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Investigating Children's Emerging Digital Literacies

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Abstract:

Departing from the view that the digital divide is a technical issue, the EDC Center for Children and Technology (CCT) and Computers for Youth (CFY) have completed a 1-year comparative study of children's use of computers in low- and middle-income homes. To assess emerging digital literacy skills at home, we define digital literacy as a set of habits through which children use computer technology for learning, work, socializing, and fun.

Our findings indicate that both groups of children used the computer to do schoolwork. Many children with leisure time at home also spent 2 to 3 hours a day communicating with peers, playing games, and pursuing creative hobbies. When solving technical problems, the children from low-income homes relied more on formal help providers such as CFY and schoolteachers, while the children from middle-income homes turned to themselves, their families, and their peers. All the children developed basic literacy with word processing, email, and the Web. Not surprisingly, those children who spent considerably more time online developed more robust skills in online communication and authoring.

The results also show that children's digital literacy skills are emerging in ways that reflect local circumstances, such as the length of time children had a computer at home; the family's ability to purchase stable Internet connectivity; the number of computers in the home and where they are located (bedroom or public area); parents' attitudes toward computer use; parents' own experience and skills with computers; children's leisure time at home; the computing habits of children's peers; the technical expertise of friends, relatives, and neighbors; homework assignments; and the direct instruction provided by teachers in the classroom.

The findings highlight issues impacting social, school, and assessment policy and practice. Specifically, these results have implications for local educational systems interested in developing digital literacy assessment instruments that demonstrate progress as well as specific areas that need improvement. The digital literacy analysis model developed in this study affords teachers opportunities to start to construct activities based on 5 central digital literacy components: computing for a range of purpose, understanding the function of and ability to use common tools, communication literacy, Web literacy, and troubleshooting skills. These activities can help teachers scaffold for their students and themselves the range of digital literacy proficiency skills, that is, their proficiency in using common tools as well as their use of different communications and Web tools. However, when it comes to large-scale assessments of digital literacy of teachers and students at the national and federal levels, the use of the digital literacy analysis model outlined in this study would be operationally and financially impractical.

The field urgently needs to develop valid methods and instruments of assessment that help aggregate state and federal data as schools and districts at the local level acquire more and more technology. These methods and measurement instruments are likely to include surveys, e-readiness assessment tools, multiple-choice tests, pre- and post-tests, etc., that can measure individual as well as group progress in digital literacy.

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Investigating Children's Emerging Digital Literacies

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Introduction

For the past several years, policymaking around low-income children's computing has been driven by a concept of a "digital divide". The term "digital divide" as commonly understood refers to inequities of access to technology based on factors of income, education, race, and ethnicity (U.S. Department of Commerce, 2000). To rectify this issue, policymakers have funded programs that put students in urban and rural schools that serve high percentages of minority and low SES students "next to" technology. To date, it has been far easier to hook up computers, however, than to make them relevant to people's needs or to help people use them in empowering ways. Some researchers have suggested that efforts to improve people's circumstances with technology have gone unfulfilled because the digital divide has been defined as a *technical* issue rather than as a reflection of broader social problems (Light, 2001).

Rather than perceiving the digital divide as a problem of equal access to technology, an alternative construction defines the digital divide as a *literacy* issue. From this perspective, information technologies are viewed as cognitive and cultural tools used to manipulate symbols and share meaning. Indeed, business leaders, policymakers, and educators are in wide agreement that definitions of literacy must be widened to include skills with digital technology and that children will need the ability to use information technologies in order to function effectively as citizens and workers in the 21st century (CEO Forum on Education and Technology, 2001; International Technology Education Association, 2000; Lemke, 2002).

Multiple Conceptions of Digital Literacy

While there is agreement that a new set of 21st-century skills involving technologies is important, there is little consensus about precisely what knowledge and abilities are necessary for children to be information-technology literate. Most definitions of information technology literacy describe skills with specific tools—the ability to use a word processor or a search engine, or to configure an input/output device (Adams, 1984; Gilster, 1997; Inskeep, 1982). While such definitions have the virtue of specificity and measurability, they also present problems. First, they quickly become obsolete because of the rapidly changing nature of technology. In the 1970s, definitions of computer literacy involved identifying floppy disks and programming in BASIC (Inskeep, 1982), while now computer literacy includes the ability to unzip a zipped file and upload files to a server (Gilster, 1997). In addition, such tool-dependent definitions typically enumerate countless specific skills, begging the question of whether literacy might entail the development of more general capabilities that people may apply across tools and settings.

If these definitions are too specific, many others are too general. Business leaders, policymakers, and educators have sought to view technology-related skills within the wider frame of skills needed for contemporary business organizations, as well as citizenship skills needed for a civil society. The CEO Forum's School Technology and Readiness Report defines digital literacy as a list of basic and intellectual skills "including language proficiency, namely, reading, writing, listening and speaking; scientific thinking, defined as the knowledge of science, mathematics and the relationships between science, mathematics, and technology; and technological literacy, including competence in the use of computers, networks and digital content" (CEO Forum on Education and Technology, 2001). However valuable these broad definitions may be as guidelines for education, they are difficult if not impossible to operationalize for purposes of research.

Other definitions strive for a middle ground. Members of the library community, for example, faced with patrons who suddenly have access to vast, ill-organized databases and archives, define their goal as "information literacy," by which they mean, essentially, research skills—posing a question; identifying appropriate sources; finding, evaluating, or synthesizing information; or using it in a product (American Association of School Librarians, 2001). This is what might be called a problem-based definition of information technology literacy: it reflects the fact that our digital environment has created new challenges—learners who can potentially learn from vastly greater access to resources, but who can also be sidetracked, slowed down, overwhelmed, or tempted to simply copy and paste information without thinking. Other problem-based approaches to defining literacy focus on the dangers children purportedly face in using networked media, and on giving children the skills to navigate the web safely—not going to adult web sites, not giving personal information to marketers, talking only to people one knows, and so on.

Another interesting middle ground is the effort to define what have been called "generic" skills with information technology—conceptual and practical knowledge that cuts across tools and applications and reflects what is unique about the digital medium (Anderson & Bikson, 1998). These include an understanding of connectivity (the movement of data across a network), logic, and digital representation of information. They also include use of common tools like a word processor, email, and a spreadsheet.

Similarly, the National Research Council's report Being Fluent With Information Technology provides a hybrid description of technology fluency (Committee on Information Technology Literacy, 1999). This report defines fluency in terms of the following three elements: skills with tools, computing concepts, and intellectual capabilities toward solving real-world problems using technology. It is this concept that comes closest to the one we set out to explore in the research presented here.

Digital Literacy as a Set of Habits

From our perspective, digital literacy is best viewed as a set of habits children use in their interaction with information technologies for learning, work, and fun. This definition strives for a middle ground between tool-based skills and the purposeful use of tools in actual settings. Specifically, the set of habits comprising this definition of digital literacy includes the following five dimensions:

- their *troubleshooting* strategies;
- the range of *purposes* connected to their computing;
- their skills in *using common tools* such as word processing, email, and web searching;
- their *communication literacy*—how they use email, Instant Messaging, and other tools to talk to peers and adults; and
- their *web literacy*—how they use the web to find, cull, and judge information and their skill at creating web-based material themselves.

Below, each of the dimensions is described more fully.

Troubleshooting

Fluency on this dimension means being able to keep one's computer running when faced with inevitable technical challenges. The closer an individual is to becoming a technical problem-solver, the greater that individual's troubleshooting fluency. People with the highest level of troubleshooting fluency have the knowledge and confidence to solve technical problems themselves. People with a moderate level of troubleshooting fluency can find technical help from "close" family members, friends, or colleagues. Those who do not personally know anyone who can help them but who know how to call on more formal channels of support (e.g., phoning a help desk) exhibit the next lower level of troubleshooting

fluency. Individuals with the lowest level of troubleshooting fluency are those who do not get their problem fixed: he or she knows of no one who can help them nor do they make use of any formal channels of support, either because they do not know of any available to them or because they are afraid or uncomfortable to use them. Given the large number of technical problems that arise for people using home computers (Keisler, Zdaniuk, Lundmark, & Kraut, 2000), these are skills and habits that are essential and currently underrepresented in the literature on information technology. If technical problems are not surmounted, literacy levels in other categories will be greatly constrained.

Purposes

This dimension of literacy refers to the social and personal ends that computing serves. Purposes can be school-related, communicative, recreational, practical/informational, or income-related. In this dimension, greater fluency means greater variety of purposes: a child who uses the computer to work on school projects and chat with friends and help a parent find a phone number and play games is more fluent than one who uses the computer for only one activity.

Literacy With Common Tools

This dimension of digital literacy means using and knowing what to expect from standard or common software tools. These tools include the computer operating system for file management, a word processor, email, a spreadsheet or database, and programs for displaying graphics and audio files. Greater fluency with these tools means both more differentiated use, namely the familiarity with a range of tools, and more depth in using any single tool. We define "depth" as using more than the routine or surface-level features of a program to achieve individualized or personalized results or effects. In using a word processor, for example, a child who varies font style, color, and formatting to achieve an effect in a poem is demonstrating greater fluency than a child who never varies formatting or whose font or color changes are aimless. In this way, fluency with tools is connected with the concept of authorship—using technology to put one's own stamp on the world.

Communication Literacy

This term refers to children's use of computer-mediated communication tools—email, instant messaging, chat, bulletin boards—for a range of purposes from recreation to work. Fluency in this dimension means being able to mobilize features of these tools for differentiated ends. The child who uses email or Instant Messaging only for recreational text-based chatting, for example, is less literate than the child who also uses the file attachment feature to send and receive text or audio files, or who copies URLs into messages to help a friend/relative access a recommended web site, or who creates online chat profiles that include no identifying information, in order to protect his/her own privacy.

Web Literacy

This dimension of literacy refers largely to children's level of ability to find and interpret information and represent their own viewpoint within the complex and chaotic information environment of the web. Greater fluency here means more effective research or "information literacy" skills, such as more effectively using search engines to find information; taking a greater evaluative stance toward information (e.g., the commercial nature of much web material); and using a browser's features to more effectively organize (store and retrieve) web material or make use of web material (e.g., cut and paste web information, or cite it correctly). It also means understanding the limitations of the web as a medium, for example, in comparison to other media such as books and the library. Finally, it means establishing a "voice" within the web medium—creating a web page, contributing one's views or artwork to an existing site, etc.

Examining Digital Literacy in the Home

While literacy skills may be taught in schools or libraries, they are practiced and fortified at home. Moreover, these skills are situated in particular practices and approached by children's homes and local communities in their own ways (Brice-Heath, 1983). For example, Brice-Heath found that in the communities she studied children learned quite different habits of storytelling and language use at home than at school, and the literacy practices at school drew on some of these habits, but not others. Just as early childhood experiences like drawing pictures, reading cereal boxes, telling stories, and writing notes are the foundations of print literacy, the experience and knowledge children gain at home as they engage with video games, handhelds, email, Instant Messaging, and audio file sharing may help them understand the grammar of digital media. Children developing digital literacy in their homes are likely to do so in ways that reflect their own particular environment and culture. In addition, literacies are always situated in particular communities and particular practices (Street, 2000).

To examine students' digital literacy and how these literacies are acquired, we undertook a comparative study that was guided by the following question: *What kinds of digital literacy are emerging for children in low- and middle-income households where there is access to computers and the Internet, and why?* More specifically, we focused on: (a) the kinds of literacy that children are developing around information technologies in their home environment, and (b) how this literacy relates to computing activities around learning, work, and play.[1]

Research Design and Methods

Case studies were conducted as part of a collaborative evaluation by the Education Development Center's Center for Children and Technology (CCT) and Computers for Youth (CFY) to document effects of a CFY technology project that seeks to improve low-income students and their families educational, social, and economic prospects by giving them the means to develop computer and Internet skills. Through the CFY project, hundreds of low-income families received, free of charge, a used computer with Internet access for use in the home, as well as training, technical support, tailored web content, and email accounts on a community-wide system. While individual case studies of families participating in the CFY project alone would provide valuable insights into the project's effects, case studies were also conducted in a comparison middle-income cohort to better elucidate the dynamic between home environment and technology literacy.

This comparative study included 19 students and their families: nine low-income families and 10 comparison middle-income families. All the low-income families were selected from two middle-school communities in New York City who were participating in the CFY project. Eight of these families lived in Southchester and had children enrolled at CFY's first school partner: the Academy for Scholastic Excellence (ASE). One family lived in Eastside Heights and had a child enrolled at another CFY school partner: the Power through Arts and Community (PAC) School. (See Appendix A for a description of the schools.) The 10 middle-income families were selected from two middle-school communities in suburban Greenville, New Jersey, a small, racially and socio-economically mixed residential suburb located 20 miles west of New York City. (See Appendix B for a description of each group's characteristics.) [2]

The recruitment of children and families for the study was different in the low- and middle-income communities. In the low-income communities, comprehensive information was collected from parents in the two CFY participating schools to recruit a diverse group of families. Families were invited to participate through letters and consent forms brought home by the students.[3] In the middle-income community, a researcher's social connections and knowledge of the area was used to select families for the study. The researcher, who lives in Greenville, had access to 7th- and 8th-grade class rosters from the local middle schools and was able to select children from a range of academic rankings.

Despite the differences in recruitment, one set of criteria was used to select the final sample of families from each community. The selection criteria were defined at a sample level as well as a family level (see Table 1).

Table 1 Selection Criteria

Sample-Level Selection Criteria	The sample should include a range of ethnicities, including both African American and Latino families. The sample should include both immigrant and non-immigrant families. The sample should be gender-balanced with regard to its key student informants. The sample should include families in which key student informants represent a range of academic achievement levels.
Family-Level Selection Criteria	Families must have a child in grade 7 or grade 8. Families must have a working computer and Internet access. The language spoken at home must be either Spanish or English.

Research Instruments and Data Collection

The development of digital literacy assessment is hampered by many factors, particularly the lack of consensus on what constitutes measurable dimensions of digital literacies. As discussed previously, the existing literature uses various concepts to describe what we have defined as *information technology literacy,* a hybrid framework encompassing skills with tools, computing concepts and abilities, and cognitive capabilities toward solving real-world problems using technology. It is also difficult to construct assessment/measurement instruments that take into account the ever-changing nature of computers and the Internet. Thus, we refer to an *emerging* digital literacy analysis model, which strives to reflect a specific range of competencies likely to be developed in children living in low- and middle-income families.

The CCT-CFY team developed interview instruments for both parents and children. The parents' interview focused on family demographics, literacy practices, technology use and meaning, social networks, and social interaction. The children's interview and computer tour (e.g., show-and-tell exercise) were designed to map out a child's experiences with his/her computer and to identify his/her degree of engagement with these tools in the home setting.

CCT researchers made a total of 49 home visits to these families (two or three visits per family) to observe computing practices and family environment, and to engage children and family members in interviews and computing activities. Home visits lasted approximately two hours and were conducted between the months of November 2000 and July 2001.

Data Analysis

Researchers analyzed the family interview and observation data thematically (see Strauss & Corbin, 1990) around the following themes: family's housing conditions, immigration status, ethnicity/race, and number of children; parents' profession, education, and experience with computers and Internet; family's reading practices and TV-watching patterns; the location of the computer in the home; and the participating children's ages, academic track, and computer interest and use. These data were critical in forming the contextual backdrop to our interviews and observations of children.

For the child interviews and observations of computer use, we analyzed the data along the five dimensions of digital literacy as summarized in Table 2.

Table 2 Digital Literacy Analysis Model

Dimensions of Literacy	**Aspects of Each Dimension**					
Trouble-shooting	Self	Peer	Parents	Siblings	Neighbors, Extended Family	Professionals
Purposes	School-related	Communica-tion	Recreational	Informational	Income-related	
Tool Use (Applications)	Word Processing	Image & Audio Tools	File Management	Search Tools	Communica-tion	
Communication Literacy	Email	Instant Mes-saging	Chat	Bulletin Boards		
Web Literacy	Search Strategies	Organizing Information	Evaluating Information	Authoring		

Findings

The findings are organized into two sections: a) major findings in both communities and the interrelated factors strongly influencing children's home computing practices, and b) detailed comparisons of low- and middle-income children's digital literacies across the five dimensions.

Major Findings

Across the two communities, all the children in the study used their computers to do schoolwork. Many children with leisure time at home also spent two to three hours a day communicating with peers, playing games, and pursuing creative hobbies. Children from low-income families, however, had fewer resources available to them for solving technical problems than children from middle-income families. Low-income children relied more on formal help providers such as CFY staff and schoolteachers, while middle-income children relied more on themselves, their families, and their peers. Overall, we found that all the children in the study developed basic literacy with word processing, email, and the web. Not surprisingly, those children who spent considerably more time online developed more robust skills in online communication and authoring (see Table 3).

Table 3 **Summary of Comparative Findings: Literacy Skills That Are Paramount in Each Community**

Dimensions of Literacy	Major Literacy Skills in Each Community	
	Children from low-income homes	Children from middle-income homes
Troubleshooting	Use professional help providers	Use self, parents, peers, extended family
Purposes	School-related purposes	Communication with peers
Tool Use	Surface-level fluency	Fluency with surface-level and advanced features
Communication Literacy	Email	Instant messaging, email, chat rooms, bulletin boards
Web Literacy	Basic web search & file management	Basic web search, file management, evaluation, and authoring

We also found that children's digital literacies were emerging in ways that reflected their local circumstances. In each community, children's home computing practices were strongly influenced by the following interrelated factors:

- the length of time children had a computer at home;
- a family's ability to purchase stable Internet connectivity;
- the number of computers in the home and where they were located;
- parents' attitudes toward computer use;
- parents' own experience and skills with computers;
- children's leisure time at home;
- the computing habits of children's peers;
- the technical expertise of friends, relatives, and neighbors;
- homework assignments; and
- the direct instruction teachers provide in the classroom.

Children's Digital Literacy in Low- and Middle-Income Homes

This section presents findings for each literacy dimension for children from low-income and middle-income families. Findings are presented in the following order: troubleshooting literacy; the differentiation of children's purposes for using their home computer; their literacy with common tools; their communication literacy; and their web literacy. It is important to emphasize that the majority of low-income families in our sample were members of a unique school community, the ASE community. With its extended-day and mandatory weekend schedule, ASE substantially influenced the computing patterns and habits of these students. As such, it may be difficult to generalize findings from this low-income community to others.

Troubleshooting Literacy

Students from middle-income homes evidenced fluency with solving technical problems themselves or finding technical help close by, whereas children from low-income homes were found to rely on formal channels of support.

As new computer users, the children from low-income families were unable to rely solely on themselves, siblings, parents, or neighbors for technical support. In only a few of these CFY families (three out of nine) did parents (specifically, fathers) provide some home technical support to their children. Older siblings in low-income families were also perceived as knowledgeable about computers and, thus, provided some level of technical support in the home.

Largely, though, when dealing with computer and Internet issues, most children in this study from low-income families (seven out of nine) reported that they

called the CFY help desk and asked for assistance with their computer and Internet issues. Families who needed computer repairs made use of two of the options offered by CFY. Some requested help from a CFY-approved computer technician who then visited their home for a modest fee. Some brought their computer to their child's school where CFY repaired the computer. If they couldn't find a convenient time for CFY staff to work with them, children usually asked their science and/or computer teachers for help.

> *In recent weeks we used the services of CFY staff to fix the CFY computer Internet connection and received an upgrade of computer parts and training. CFY repaired our Internet connection, put in new sound cards, and got us free Internet access. [Valentina reported taking a bus and a subway to reach the place where CFY was making repairs.] CFY made it [the computer] better. We got more than what we were expecting.*
>
> Valentina, 12, CFY

> *I called the 1-800 number, the* [CFY] *help desk, because I deleted my Internet password, and also wanted some information about our billing problems.*
>
> Krumah, 12, CFY

> *I called the CFY number [help desk]. Two weeks later, someone from CFY came and fixed it. The computer is now working perfectly. . . . If I have problems with the computer, I always can contact my computer and science teachers who always get back to me.*
>
> Adriana, 13, CFY

> *If I have questions about the computer, I ask Mr. Feldman [science teacher] at school. He helped me reinstall the software programs on the CFY computer.*
>
> Luis, 12, CFY

Unlike their low-income counterparts, the children from middle-income families did not use telephone help lines or teacher support but rather tried solving problems themselves or were assisted by family and friends. When troubleshooting problems themselves, these children did so mostly by trial-and-error and, more rarely, by consulting manuals or on-screen help. The types of troubleshooting they described included: getting peripherals to work when setting up a new computer (by using an on-screen manual), overcoming persistent crashes (by reinstalling a program), recognizing server failures (by interpreting error messages), and finding misplaced files (by searching the computer hard drive).

> *My brother and I set up the computer all by ourselves, and when we didn't know how to do something, we went to the HP Tour guide to figure it out.*
>
> Lucy, 12, Greenville

> *When Cole, 13, kept getting "server not found" messages for a chat page he likes (Damaged.net/pwchat), he first retyped the URL twice, then said: "Let me try a different address—htloz.com. It's another way into the damaged.net server."*
>
> Fieldnote, Greenville

These children's troubleshooting strategies did not always work, but they displayed confidence and resourcefulness:

> *Mike, 12, said that when he got error messages when trying to play a sound file he had downloaded, he typed them into the search box in the ask.com web site.*
>
> Fieldnote, Greenville

Not all children from middle income families, though, demonstrated a level of personal confidence in their own skills for troubleshooting technical problems. Two of the six girls from Greenville perceived themselves as the cause of something going wrong. One said: "I don't want to [download anything]. I did that before, and I broke the computer." But the four other girls showed confidence in troubleshooting problems themselves.

When unable to fix a problem themselves, all ten children from middle-income families sought help from others—first and foremost, from others in their house. Six turned to parents, and three to older siblings. (When older siblings were in the household, they were usually deemed the computer expert.)

> *If I can't figure it out I ask my dad for help. He does a lot of stuff with computers in his job.*
>
> Ben, 13, Greenville

Two of these children described getting help from extended family members such as uncles or cousins. Three children from middle-income homes turned to peers for help, usually school friends, especially around the use of Instant Messenger (such as managing Buddy Lists). Two sought help online, from the Microsoft and ask.com web sites.

Children's Purposes for Computing

The children in this study from low-income families mainly used their home computers for schoolwork, followed by using the computer for communication and recreational purposes. Comparatively, the children from middle-income families mainly used their home computer for communicating with peers, mostly using Instant Messaging, followed by recreational purposes (e.g., playing games, browsing web sites, and downloading files), and then by school-related purposes. Each type of use, school-related, recreational, and communication, is described separately.

School-Related Computing

Seven of the children from low-income families said that they primarily used the computer for school-related activities; only two children from middle-income families identified schoolwork as their primary purpose for use. Nonetheless, children from middle-income families seemed to use the computer in more advanced ways for school-related activities.

Most of the children from low-income families (seven out of nine) used the home computer to complete and enhance their schoolwork. Their school-related activities included searching the web for answers to questions posed by their teachers, searching for information on CD-ROMs like Encarta, and typing their homework (for example, science experiments, book reports, essays on literature, language arts writing contests, social studies projects, and math problems).

The CFY children made the following comments about their schoolwork:

> *I write my papers with the computer. I did a project on the Oregon Trail. We wrote, we had a poster board, and we had a map. In social studies, I use it [the Internet] to answer questions like 'which person made this machine at this year?'*
>
> Adriana, 13, CFY

> *Well, I usually use it [the computer] for homework. We had to do social studies book reports. If you type your book report on the computer, you get ten extra points on your grade. That's the reason I like to go on the computer. For instance, you get ganas, it's like extra credit, if you do something on the computer, you type it or something, that's what I really like about the computer.*
>
> Tisha, 12, CFY

> *We also have every month, we have a contest, a writing contest. We have to do it in our class. And they want it typed, so we have to type it.*
>
> Luis, 12, CFY

One child from a low-income family used her home computer for schoolwork less than the others; she used the computer at school to complete her schoolwork before she got home because she felt that her older sisters monopolized the home computer. One other child from a low-income home indicated that she spent more time on communication and computer games than homework.

All the children from middle-income families said they used the computer for school-related tasks at least once every two weeks. School-related uses moved to the forefront at times when reports or major assignments were due. But these children differed from children from low-income families in the degree to which school tasks were central in their overall computer use.

For 5 out of 10 of these Greenville children, school-related tasks took a back seat to communication and recreation. Their school-related computing was limited to two common tasks—typing reports and homework assignments, and occasionally looking for information on the web. They fit in their homework around their recreational computing, rather than the other way around.

> *I usually type my homework in the morning before school, when my friends aren't IMing. I don't want to miss anything.*
>
> Darla, 12, Greenville

Three of the 10 Greenville children said that their school-related computing followed close behind, or was about equal to, their chatting and recreational computing. These three children were in the high academic track, but also spent a great deal of time in online recreation. They appeared to balance school and non-school computing fairly successfully, aided by their parents, who set limits on their chatting and game playing, getting involved in finding good software and web sites for their school projects, and teaching them how to manage their time and the multiple demands on them.

The boundary separating computer use for fun and for work was fluid for some children and a challenge for others. One Greenville boy said that he couldn't concentrate on his homework unless he was online with Instant Messenger open, able to switch back and forth between typing his homework and chatting. If not his mind became "too restless." Others worked to maintain the boundary between work and fun. One Greenville girl said she went online to do homework using her mother's screen name not her own, because "I'm not like other kids. I really need to concentrate to do homework, and I get distracted too easily if people are private messaging me. Also, I think it's rude not to respond to them."

One Greenville child, Cole, exemplifies a child who balanced school-related and recreational computing. He was being home-schooled by his mother and had a lot of studying to do at home, but he was also very involved with the computer: playing computer games, taking a course in Japanese on the computer, learning about programming, and studying topics and questions his mother assigned using web sites she identified.

> *We've visited the whole world. There's so much information. We can hear French radio to reinforce our French. There are books online. We can read the Constitution, or the Declaration of Independence. We study the Amendments and look right at them.*
>
> Carla, Cole's mother, Greenville

Two of the 10 children from middle-income homes in Greenville said that school-related tasks were a focus of their computing activity, well surpassing their recreational computing. Renee, a girl in the high academic track, said, "The computer is mostly about work for me. I have so much work!" For example, her work consisted not only of typing and web research, but also web-based simulations and web quests (inquiry exercises) that her teachers assigned, and more elaborate science projects involving graphs and spreadsheets.

Three of the more school-focused Greenville children showed the researchers technology-related schoolwork that was more in-depth than a report written with information from the web. One girl had done a stock-watch simulation for her social studies class, requiring her to pick a stock and follow its value all year using web sites and the newspaper, then write a report summarizing the stock's performance at the end of the year.

> *Mrs. Wiggins, my math teacher, assigned [the stock activity] towards the beginning of the year. Our goal was to pick two stocks that we thought would earn us money. We recorded the stock's information about once every month, or went back to a month using the historical quote function on the web site. Our goal was to gather enough information to write our paper, and draw a graph. Stocks are a great way to study math; we had to figure means, medians, and modes, all of which we were reviewing that year. I know that stocks could be a major part of my life later, and it was helpful to learn about how they work and make us money.*
>
> Eliza, 12, in an email, Greenville

Another girl from Greenville showed researchers a science fair presentation on "killer backpacks" in which she used Excel and a graphics program to summarize data about a survey of backpack weights and back pain experienced by fellow students. Both these children were in the high academic track, where they were given more ambitious assignments than other children in the school.

Cole, the Greenville boy being home-schooled, showed the researchers an assignment asking which events led to American involvement in the Vietnam War, for which he had used the web to find out about French Indo-China and the anti-Communist fervor that followed World War II.

Recreational Purposes

Whereas most of the children from low-income homes cited recreational computing as a secondary purpose following school-related computing, 8 out of 10 of the children from middle-income families said that for them, using the computer was "mostly about fun" rather than "mostly about work." Children from both low-income and middle-income families described using the computer for playing games, visiting music sites, and downloading music files and pictures. Three children, each from middle-income families, used the computer for in-depth, creative, recreational projects—only one child from a low-income family, reported participating in a comparable activity.

Children from low-income homes cited playing games as their most common recreational activity. They played computer games (e.g., Solitaire, Minesweeper), games available on the Internet (e.g., chess, raising virtual pets), and games on CD-ROM (e.g., Barbie, Dr. Doolittle, Math Blaster). One child, Renee, authored a series of mystery stories on her computer. Others visited music sites and downloaded music files or pictures of musical celebrities they liked (e.g., Back Street Boys, Big Pun, Cuba); some typed letters and music scores. Another recreational activity the children cited was sending and receiving email and using Instant Messaging.

Within the CFY cohort, stark differences were observed in recreational computer use between the one PAC student in the study (who had a large amount of leisure time during the week because her school day ended at 2:30 p.m.) and the ASE students (who had very little leisure time during the week because their school day ended at 5:00 p.m.). In fact, many ASE students could pursue recreational computing at home only on weekends.

For children from middle-income homes, their most common recreational pursuits (excluding communication) were playing games, browsing the web, and downloading music files and pictures. As noted earlier, a subset of three Greenville children used the computer for sustained, in-depth pursuits of hobbies or interests.

Games played by children from families with middle-incomes included CD-ROM-based games like X-Men and the Sims, educational or "edutainment" titles like Math Blaster or Carmen Sandiego, and common computer-based games like Solitaire and Free Cell. Five of these Greenville children said they played games on the web regularly, including Neo-Pets (an adopt-a-pet game), doll dress-up games, online chess, and networked battle games where they competed with remote players.

> *Mostly I like playing games, like Sonic Adventure, or Spiderman, or Arcade. We also have learning games on CD-ROM, like Treasure Math Storm. I used some of the CD-ROMs in school and then I asked my mom, and she got some for me.*
>
> Phoebe, 13, Greenville

Browsing the web was a popular recreational activity for 6 of the 10 children from middle-income families. The web sites they visited were most often related to commercial entertainment and products such as MTV, Gap clothing, bands, and movie and TV celebrities.

> *I go to freearcade.com to play games, and I like going to sites for the bands I like, like korn.com, blink182.com, and eminem.com.*
>
> Craig, 12, Greenville

> *Someone will say, oh you've got to check out this site I found—the perfectjoke.com, or the Internet movie database. We don't really talk about the computer—we just talk about what we saw on it.*
>
> Eliza, 12, Greenville

Finding and downloading music files was a popular activity for 4 of the 10 children from middle-income homes. (Napster was a very popular file-sharing utility during this research.)

> *[The Napster] Library is my favorite—it's where all my songs are stored. They're alphabetical—most of my songs start with I for Insync [sic]. [She pulls up a track and plays it and the music comes pulsing out of the multimedia speakers.] This is their latest song. It's from their new CD, that's not out yet.*
>
> Lucy, 12, Greenville

Finally, 3 out of 10 of the children from middle-income families created their own homepage using AOL templates (which make the process relatively easy). The pages consisted of basic personal information, such as favorite music and web sites, and in one case, original poetry.

Three children from middle-income homes, Cole, Eliza, and Ben, stood out in their recreational computing because they engaged in in-depth recreational projects using the computer. Cole maintained his own web pages devoted to the electronic games he loves, hoping to attract the sponsorship of the gaming companies. He regularly emailed hosts of similar sites, and contributed game reviews to their sites. All told, his own site had registered 1,123 hits during the time of the research.

> *This is the gaming site....[types in www.geocities.com/ gamingzone2002] I wrote all the reviews. Here's my review for Guilty Gear X. This is the best one I ever wrote, because I wrote in paragraphs. And I had the set-up [layout] nice, with the pictures, and the text all put together.*
>
> Cole, 13, Greenville

Eliza, a girl who was very involved with music, composed songs using a music-writing program her mother gave her as a present, typed her poems and lyrics using MS Word, and visited web sites devoted to song writing and song lyrics in order to get ideas.

> *Sometimes if I like a song we're doing in chorus or something I'll borrow the sheet music from the teacher and then copy it into this [Midisoft Desktop Music 2000]. It takes about an hour, but it's worth it. 'Cause I can play the parts back, one part at a time. So for the tricky rhythms I can see what the left hand's doing, what the right hand's doing on the piano.*
>
> Eliza, 12, Greenville

Ben and his best friend were bored playing video games every day after school until they found several web sites devoted to *BattleBots,* their favorite television show, and began building their own robot to enter into competition. Guided by information posted on the web sites, they created an initial robot design, then revised it as they built the robot piece by piece in Ben's basement. They used a spreadsheet to keep a budget for the money raised from neighbors and parents' co-workers, used a computer-aided-design program to make more elaborate 3-D drawings of their robot, and queried design experts on the web sites when they needed help with a mechanical or design problem.

> *Building the robot has been going great. We found this program called Rhino 3-D, it's a 3-D design program and it let us design the body in 3-D. To buy the CD-ROM costs 739 bucks, so we downloaded it on the web. It's better than Auto-CAD for us; with Auto-CAD you can only design stuff in two dimensions—width and height. In Rhino, you can see the design from four different points of view. We saved the file, the different views, and we printed them out. It's helped us see what the bot's going to look like, and how to make changes.*
>
> Ben, 13, Greenville

Interestingly, a theme that emerged among families with low-incomes that was not dominant in families with middle-incomes is that for most children from low-income homes (seven out of nine), recreational time on the computer was family time. Family members spent time together typing their mother's college homework, writing letters to relatives and friends in other countries, writing to newspaper editors, scanning old family pictures, typing ancestral songs and religious verses, or scheduling church meetings and events. These families appeared to have very strong sibling and parent-child ties, and the computer seemed to provide a place for increased family interactions.

> *Before we had the computer in the home, we didn't get together much to do stuff. Today we use the computer together when I am typing my school [college] assignments, searching for things like scholarships on the Internet, playing games on the Internet, and scanning old family pictures.*
>
> Roberta's mom, Teresa, CFY

> *We explore the Internet together and show mother/dad about Yahoo. We'll search historical stuff about Mexico, ancestors (Maya, Aztec emperor). We found a free English tutor for Mom [who is learning to speak English]. Dad gets Spanish news at the web site 'UNO Vision.' ... Some of the information about Mexican emperors we obtained from the Internet are posted on our living room walls, and the Mexican songs and religious items we typed are put in a binder.*
>
> Juan, 12, CFY

Communication

Using the computer for communicating was evident in both communities but was exceedingly more common in the middle-income homes. Children from homes with low-incomes cited some use of email but communication was not a dominant use of the computer especially in comparison to their middle-income counterparts who used the computer for communicating on a regular basis. The types of communication and tools used for communication are elaborated on in the section *communication literacy.*

Literacy With Common Tools

Children in both cohorts exhibited functional fluency in using common computing tools. Children were able to manage files and do word processing among other things. The most obvious difference in this literacy dimension is in their ability to make more individuated uses of the applications.

Both groups of children exhibited an ability to use many of the applications such as Microsoft Word, their email program, Internet Explorer, and interactive games. Children also showed how they managed files using their computer operating system and how they searched for information using a search engine. While children from low-income homes were able to demonstrate these skills, they were not yet completely fluent with such tools as defined by the ability to make more differentiated and personalized use of the applications. Four of the 10 children from

middle-income families exhibited fluency with advanced features of several tools to enhance their self-expression and creative abilities. In addition, the children in the middle-income group used a more diverse set of computer programs and tools than the children from the low-income group. These children from middle-income families used more audio and graphic programs as well as Excel and PowerPoint.

The children in the study from low-income families primarily used Microsoft Word, exhibited basic file management skills, were able to use programs on CDs, and could work with email attachments. All of these children had some file management skills and could, for example, locate files they had stored on the hard drive, open them, and save them as new files. The relationship between documents and the application that created them seemed less clear to many, except in the case of Word. Some, but not all, of these children from low-income families also knew how to change features of the desktop such as the background, and how to download and install files on the computer. They understood the difference between a file and a folder and the interface/relationship between the file management system in the hard drive and the visual representation of some files on their computer desktop. For example, most of them pointed out during the computer tour session that the file management system allowed them to get more detailed information about the documents in the computer.

> *We can see the documents and then we get everything more in detail. My dad and science teacher said don't mess with it.*
>
> Maya, 13, CFY

> *They told us in school that the hardware is basically like the computer's brain. Like the hardware is where it does everything. Where it has like all the information. Okay, then on the next icon is my documents and it has like all the documents that I've written.*
>
> Valentina, 12, CFY

Microsoft Word was the application the children from low-income families used most often. With word-processing, they knew how to use features like Help, Save, Zoom, Cut and Paste, Open New File, Format Documents (e.g., font/size, bold/italic/underline, and page justification), Insert Picture, and Spell Check. The children used these functions every day in typing their homework assignments.

Another program used by the children from low-income homes was ACCU-Type, which helps users learn how to type. In addition, more than half the children (six out of nine) knew how to play online interactive games (e.g., chess). Some of the children (four out of nine) had access to CD-ROMs, which their parents purchased and which were usually educational (e.g., Encarta, Math Blaster). These four children knew how to use these CD-ROMs to search for information for schoolwork; find fun artifacts (e.g., music, pictures); and manage these digital information files by downloading them or bookmarking them. Further, they were aware of the filter (CyberSitter 2000) installed in their computer.

> *The filter means you can't get access to certain web sites. I have Cybersitter. It's sitters, you know, like babysitter. Cybering's like when you're on the Internet. It is just something that blocks sex images and things that aren't supposed to, you know. It stops little kids from watching things they're not supposed to be watching.*
>
> Valentina, 12, CFY

In addition, all of the children from the low-income homes knew how to send and receive email and file attachments via the Internet. Most important, they knew when the best times were to connect and whether they were connected to the Internet.

> *My Internet is working. No, it's just that sometimes at a certain point of the day there's like a lot of people on the Internet and then all the lines are busy. Usually it happens on the weekends because people are not at work. Like on the week, usually like when I get home around 6–6:30 and I get on the Internet before 8:00 it's great till like 9:00. If I log onto the Internet like after 9:00 it starts getting busy.*
>
> Juan, 12, CFY

As mentioned earlier, all the children from middle-income homes had at least basic or functional literacy with file management and word processing. In addition, just over half (six) were becoming fluent with a new generation of graphics and audio tools. Four achieved fluency in using the advanced features of several tools to enhance their self-expression and creative abilities.

All 10 of these Greenville children from middle-income homes showed a functional grasp of their computer's operating system and the basics of file management. For example, they could navigate to and open applications and files in multiple ways (using the Windows Start menu, or the Apple Finder, or starting from either a file or an application), and could save and retrieve files from multiple storage media (floppies, hard drive, email).

Three children from middle-income families showed greater fluency in the ways they managed files, by storing and sorting them according to a personalized organization scheme. For example, Eliza, 12, sorted her files into separate categories with labels like "Projects—Typing," "Songs," and "Personal Writing." Every six months Renee, 13, culled from her desktop folder the files she was very interested and invested in, and saved them on a floppy disk. She had filled six floppies, with labels such as "Renee–academic" or "Renee–poems." These children were thus learning to organize and store the often ephemeral-seeming world of computer data in terms that corresponded with their own identity and interests.

All 10 of these middle-income Greenville children showed facility with word processing software, which they used regularly for school tasks and sometimes for their own personal and recreational uses. Over half of the children (6 out of 10) appeared to have functional literacy with word-processing features. For example, they knew how to use basic text formatting features like changing font style, size,

and color and how to cut and paste text from other sources (such as web pages) into text documents. Lucy, for example, liked to print out her work in a pink font. But like other children with basic facility, she did not change fonts to any particular effect:

> *I like using fonts like Century Gothic, Comic Sans, Jokerman, Juice. Because they're fun. I don't use them with my English teacher, though—he's proper. He would tell me, 'Just use a font that I can read.'*
>
> *Lucy, 12, Greenville*

Four of the 10 children from middle-income homes were fluent with word-processing features—for example, they used the margin feature to vary the line shape of poems they had written, they incorporated images and Excel charts into a report, and they used the "track changes" feature to monitor edits in a co-written document.

One child had difficulty typing and felt this slowed her down a lot compared to her peers. For the rest, typing was not perceived as a difficulty. It was a skill they had acquired through email and Instant Message communications (4), through classes they had taken in school (3), and also by working with learn-to-type programs their parents had bought for them (2). Five of the children from middle-income homes were very fast, fluent typists.

These Greenville children learned to use programs other than Word such as Excel. Two of the children had used Excel spreadsheets—one in creating graphs for a science fair presentation, the other in maintaining a budget for a personal project he and a friend were doing. Both learned the program with the aid of a parent.

Several of the children from middle-income homes also developed skills in using graphic and audio tools. Six of the 10 children had acquired basic literacy with new consumer-level tools for capturing and manipulating images and audio files. Five of the children created digital pictures using a digital camera or scanner, and manipulated them using graphic software like PhotoShop and Barbie Photo Designer. Three children helped parents or siblings put family photographs onto their computer for use as screensavers and also as a way to share them with relatives, via email. Two children used graphics software to open and resize celebrity photos they had downloaded from the web before putting them on their bedroom walls. One girl recorded audio messages with her brother and sent them to friends during IM sessions. Four used simple graphics software like Greetings Workshop, Windows Paint, and Disney Art Studio to create birthday and holiday cards and sent them to friends and relatives.

Five of these Greenville children also used the web-based audio tool Napster to find and download songs they liked from the web. Children were taught to use Napster by older siblings, friends, and sometimes by parents or other relatives. In two families children downloaded songs as part of family gatherings, in others they did so privately or with friends. One child used a CD burner and Adaptec software to create mix CDs for two friends.

Most of the children from middle-income homes used these consumer-level image and audio tools for informal family communications and entertainment. Three, however, created more polished presentations using the features of these tools. One boy helped his father (an audiovisual producer) create and run a PowerPoint slideshow for an event that the father was working on. Two others created PowerPoint presentations for their social studies class that were organized nonlinearly and used graphic and audio elements to deliberate effect.

> *Usually when kids do PowerPoint they just have a slideshow playing. You just press buttons; you don't get to perform what you know. But I like to speak. I like drama too. So we did [a presentation] where we stood at the front of the class, and played music with each slide, and then spoke over it.*
>
> Eliza, 12, Greenville

Communication Literacy

An interesting distinction emerged in regards to children's communication literacy: While students from low-income families mainly used email, children from middle-income families used Instant Messaging extensively while also expressing familiarity with communicating using email, chat rooms, and bulletin boards.

The CFY children's online communication literacy skills consisted mainly of emailing peers and friends. Notably, while Instant Messaging was common practice in the middle-income community, only a couple of children from low-income families (two out of nine) were starting to engage in Instant Messaging (IM) and chat activities by the end of this study. All of these children were familiar with email, often learning to use it from CFY training and from school.

> *Sometimes like the teachers, like they want us to know how to use the email and everything. They taught us that everybody has to send email to one of their teachers. And then sometimes I email my friends. Like if I find a nice picture on the Internet, then I'm going to email it to them.*
>
> Tisha, 12, CFY

Two children from low-income homes used email for school-related activities. One child, who had no printer at home, sent herself completed homework assignments at school to get them printed. The other child used email to turn in her homework and ask questions of her teachers.

The children from low-income homes primarily used email for socializing with peers, especially classmates. While CFY teaches children how to email during their training session, children learned about IMing and chat on their own and two of these children were just beginning to use these functions. These tools were relatively new for them and their friends, and most had not yet created screen names or buddy lists on Instant Messenger. Two children said they had gone to chat sites. One child commented: "So in communicating, like I'd probably, if I had found out about the chatting sooner, I would have been chatting more." One CFY child, Yolanda, enjoyed chatting online with peers using Instant Messaging. Even

at school she said that she often talked to her friends about when they would be on chat rooms, and she could recognize who was online by their screen names. She also had a Yahoo account and screen name, which she created herself. Some children also enjoyed emailing or chatting with strangers, although communicating with strangers held less appeal for these children than communicating with their classmates.

A majority of the children from middle-income families, 7 out of 10, used communication tools every day or nearly every day. Instant Messenger (IM) was the "killer app" for these kids, followed by email, and then chat rooms and bulletin boards.

These seven Greenville IM users liked to talk with as many of their friends as possible at the same time; their major literacy challenge in using IM was coordinating simultaneous conversations with multiple partners in a text-only medium so that misunderstandings and hurt feelings were minimized. Eliza characterized it well.

> *It's like having sixteen different phone lines that you can talk on all at the same time, if you have sixteen friends on.... Mom thinks it's so confusing, like 'how can you talk to all these people at once?' It's like, well you just, put up their screens, they have their separate screens. It's so easy.... But talking online is sometimes really hard because you don't know whether the person's being sarcastic or what emotion they have. You don't have their tone of voice. And when they don't answer you right away you don't know if they're thinking about what you said, or off talking to someone else and just ignoring you. So I'm always checking, and saying 'Are you serious in saying that or are you just kidding?' And I try not to worry if someone doesn't answer me—they could have just been bumped off by AOL.*
>
> Eliza, 12, Greenville

At least three middle-income IM users had problems managing windows, keeping track of messages, and responding to the right people. Darla said, "The windows change when someone sends you a message, so sometimes I'll be typing along and hit return and all of a sudden I sent the message to the wrong person—it can be really awful, especially if you're talking about each other."

Three other middle-income users developed skills in using certain IM features to minimize these mistakes and confusions in communication.

> *I have a little technique. If there's more than one person online, I'll put their [windows] down here [on the task bar]. That way you can always tell because there's a little arrow, if they've said something, that appears here. You can tell who says what, but it still doesn't, like, clutter up your screen.*
>
> Renee, 13, Greenville

Another literate practice we observed with IM occurred between two girls who habitually stored and saved IM chats that were significant to them—essentially archiving elements of a synchronous communication. They saved the conversations by name, date, and topic and said that they would sometimes refer back to the conversations in order to resolve a conflict that had come up in the meantime.

Among the three children from middle-income homes who were not regular IM users, Jasmine, 12, said the major barrier was her inability to type well. "Some of them type so fast!" she said. "I can't keep up with it. So I don't try." Phoebe, 13, explained that only one or two of her friends at school use IM, though she knew lots of other kids used it. By the end of the study, however, she was trying to install IM on her computer to talk to a growing number of friends online.

Email is a distant second to Instant Messaging for this middle-income group. Nine out of 10 children from middle-income families had their own email addresses, and seven checked their mail at least once a week, but email use was minimal compared to Instant Messaging. Email use appears to be more functional in nature than IM and chat, which are recreational. Children described emailing friends when they are not on IM, asking them why they are not on. Three described sending homework assignments to each other. They received email greetings and emailed "forwards" (of jokes and web sites) from friends, and sometimes they replied or forwarded these to someone else they knew. Only one child from a middle-income family had no email address of her own, but borrowed her father's account if she needed to send something.

Three of these children from middle-income homes liked to spend time talking in chat rooms, such as AOL Teen chats, MTV chats, and other teen chat rooms. This too was classified as a form of recreation, and the skill that comes to the fore here is managing an identity among strangers, avoiding inappropriate people and advances, and interpreting information in people's profiles to form a picture of the conversational "other." Darla, 12, a girl who spends a great deal of her spare time on IM, was very fluent in the conventions of the medium, especially in finding out about her fellow-chatters by deciphering their profiles. Yet, this form of literacy has its perils. It is easy (and tempting, apparently) in this medium for children to cross the line toward rudeness in language. Two boys were stripped of their AOL usernames for violating AOL's rules on appropriate language use in chat rooms (but were later reinstated with their parents' intervention), and Darla was observed in a long, taunting exchange with several other girls in a chat room, a type of conflict she liked to spark, she said, "just for the fun of it."

Finally, a last literate practice we noted with children from middle-income families was one boy's use of public bulletin boards as a place to absorb the knowledge of expert practitioners of his newfound hobby—building a robot. In the robots.com bulletin boards, Ben and his best friend were entering a social world of adults that was unfamiliar to them, and they had to observe the dialogue, decide how to make an initial foray in with their questions, and then gradually become recognized and welcomed as peer bot-builders.

Web Literacy

Most CFY children from low-income homes (eight out of nine) developed some web search and file management skills such as strategies for accessing information on the web, as well as ways of organizing the information that they found, but they were not reported to be evaluating the web sources or authoring on the web like their middle-income counterparts. Half of the middle-income Greenville children in this study (5 out of 10) were functionally literate: able to conduct searches to find information they wanted, organize/store what they found well enough to return to it later, and keep in mind that web information and communication might be biased or untrue. Two of these children from middle-income homes were also able to produce simple web materials, for example, by creating their own homepage using an AOL template. The remaining five Greenville children displayed even greater fluency in using the web. In each web literacy area, including searching, organizing files, judging bias, and authoring web information, these five children had an ability to use web tools well for their own individual goals.

Most of the children from low-income homes learned about web sites from school, CFY, and TV. At school, teachers often recommended educational web sites. In addition, CFY loaded 112 educational bookmarks on each computer and developed a tailored web portal, Community Corner (www.communitycorner.org), which was eventually made the home page on each CFY participant's computer. Television advertisements were another source of web site URLs for these children.

They also went to the web to look for information for school assignments. They said they liked web sites with a lot of visuals, links, and updates. At ASE, for example, the students were asked to do online research on current information and general questions such as "What is the largest ocean in the world? What is the largest seashell in the world?"

> *Today we've been studying slavery, so we had to go on the Internet to look up these web sites about stuff that we can't get [from textbooks]. Say we're studying modern-day slavery, so that's not in textbooks, so we have to look on the Internet and research different stuff like that.*
>
> Tisha, 12, CFY

While most CFY children went to the web for school-related research, some also went to web sites for entertainment.

> *ABC.com, the reason I have that down as my favorite is because I like to play while they have the thing on the TV, the 'Who Wants to Be a Millionaire' while people on TV are playing it.*
>
> Valentina, 12, CFY

Interestingly, half of the children from low-income homes used the web to find practical information on housing, car sales, etc., needed by their families. No children from middle-income homes highlighted this type of use.

All 10 children from middle-income homes used the web to find information for homework fairly regularly, but beyond this, they used their web literacy in very different ways. Of the seven children from middle-income homes who browsed the web regularly for recreation, three used it mostly to access commercial media, entertainment, and shopping sites, as well as chat sites. The four other children who browsed the web for fun also enjoyed commercial media sites, but, in addition, they used the web to pursue their own personal interests and hobbies in such areas as music, writing, humor, video game reviewing, robots, chess, books, language learning, sports, and photography. Eliza was one of these children, as her recitation of her bookmarks suggests.

> *My favorite sites are, ok, Google.com first, 'cause that gets me to any of my interests: soccer web sites; kids' writing web sites; this song writing site my teacher gave me; lyrics.com—I love lyrics, and singing along to songs, and if I like a song I have to find out what the lyrics are; movie sites—I go to IMDB, the Internet Movie Database, to read about a movie when I want one to rent; MTV.com; perfectjoke.com; Mr.biology.home.att.net—that's my teacher's site; Bored.com; Cartoon dolls–that's a doll-making site; sites for TV actors I like; Internet Chess; quizzes on teen web sites; sports sites—so I can get scores; The Importance of Being Earnest—a web page with that play, I found it 'cause I love that play; Photography.com—that's my dad's photography web page.*
>
> Eliza, 12, Greenville

Search Strategies and Organizing Files

CFY children's most common search strategies were entering specific URLs (e.g., www.encyclopedia.com) and going to specific search engine sites (e.g., Yahoo, MSN). Once they found the information they wanted, half of them used bookmarks to organize and keep track of the information. Another way they managed digital information and artifacts (e.g., pictures, music, and text) found on the web was by downloading and organizing them on their computer hard drive.

All 10 Greenville children from middle-income homes showed some facility with at least one search tool, and 9 out of 10 named several search engines that they had used. Half of these children relied mostly on the search tools that appeared on their service provider's homepage—AOL Search (3) or MSN Search (2). The other half chose from a range of search tools—Google, Yahooligans, Ask Jeeves, and ask.com. Five of these children also used the Napster's powerful search engine to locate copies of songs they liked.

Six out of 10 children from middle-income homes had basic or functional skill in using search tools. They could locate "good enough" information fairly quickly by some method they knew such as typing a word into the address box, followed by ".com," or typing search terms into a search engine and quickly browsing the top two or three sites. Still, they found the web a chaotic and sometimes overwhelming information environment, and sought ways to limit their encounter with it. The search engines they used—Google, Yahooligans, Ask Jeeves—organize and filter the web in various ways. Four of these children said they preferred using Encarta

(a CD-ROM encyclopedia) to the web for most school assignments, because, for example, "It gives you better results for general topics."

Four children from middle-income families showed more fluent use of search tools, mainly in the capacity to narrow and revise searches to better specify what they want. These children were untroubled by the chaos of the web—they moved easily through it to the things that interested them. They had some understanding of the way a search engine works and how the web is organized.

> *[Using a search engine] is like a puzzle. The computer is dumb. It just looks for exactly the words you told it. So when you get back results, you can see more about what your topic is, and how you have to narrow down what you want. Be more specific. It makes you think about what it is you really want, and what you don't want.*
>
> Eliza, 12, Greenville

Another child, Ben, 13, also from a middle-income home, figured out the trick of intentionally misspelling song titles or artists' names in the period after Napster blocked most artist names and song titles from its index. "You just have to realize that lots of people are terrible spellers when they type in their song titles, so when you misspell a name, chances are you'll get to a song somebody put in wrong."

Web Evaluation and Web Authoring

Students in this study from low-income homes did not exhibit web evaluation or web authoring practices. Several web users from the middle-income homes, though, exhibited one or both skills. For example, among these children, four out of seven regular web users indicated an awareness that a web source might be biased or not fully credible. Most often children raised the distinction between facts (which they considered trustworthy) and opinions (which they considered untrustworthy), a distinction reinforced by their school library-media specialist, according to several.

> *I would say [a web site] is good info if it has a lot of facts instead of opinions. And if it has a lot of stuff on the topic I'm looking for.*
>
> Jasmine, 12, Greenville

Commercial bias was mentioned by only one child, echoing her mother's comments.

> *I never just browse the web. It's full of so many ads, it's a waste of time. I always go to sites I know, like Historychannel.com, or I use a search engine to find specific things.*
>
> Renee, 13, Greenville

Finally, aided by talk with their parents, three children from middle-income homes were developing a perspective on the value of the web as a whole:

> *For information I'll go to the web instead of the library because the web is more recent. But if it's a book I want, or art, I won't download it, I'll go to the library. The web should be a tool, not the main thing.*
>
> Eliza, 12, Greenville

Only the children from middle-income families exhibited web authoring skills. Two of these children created simple personal web pages using templates provided by AOL. These pages contained basic profile information, favorite web sites, bands, etc. In both cases the information on them was out of date and replete with misspellings, which did not trouble the authors since, as one said, "Hardly anyone goes to my page."

In addition, three of the children from middle-income families went beyond this form of authoring and used the web as a way to publish their own thinking, writing, and artwork. Cole, 13, published his own web site on his favorite video games, hoping to attract the attention of the manufacturer; he also published his video game reviews on other, bigger sites. Eliza, 12, submitted her poetry and drama writing to online children's writing sites, worked with an editor briefly, and saw two of her pieces published. Ben and his best friend posted 3-D drawings of their robot to a mock "company" web site (created with the help of Ben's dad) to help their financial backers and friends see their progress.

Summary and Implications

Summary of Major Findings

Across the two communities, we found that all the children in the study used their computer to do schoolwork. Many children with leisure time at home also spent two to three hours a day communicating with peers, playing games, and pursuing creative hobbies. Children from low-income families, however, had fewer resources available to them than children from middle-income families for solving technical problems. Children from low-income families relied more on formal help providers such as CFY and schoolteachers, while children from middle-income families relied more on themselves, their families, and their peers. Overall, we found that all the children in the study developed basic literacy with word processing, email, and the web. Not surprisingly, those children who spent considerably more time online developed more robust skills in online communication and authoring.

We also found that children's digital literacies were emerging in ways that reflected their local circumstances. In each community, children's home computing practices were strongly influenced by their technological, social, and school environments. Regarding the technological environment, we identified three elements that impacted how children use their home computer:

- *The length of time children had a computer at home.* Children from middle-income families had more comfort and confidence in using their home computers because computers had been present in their homes for a considerably longer time.
- *A family's ability to purchase stable Internet connectivity.* Credit cards made it easy for middle-income families to purchase Internet access. Low-income families without credit cards needed to find providers that accept other forms of payment, which CFY assisted them in doing.
- *The number of computers in the home and where they are located.* Low-income homes usually had only one computer located in a heavily trafficked area, such as the living room or kitchen. As a result, the children's activities were more likely to be shared with the family and supervised so as to encourage use of the computer for educational purposes. Middle-income homes, in contrast, often had more than one computer and children were more likely to use it alone in a private area such as a bedroom. As a result, there was less social interaction around the computer and children used them more for recreation rather than educational purposes.

We also identified five elements of children's social environment that shaped their computing:

- *Parents' attitudes toward computer use*. There was little difference in attitude between low- and middle-income communities. Most parents believed that home computer use helped their children succeed in school and they created rules that encouraged their children to put homework before fun. In the low-income households, parents also perceived their CFY computers as keeping their children home and off dangerous streets.
- *Parents' own experience and skills with computers*. Middle-income parents who had developed extensive computer skills through their jobs and schooling were able to model rich and varied uses of the computer, and engaged their children in critical talk about the web. Many of the low-income parents, who had never before touched a computer, were less able to model computing practices for their children. Instead, they supported their children's computing by suggesting certain activities, many of which were cultural and brought family members together.
- *Children's leisure time at home*. The children from the middle-income homes had more leisure time at home and were able to develop more skills and used their computers for varied purposes. Besides homework these children also used the computer for fun and social interaction. In contrast, almost all of the children from low-income families in this study, because of their school's extended-day schedule, had very little leisure time, and used their computer primarily for schoolwork.
- *The computing habits of children's peers*. Children's online communication usually depends on what their peers are doing. The children from middle-income families primarily used Instant Messenger (IM), while the children from low-income families mostly used email. Children from low-income families, however, as they discovered IMing, were using it more and introducing it to their peers. CFY's strategy of wiring an entire school community appears to leverage "peer culture" in helping children foster new communication skills.
- *The technical expertise of friends, relatives, and neighbors*. Middle-income families often had friends, relatives, or neighbors who have strong technology skills and can help them troubleshoot computer problems. Low-income families were less likely to know people with such skills and so turned to schoolteachers and to CFY for help. This finding demonstrates that organizations like CFY are greatly needed to provide crucial technical support to new users in low-income communities.

Finally, we identified two elements of the school environment that helped shape children's home computing:

- *Homework assignments*. In all the schools attended by our participating children, teachers helped students develop digital literacy through homework assignments. For example, in the CFY partner schools, teachers assigned homework requiring Internet research and gave extra credit for typed reports. In the schools serving the children from the middle-income families, teachers' assignments were similar except that high-track students often received more in-depth and inquiry-based assignments (such as stock simulations and web-quests).
- *The direct instruction teachers provide in the classroom*. Children learned computer skills from instruction in their schools. For example, in the CFY partner schools, some teachers provided instruction on MS Word and on using the Internet, while in the schools attended by students from middle-income families, a library-media specialist offered group computer instruction on how to do an Internet search and evaluate the information found.

Implications for Policy and Future Research Studies

Based on our findings, we believe that policymakers and private funders can do a number of things to support a research agenda focusing on children's acquisition of digital literacy. There are major implications for social policy, school policy, and assessments.

Social Policy

Based on our findings, it seems imperative that support systems be put in place to assist low-income families in not only gaining access to technology but in maintaining access and computer functioning. This support can be structured in a variety of ways and made available in several formats. While organizations such as Computers for Youth can serve as a model for supporting low-income families in developing computer literacies, there are a plethora of options for an integrated approach to supporting low-income families in achieving digital literacy. These supports range from technical troubleshooting to flexible financing structures.

Technical assistance. The type of technical troubleshooting provided by CFY should be made available in other low-income communities. Since unlike their middle-income counterparts, these children do not have access to experienced troubleshooters among their families and friends and, therefore, need a formal contact for "help" and problem-solving. Research needs to be conducted on the various possibilities and forms for this technical assistance to ensure the best fit for the community it serves.

Industry support. Computer companies can serve as a support to families with low-incomes by providing information to parents and steps they can take to

improve their children's digital literacy. For example, they can provide pamphlets with each computer identifying research-based guidance on such issues as using the computer for varied purposes, effects of location of the computer in the home, types of communication tools (e.g., email, chat, IM), options for technical assistance, issues with gaining Internet connectivity, etc.

Financial conditions. Policymakers need to be aware of issues that arise due to incompatibility between the community's financial conditions and the industry's mode of functioning. A prime example is the problem that the low-income families in this study had with paying the Internet Service Provider (ISP). The ISPs traditionally charge through credit cards over email. This caused problems for the CFY families since many did not own credit cards and were unfamiliar with and confused by the email billing system. Only through mediation did the families find another acceptable form of payment. The structures of established systems like the ISP may not only deter low-income families from gaining and maintaining access but can result in them being unable to gain access at all. Policymakers should be made aware that most low-income families have no credit cards, whereas most ISPs require a credit card number for monthly billing purposes. Conditions need to be established to allow for alternate options for payment. In addition, further research needs to be conducted on other systems that may be incompatible with the conditions of low-income families.

School Policy

As evidenced in this study, schools play a critical role in developing children's digital literacy development–especially for children from low-income families. This study suggests that schools in both low-income and middle-income communities help shape children's home computing–chiefly through homework assignments but also through direct instruction. Through in-school instruction, computer-based homework assignments, and high expectations, schools can make an enormous impact on students' fluency.

Instruction. Students in this study gained various skills from direct instruction in school, including introductory tool use and more advanced skills of evaluating web content. For students from low-income communities, schools can be instrumental in developing troubleshooting abilities and understandings of the uses of different programs and features of these programs, and can impact children's digital literacy by integrating technology in the curriculum in meaningful ways. For example, teachers serving students from low-income families could be enormously helpful if trained to assist their students in developing troubleshooting strategies, which are a prerequisite to deeper engagement with electronic tools. As described previously, we saw that troubleshooting strategies are grounded in social supports, that is, to whom you go to for help. The core of this interaction can be described as the user having a "good enough" knowledge of the technical difficulty at hand and being able to communicate it to a help provider. Functional understanding of the human-computer interface includes, for example, recognizing an error when it happens, writing down the error message or a description of what happened or

didn't happen, and being familiar with the input/output relationships of different computer components (e.g., CPU, modem, printer). Such basic understanding is needed, at minimum, to communicate effectively with distant help providers, and to participate in corrective efforts. Teachers and schools should be aware that the inability to articulate technical issues can be a great challenge to computer literacy for students from low-income families. Continued research needs to be undertaken targeting the specific instructional techniques that engender students' digital fluency as well as the training that teachers might need to be supportive in these ways.

Homework assignments. Most of the children in this study from low-income families used the computer primarily for homework assignments. These homework assignments provided the students with directed activities for using the computer and as a result more familiarity with certain programs. By assigning technology-related homework, schools can advance students' fluency with programs, communication tools, and the World Wide Web, stimulating richer and more varied home computing.

Expectations. High-tracked students from middle-income families had extensive experience with using technology for school assignments as compared to their low-income and lower-tracked peers. These high-tracked students were asked to use a variety of programs in advanced ways. By having higher expectations of children's abilities and providing lower-tracked students and students from low-income families with advanced experiences, they too may begin to expand their fluency with and use of the computer.

Assessment

This study suggests that, among students who have access to technology, there is a notable divide in student digital fluency level. Thus far, to bridge the digital divide, the focus has been on providing access and then assessing the extent of the divide by counting the number of computers in each school or classroom. Assessment of the digital divide needs to go beyond an issue of access to an issue of literacy. Two broad areas interest us in the development of digital literacy assessment tools: (1) assessment of digital literacies in local contexts and (2) large-scale digital literacy assessment tools at the federal and state levels.

Assessing digital literacies in local contexts. As this study demonstrates, children's digital literacies are emerging in ways that reflect their local circumstances. Examining children's digital literacies in local contexts reveals the complexity and progressive nature of their computer and Internet skills and knowledge. It is important to keep in mind the two local contexts critical in this assessment process: school and family context. As indicated, local context is a significant factor in the development of children's digital literacies (e.g., family attitudes and practices). Thus, in order to intervene effectively to develop and support students' digital literacies, a productive first step is for schools and teachers to perform a basic-needs assessment that takes into account local circumstances. We believe our definition

of literacies, with its description of basic and greater fluency, would be a very useful starting point for the development of a digital needs assessment in the classroom.

Large-scale assessment of digital literacy skills and knowledge. The other major implication of these findings for assessment purposes is the need to develop valid large-scale assessment systems. When it comes to valid large-scale assessments of digital literacy of teachers and students at the national and federal levels, the use of the digital literacy analysis model outlined in this study would be operationally and financially impractical. Our assessment model depends on researchers being intimately involved in the process of developing and administering it in specific locations, as well as making the necessary adjustments as teachers and students gain a better understanding of how it fits with their digital literacy activities. At the national and federal levels, performance-based and project-based assessment models would be time-consuming and thus financially costly. Nevertheless, if digital literacy—that is, the ability to use technology creatively for a variety of personal and academic ends—is to become a skill set taught and developed by pre-college schools, the field urgently needs to develop valid methods and instruments of assessment that help aggregate state and federal data as schools and districts acquire more and more technology. These methods and measurement instruments are likely to include surveys, multiple-choice tests, pre- and post-tests, etc., that can measure individual as well as group progress in digital literacy.

Conclusion

It is presently our belief that, because the use of digital tools by adults and children are evolving so rapidly in so many different directions, it will be some time before researchers will be able to distill a stable set of skills and habits of mind that comprise digital literacy in a way amenable to large-scale assessments. Until then, we need a high degree of collaboration and communication among researchers pursuing analytically rigorous investigations of digital literacies in local contexts.

Like reading literacy, the development of digital literacy is impacted by home and school factors. Children who have computers at home and have parents who use computers develop digital literacy at a rate and manner different than children whose families have only recently acquired a computer in the home or are not experienced computer users. Additionally, children's computing is impacted by other home factors including their access to technical support, their ability to attain and maintain Internet connectivity, the location of computers in the home, the amount of leisure time children have at home, the computing habits of peers, and parents' attitudes toward computer use. The ways in which teachers ask students to use computers also influence the development of a child's digital literacy.

As educational leaders grapple with the digital divide and how best to develop students' digital literacy, it seems imperative that policies are developed to a) encourage and support the acquisition and use of computers in the classroom and at home and b) measure digital literacy skills in a more systematic and valid manner. Absent a coordinated, multi-faceted approach to developing digital literacy, the digital literacy divide will persist into the foreseeable future.

Endnotes

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1 In September 2000, the EDC Center for Children and Technology (CCT) and Computers for Youth (CFY) began a one-year comparative study of children's home computer use in low- and middle-income families. From its inception, CFY and CCT approached the project as a collaborative effort.

CCT, a technology and education research and development organization, brings together three domains of work—research/evaluation, program design, and technology development. CCT has been conducting research on the roles technology can play in supporting learning and teaching in school settings for over twenty years. Over the past four years, CCT has been investigating the consequences of the digital divide for children's learning and development in informal settings including community-based organizations, after-school programs, and homes. Through this work, the CCT has begun charting the influence of different social settings on the ways children embrace computer and Internet technologies.

The mission of Computers for Youth (CFY) is to improve the educational, social, and economic prospects for low-income students and their families by giving them the means to develop computer and Internet skills. CFY's goal is to build an innovative, low-cost program that can be expanded throughout New York City and replicated elsewhere. Since launching their program in 1999, CFY provided home computers to about 1,000 families and teachers in New York City. CFY insists that all recipients attend a half-day training session on the CFY computer they then take home. CFY also insists that all students attend training with a parent or guardian. These prescriptions have led to CFY's training more than 1,500 students, parents, and teachers since it began operations.

2 The names of communities, schools, and individuals have been changed to protect participants' privacy.

3 All consent forms were available in English and Spanish.

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Appendix A: CFY School Profiles

The Academy for Scholastic Excellence (ASE)

ASE, a college preparatory middle school located in Southchester, serves children in grades 5 to 8. The ASE school day extends from 7:25 a.m. to 5:00 p.m. Monday through Thursday; 7:25 a.m. to 3:00 p.m. on Fridays; and 9:00 a.m. to 1:00 p.m. on Saturdays. Hence, ASE students spend most of their waking hours at school. Tisha's mother, Michelle, commented:

> *"The KIPP academy is a very long program. They go to school from 7:25 in the morning until 5 each day, and most times they stay till 6, in the computer lab, or in the gym. They go to school on Saturdays. It's pretty much regimented..."*

At the time CFY partnered with ASE, ASE was a public school. The following year, the year of this study, ASE became a public charter school. ASE is unusual in its focus on discipline, character, and a devotion to educating all children in a way that will prepare them for future college attendance. Children wear uniforms and regularly recite the five pillars of the ASE philosophy. One of these is "More Time" for academics. The children learn that "There are no excuses. There are no shortcuts to success."

Middle-school-aged students apply for admission to ASE. When their child is accepted, parents are required to sign a contract promising to support their child academically.

ASE did not have a dedicated technology teacher during the time of the study. However, the science teacher took it upon himself to provide instruction on software such as MS Word and on using the Internet. He also routinely assigned homework requiring his students to do Internet research. To promote the use of home computers, other teachers gave extra credit points to students if their research reports were typed.

The Power Through Arts and Community (PAC) School

PAC is located in Eastside Heights and serves students in grades 7 and 8. It is a small, public middle school in a building that houses four other small schools. The administration and staff at PAC are committed to providing students with an education that develops and supports both their creativity and cognitive growth. In most classes, teachers make an effort to combine art projects with academic instruction. For example, during the time of the study, PAC students wrote and produced an opera.

There is a technology teacher at PAC, and every student is enrolled in a computer class. Collaborating with a science teacher and an artist, the technology teacher uses a project-based approach in her computer instruction. For instance, eighth-grade students learn to use graphics software and word-processing programs in the context of creating a business identity for themselves (e.g., a logo,

slogan, and business plan). Students also create web pages and Claymation animations. During the time of the study, students created their own books—adaptations of Shakespeare plays—in conjunction with a project in their English class.

At PAC, staff and students also use the FirstClass e-mail system that was provided by CFY and their district. Each teacher maintains a *folder* (similar to a bulletin board) on the system to post homework assignments. Special project folders, such as a Harry Potter Book Club, have also been set up, and students can contribute regularly to both from home.

Appendix B: Family Profiles

The Low-Income Families and Their Children

In this overview we describe the nine low-income families in terms of their financial, educational, employment, racial, and lifestyle characteristics.

Income/Education

The nine CFY families in the study were all low-income and lived in a variety of housing conditions (e.g., public housing [2], rented apartments [5], and self-owned homes [2]). They perceived and experienced their neighborhoods as unsafe for themselves and their children. Children were often discouraged or prohibited from playing outside. Similarly, adults and children may limit their social activities with neighbors or their use of community resources due to fears about safety. Of the nine mothers, five were either currently enrolled in college or had some college education, one had a high school degree, and three had completed six or fewer years of formal schooling. In the six families where fathers were present, the fathers generally reported a comparable level of education. However, in one family, the father held an MBA degree.

Employment

Both single-parent families were supported by welfare; one of these mothers also held a WEP (Welfare Employment Program) job. In two of the seven two-parent (intact and divorced) families, both parents had jobs outside their homes. These families included two parents who were administrators, and one set of parents in which the mother was a paraprofessional and the father (who has an MBA) was employed in an undisclosed profession. In the remaining five families, the mothers did not work outside the home and the fathers had the following jobs: one was a manual worker at a food market; one was a telephone technician; one was a daycare worker; and two were businessmen.

Race/Ethnicity

All families were of color. The majority were immigrants and did not speak English as the primary language in their homes. Three of the families were of Puerto Rican descent, two were Mexican-American, and two were from the Dominican Republic. Of the remaining families, one was African-American and one was African (Nigerian). In six of the nine families, Spanish was the primary language spoken between parents and children at home. In three of the families, English was the primary language spoken at home.

Family Types

The nine families who took part in our study represent three different family structures with a total of 16 parents. Six were two-parent families; two were single-parent families; and one was a divorced family in which custody of the children was shared between the mother and father. The number of children in each family ranged from two to four, with an average of three per family.

Leisure and Media Use

The ASE students in the study spent little leisure time at home because their school day extended from 7:25 a.m. to 5:00 p.m. Monday through Thursday; 7:25 a.m. to 3:00 p.m. on Fridays; and 9:00 a.m. to 1:00 p.m. on Saturdays. Such hours are unusual for public schools. In comparison, the one PAC student in the study had a large amount of leisure time because, like most public schools, her school day extended only until 2:30 p.m. Thus, the one PAC student had far more time to spend with media, including television and the computer/Internet than did students from ASE.

CFY Children Studied

At the time of the study, seven of the nine students were in seventh grade; two were in eighth grade. According to data gathered by CFY researchers from the students' teachers, three of the students were in the high academic track, five in the middle track, and one in the low track.

There were six girls and three boys in the CFY study sample. Two of these students had younger siblings, four had older siblings, and three had both older and younger siblings.

Technology at Home

All nine low-income families received from CFY a Pentium-level computer with CD-ROM drive, floppy drive, and 56kb modem. The CFY computers were outfitted with the MS Windows 98 operating system; MS Office 2000; and CyberSitter 2000 (an Internet filtering program). The eight ASE families received their computers in the 1999–2000 academic year. CFY preprogrammed these computers with Internet Explorer and provided a set of 112 educational "bookmarks." These families received email accounts through CFY's email server or through eChalk (a provider of web-based email solutions to schools). The one PAC family received their computer in the 2000–2001 academic year. By this time, CFY had built a tailored web site, Community Corner (www.communitycorner.org), which was the homepage on all computers distributed that year. In addition, the PAC family received email accounts through FirstClass, and additional software such as AOL Instant Messenger, Adobe Acrobat Reader, as well as ACCU-type (a free typing program).

Most of the CFY families purchased additional items for their computers. Some seemed to take great pride in purchasing computer desks—actual pieces of furniture designated for computer use. Parents also purchased hardware peripherals (e.g., keyboards, mice, printers, speakers, and scanners) and software (e.g., CD-ROM resources including encyclopedias, educational software, and games).

After receiving the CFY computer, one family invested in a very high-end computer system for the children that included a DVD player and fax machine. Another family used their scarce financial resources to buy a child's laptop (a functional model with printer) for their four-year-old daughter, who wanted to use her older brothers' CFY computer but was prohibited from doing so. Interestingly, the mother in this family began to develop her own computer confidence and competence by using this toy laptop. She had been uncomfortable using the CFY computer for fear she might break it.

Internet Connectivity

In the 1999–2000 academic year (the year CFY worked with ASE), CFY provided families with unlimited Internet service from a local Internet Service Provider (ISP) at a reduced rate of $8.95 per month. CFY paid for the first three months of access, after which time, families were given the choice to either continue paying for the ISP themselves or to switch to another provider. In the 2000–2001 academic year (the year CFY worked with PAC), CFY provided families with a free, advertising-supported ISP that had not been available earlier. Most CFY families had only one phone line at home. When a family was connected to the Internet, they were unable to make or receive phone calls.

Formal computer training. CFY provided all children and their parents with three and a half hours of basic computer training. This training gave the mostly novice users familiarity with:

- assembling computer hardware (and knowing what each component does),
- using the Windows operating system (e.g., mousing, clicking, file management),
- using MS Word (e.g., creating, formatting, and saving word processing documents),
- connecting to the Internet using a modem,
- sending and receiving email,
- browsing the web, and
- configuring the Internet filter.

The Middle-Income Families and Their Children

In this overview we describe the ten middle-income families in terms of their financial, educational, employment, racial, and lifestyle characteristics.

Income/Education

The 10 Greenville families are comfortable by most American standards. First, they are comfortable physically: Greenville is a relatively safe community with little street crime, so that parents in these families allow children to walk around town by themselves or with friends at age 10 or 11. Second, the families are comfortable financially: all but one family own their homes, and most earn between $50,000 and $100,000 a year. Parents routinely pay for extra lessons, computer upgrades, and vacations that enrich their children's lives, even if for some these are a financial stretch. Third, these families have educational advantages: most parents have college degrees or higher, and all have at least some college. In addition, family size is small (most have only two children), enabling parents to attend to children more closely than in larger families.

Employment

The 18 parents in these families work long hours at their jobs in order to support their middle-class lifestyles. Fifteen work full-time, in jobs that include clerical and service jobs such as records administrator and customer service representative and, on the higher-paying end, small businessman, partner in a PR firm, and lighting and sound designer. There are four full- and part-time schoolteachers in the group. Three of the women stayed home full-time until recently to raise their children, and are now back in the work force. Two others work part-time. Work involves significant commute time (over 1.5 hours) for at least one parent in over six of the families, usually the father. Reflecting the contemporary blurring of workplace and home, many of these families have home offices, which function either as a secondary work site (e.g., where parents work at night or on days when they stay home) or a primary work site (e.g., the place from which parents run a small business).

Race/Ethnicity

Six of the ten middle-income families are Caucasian, three are African American, and one family has parents of different races (by second marriage). Most families are American citizens born in this country; but one of the African-American families immigrated from Jamaica 14 years before, and another family moved from England four years earlier.

Family Types

Five of the 10 families we studied were intact first marriages in which children lived with both parents. Two were single-parent families (one due to death, one to divorce); two more were second marriages in which the children lived with a step-parent; and in one family the parents were separating as the study occurred.

Leisure and Media Use

A consequence of parental work patterns in these families is that the children spend a large amount of unsupervised time at home, especially in the hours between 3:00 p.m. and 7:00 p.m. A large amount of this time at home, up to four or five hours a day, is spent with media, including television, video games, and the computer/Internet. In short, home is where the media are.

Greenville Children Studied

We studied six girls and four boys in these families. Five were in the highest academic track in their middle school, which means that they scored well on standardized tests and were bound for AP-level courses in the high school. Four were in the middle track, in which courses were not as intellectually demanding, though homework still can be heavy. None was in the lowest, or remedial, track. One parent was home-schooling her children. Most children had only one other sibling; four had an older sibling and six had younger siblings. Many, though not all, pursued hobbies and interests outside of school—music lessons, sports, drama, cheerleading, chorus; however, each student's intensity of involvement in these activities varied greatly and many had a good deal of leisure time, much of it unmonitored.

Technology at Home

Two features of the computing environment in these households stood out: the great accessibility of networked computers and the continuous investments made in computing. Families had between one and four working computers at home. Nearly all families (9 out of 10) have at least one powerful Pentium machine bought in the last three years. Families typically designate their most powerful networked machine the "family computer" and put it in a shared space such as living room, den, or guest room. Families with multiple computers typically regard the others as belonging to a parent (e.g., "dad's laptop," used for work), and/or as "the old computer," which they often put in a child's bedroom or basement, where it is used for games. Most middle-income families have had access to home computers and the Internet for several years. Families paid an average of $30 a month for Internet service, usually through America Online (AOL). One family had broadband network access through a cable modem. More than half the families had separate telephone lines for their Internet-connected computers, enabling family members to use the phone and the Internet at the same time.

Parents in these families continually invested in technology, for their children as well as themselves: they shopped for upgrades to new machines (three families had upgraded to powerful multimedia computers in the six months prior to the research, and one bought a new computer during the research); they bought laser printers or scanners or digital cameras to add value to what they already had; they browsed software racks in stores looking for titles that might be good for learning, for fun, or for practical tasks. They did not make these investments lightly, however, because for many they involve financial sacrifices.

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