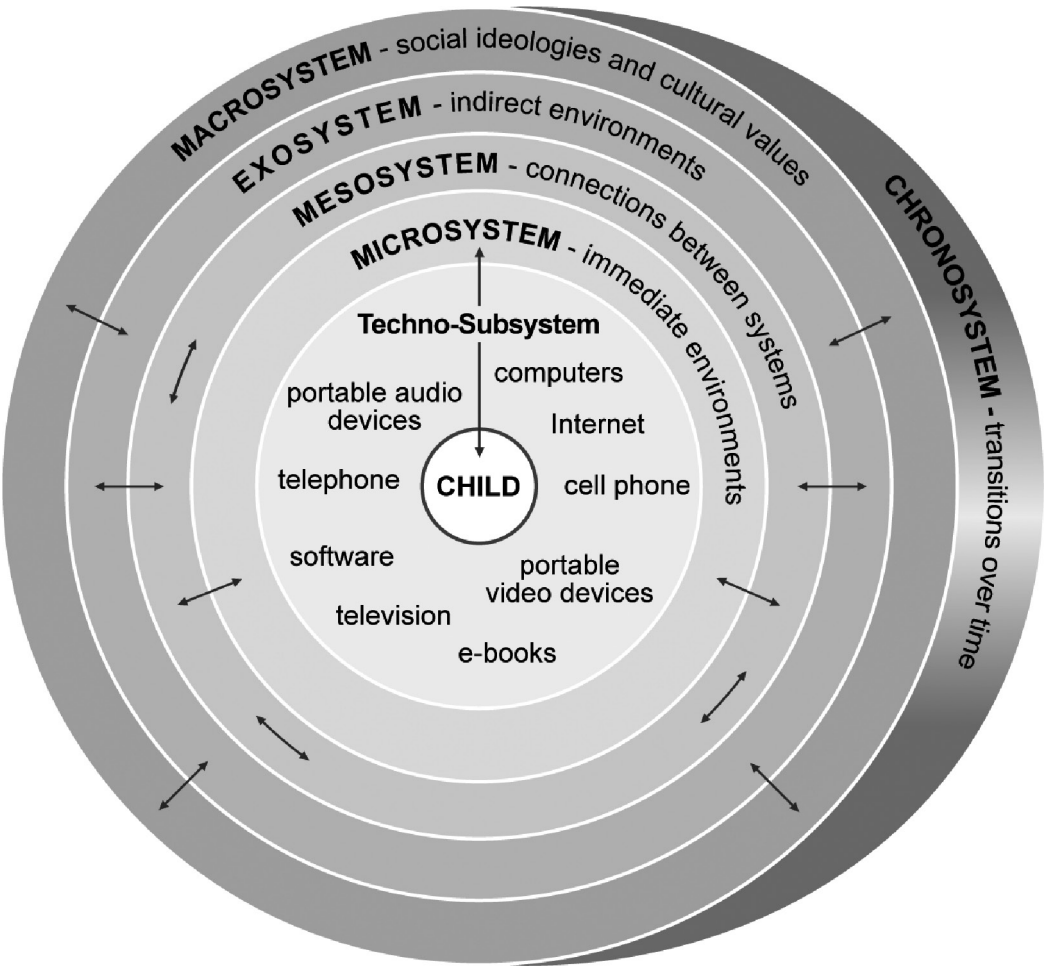

Figure 1. The ecological techno-subsystem (Johnson and Puplampu, 2008)

personal interest, 2) visit websites related to learning and school, and 3) access music and videos. In contrast, children six to eight years of age most commonly use the Internet at home, in order of frequency, to 1) visit websites for personal interest, 2) play games, and 3) visit websites related to learning and school. Factor analysis of children's capacity to define Internet vocabulary (e.g. search engine, instant messaging, and cheats), revealed two types of Internet use in children; *general-integrated-use* which included communicating, visiting websites, and playing games and *games-only-use* which precluded online communication and website access (Johnson, 2007b). 'Internet use in children may not be meaningfully organized in terms of specific applications but, rather, requires consideration of more general patterns of use' (p. 244).

From a bioecological perspective (Bronfenbrenner, 2005), early childhood is a time of rapid development because biological spurts in brain growth (Thompson et al., 2000) are accompanied by abrupt microsystemic change such as starting school (i.e. chronosystem). Increased cerebral blood flow in five-year-olds has been linked to rapid brain development in six- to eight-year-old children (Epstein, 1999). Cognitive stimulation and social interaction experienced by six- to eight-year-old children may be of particular consequent to subsequent development. Delineation of patterns of Internet use in young school-age children is prerequisite to determination of the developmental consequences of variations in Internet use at home and school. The current investigation attempts to clarify the relationship between home and school Internet use during the early school grades. What are the patterns of online behavior, across home and school environments, for six- to eight-year-old children?

Methods

A sample of young children was drawn from a semi-rural school in Western Canada, serving approximately 350 students from kindergarten to 12th grade (ages five to 17 years). Permission was requested from all parents of children in first and second grade ($N = 44$) to allow their children to complete a brief rating scale of Internet use at home and school. Forty signed parent consent forms were returned to the school and 38 children completed the rating scale (two children with parental consent to participate were absent from school the day the rating scale was administered). Of these 38 children, 19 were in first grade and 19 were in second grade. The sample of children included 14 boys and 24 girls. The youngest child in the sample was 6.3 years old (76 months) and the oldest child was 9.2 years (110 months). The mean age of the sample of children was 7.5 years (89.6 months, SD 9.0 months). According to teachers, three of the 38 participating children were diagnosed with special learning needs (i.e. disorders of development and attention) suggesting a representational sample.

The rating scale

A 10-item rating scale was designed specifically for the study. Children rated each item on a three-point scale: *never*, *sometimes*, and *often*. One item assessed child perception of extent of his/her use of the Internet at home (i.e. *I use the Internet at home*) and one item assessed child perception of extent of Internet use at school (i.e. *I use the Internet at school*). Correspondingly, two items were self-report perception of extent to which home and school Internet use were enjoyable (e.g. *Using the Internet at home is fun*). The remaining six items rated extent of exchanging email, visiting websites, and playing games across home and school environments. Thus, children's ratings of the 10 items provided description of their perception of extent and enjoyment of Internet use (i.e. exchanging email, visiting websites, and playing games) across home and school environments.

Cronbach alpha coefficients suggested internal consistency for home Internet use rating scale items (.703) but not for school use items (.406).

In the regular classrooms with teachers present, the principal investigator explained the project to the children, reviewed required vocabulary (e.g. *email* and *Internet*) and discussed the meaning of rating scale options (i.e. *never*, *sometimes*, *often*). Presented in pencil and paper format, with large font size and limited vocabulary, children completed the rating scale during the spring (one month prior to grade end) with the support of a research assistant (e.g. to help children follow along), although such support was required in few cases as most children were able to read, understand, and respond to the rating scale items.

Data analysis

Children's responses to the rating scale items where tallied in order to describe the extent and nature of home and school Internet use during the early school years. Children's use of the Internet was compared across gender (*t*-test) and age (correlation). Correlational analysis allowed for description of the relationships between children's perceptions of home and school Internet use. Factor analysis was conducted in order to determine patterns of Internet use across environments (home and school) and with respect to type of use (i.e. exchanging email, visiting websites, and playing games).

Results

Table 1 provides a summary of children's responses to each of the Internet use rating scale items. As can be seen, almost 90 percent of the sample of first and second grade children reported using the Internet at school (sometimes or often); less than two-thirds of the sample reported using the Internet at home (sometimes or often). Children who did not use the Internet at home (36.4% of sample) or at school (10.8%) were instructed to responded never to the two items that rated level of enjoyment of those uses (e.g. using the Internet at home is fun). Approximately 70 percent of children used and enjoyed the Internet at home. In contrast, approximately 90 percent of the children reported using the Internet at school; 78.1 percent reported that such use was enjoyable (sometimes or often). With respect to both home- and school-based Internet use, playing games was most frequently reported by the sample of children, followed by visiting websites and exchanging email. This sample provided no evidence of any difference between male and female Internet use during the early school years, suggesting that commonly reported gender differences in Internet use (Jackson et al., 2007) may require gender-role socialization beyond that experienced by young school children (p =.301 to .939). Alternatively, it is possible that a gender-related bias in interpreting rating scale items (e.g. sometimes) masked gender differences in Internet use. Children's ratings of the Internet use items did not significantly correlate with age, suggesting lack of variability in Internet use among children in the age-restricted sample (i.e. six- to eight-year-olds). For example, the correlation between age and Internet use at home was -.18, p = .315 (95% confidence interval lower bound -.036 and upper bound .012).

Given small sample size (N = 38), the relatively strong correlation between children's ratings of the items *I use the Internet at home* and *Using the Internet at home is fun* (r = .69, p = .000) confirmed that the sample of children enjoyed using the Internet at home. Further, approximately one-third of children reported *never* using the Internet at home and 30 percent of the sample reported that using the Internet at home was *never* fun (Table 1). Children's enjoyment of home Internet use correlated all measured home uses including email (r = .39, p = .009), visiting websites (r = .38, p = .011), and playing games (r = .32, p = .028). Presented in Table 2,

Table 1. Percentage of children selecting each response-option for each Internet use rating scale item

Internet use item	Response-option		
	Never	Sometimes	Often
Home Internet use			
I use the Internet at home.	36.4%	54.5%	9.1%
I use email at home.	81.1%	18.9%	0.0%
At home, I use the Internet to play games.	18.9%	48.6%	32.5%
At home, I visit websites.	59.5%	35.1%	5.4%
Using the Internet at home is fun.	30.6%	22.2%	47.2%
School Internet use			
I use the Internet at school.	10.8%	86.5%	2.7%
I use email at school.	83.3%	13.9%	2.8%
At school, I use the Internet to play games.	24.3%	62.2%	13.5%
At school, I visit websites.	45.9%	45.9%	8.2%
Using the Internet at school is fun.	21.6%	43.2%	35.2%

home-based Internet use was inversely related to school-based Internet use, except in the case of playing games. That is, as home-based Internet use tended to increase, school-based exchanging email and visiting websites tended to decrease; as home-based Internet use tended to increase, school-based playing games tended to increase.

The pattern of correlations among children's ratings of Internet use items suggested interaction between microsystemic context (home and school) and type of Internet use (exchanging email, visiting websites, and playing games). That is, there were no significant correlations between

Table 2. Correlations among children's responses to Internet use rating scale items

Unabbreviated items	Abbreviated items (unabbreviated items on y axis)								
	Internet home	email home	games home	sites home	fun home	Internet school	email school	games school	sites school
I use email at home.									
At home, I use the Internet to play games.	.44**								
At home, I visit websites.	.38*								
Using the Internet at home is fun.	.69**	.39**	32*	.38*					
I use the Internet at school.	−.37*								
I use email at school.	−.31*								
At school, I use the Internet to play games.	.38*			.37*	.40**	−.29*			
At school, I visit websites.				.52**					
Using the Internet at school is fun.				.39**					.40**

*$p < .05$.
**$p < .01$.

playing Internet games at home and school and between using email at home and school. Noting that multiple hypotheses testing renders significance suspect, there was a moderate correlation ($r = .52$, $p = .001$) between children's reports of visiting websites at home and at school. Visiting websites was the only type of school-based Internet use to correlate with the rating scale item *Using the Internet at school is fun* ($r = .40$, $p = .015$). As children reported that using the Internet at home was fun, school-based Internet gaming tended to increase ($r = .40$, $p = .015$).

Table 3 presents the factor loadings for three principal components extracted from children's ratings of the Internet use items. Three reasonably discrete profiles of Internet use among young school children emerged suggesting three relatively distinct patterns of Internet use among six- to eight-year olds. The first component reflected 1) extensive and enjoyable use of the Internet at home to send email, visit websites, and play games and 2) limited and less enjoyable use of the Internet at school, most commonly to play games. That is, in describing differences between children, enjoyment was less important at school that at home. The second principal component reflected 1) moderate use of the Internet at home (most commonly to visit websites) and limited use of the Internet at school (most commonly to visit websites) where enjoyment at home was less important in describing differences between children than enjoyment at school. The third principal component reflected 1) limited use of the Internet at home (most commonly to exchange email) and use of the Internet at school (most commonly to exchange email) where enjoyment at home and school was equally important in describing differences between children than enjoyment. The first principal component accounted for 30.4 percent of the variance in children's ratings, the second component accounted for 19.4 percent, and the third explained 12.1 percent.

Discussion

Results of the current investigation are based on a relatively small ($N = 38$), and thus not likely representational, sample. Analysis and corresponding interpretations may not necessarily generalize to

Table 3. Factor analysis of Internet use rating scale items

	Principal component		
	1	2	3
Home Internet use			
I use the Internet at home.	.808	–.190	–.156
I use email at home.	.465	–.332	.343
At home, I use the Internet to play games.	.452	–.556	.128
At home, I visit websites.	.606	.585	–.020
Using the Internet at home is fun.	.790	–.181	.268
School Internet use			
I use the Internet at school.	–.569	.201	.441
I use email at school.	–.336	–.307	.753
At school, I use the Internet to play games.	.674	.120	.154
At school, I visit websites.	.206	.803	.126
Using the Internet at school is fun.	.198	.567	.420

all populations of young school children. Further, self-report data with young children is subject to biased responding and may reflect variation in children's attention span, reading ability, and motivation (Johnson, 2007b). Nonetheless, the current sample included almost all children in two classrooms, reducing some forms of biased sampling. Additionally, data were collected in classrooms with teachers and peers, thereby increasing the ecological validity of children's responses.

Results of the current investigation suggest high levels of Internet use among the sample of six- to eight-year old children. Both at home and at school, young children reported using the Internet, in order of frequency, to play games, visit websites, and exchange email. In general, more young children used the Internet at school than at home but home-based used, compared to school-based use, was more often perceived as enjoyable (Table 1). Burnett and Wilkinson (2005) argued that well-intentioned school-based efforts to protect children from Internet risks (e.g. offensive content) actually provide children with impoverished online experiences. Jackson and colleagues (2007) reported dramatic decrease in childhood access of offensive Internet content (i.e. pornography) at three months and again at six months following initial home connectivity.

During the early school years, the techno-subsystem abruptly expands to include Internet use across two primary environments, home and school. For the current sample, inverse relationships between home and school Internet use suggest that young children who frequently use and enjoy the Internet at home avoid using the Internet at school, particularly with respect to email but with the exception of playing games. While the majority of the sample of children rated both school and home Internet use as enjoyable (i.e. fun), there was no evidence of a relationship between enjoying the Internet at home and school Internet. Ideally and particularly during the early school years, home and school learning and social experiences are complementary. From an ecological perspective, home Internet use is controlled by family variables and influenced by child characteristics which include school Internet experiences. Simultaneously, school Internet use is controlled by classroom and teacher variables and influenced by child characteristics which include home Internet experiences.

The 10 Internet use rating scale items were reduced to three principal components interpreted as three patterns or profiles of Internet use among the sample of young school children. The first profile reflects a child whose extensive and comprehensive use of the Internet at home is coupled with limited Internet use at school, most commonly to play games. Children with this pattern of Internet use may aptly be referred to as *comprehensive home-based users* and, given the children's age, it seems likely that parents or other family members are supporting early childhood use of a range Internet applications (i.e. communicating, visiting websites, and playing games). The techno-subsystems of these comprehensive home-based users are defined by lack of Internet integration across immediate environments; this was the most common pattern of online behavior in the sample of participating children. The second profile suggests a child whose online behavior is limited to visiting websites, both at home and at school, but school access is preferred. Children with this pattern of Internet use may be referred to as *school-oriented information seekers*. The school-based Internet preference of these young information seekers may be interpreted as suggesting limited home Internet access (e.g. dial-up) and minimal familial support of online behavior (e.g. search engine instruction). School-oriented information seekers constituted the second most common pattern of online behavior in the sample of participating children. The third profile reveals a child whose online behavior primarily involves exchanging email both at home and at school, but school use is preferred. Children with this pattern of Internet use may be referred to as *school-oriented communicators*. Again, young children with this Internet use profile may have limited home Internet access and minimal familial support (e.g. grandparent–child email exchange). School-oriented communicators constituted the third most common pattern of online behavior.

To some extent, school-based Internet use during the early grades, at least with respect to the sample of participating children, might be assumed to satisfy the Internet literacy needs of both school-oriented information seekers and school-oriented communicators, where home-based support for Internet use appears limited. Both school-oriented young user profiles, however, reflected emergent Internet literacy that was restricted in application (i.e. visiting websites or exchanging email). Such restricted younger user profiles were common, collectively accounting for approximately one-third of the variation in children's perception of Internet use at home and school. Additionally, the pattern of principal component loadings suggests that comprehensive home-based users may be alienated from school-based Internet literacy experiences. Young (2007) argued that we must move away from adult-oriented attitudes toward technology and consider more carefully the skills, knowledge, and behaviors of those individuals born after the Internet revolution.

In highly industrialized societies, the complex developmental needs of children are necessarily addressed by social institutions beyond the family such as, most notably, the school. Unlike rigid structures of public education, families easily adopt new technologies in meeting the learning and social needs of their children. Based on in-depth interviews with parents, Van Rompaey et al. (2002) reported that the needs of children were a primary concern in the acquisition of home Internet technologies. Traditional early childhood school curricula focus on the promotion of literacy and socialization. For individuals born in the 21st century, Internet literacy and online social skills may be the more pressing curriculum concerns.

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