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ABSTRACT

This literature review examines the research on the effectiveness of strategies to increase access to technology in different U.S. communities. Issues include not only how different groups and communities access hardware, but also how they organize and interpret activities and social interactions around technology, their own perceived control over the use of advanced computer and Internet technologies, and why access to these technologies is seen to be important. The report also aims to understand barriers to, concerns about, and perceptions of technology use, and to identify viable research models for furthering understanding of these issues. The report concludes that while the research community is gaining some insight into how information and communications technologies are supporting the needs of underserved communities,important questions remain about how community organizations can best make use of existing research and how additional data can be collected to enable programs to continue to grow, innovate, and refine their technology initiatives. Some research issues and areas needing attention are outlined. (Contains 57 references.) (AEF)

CENTER FOR Children & Technology

Effective Technology Use in Low-Income Communities: Research Review for the America Connects Consortium

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INTRODUCTION

Awareness of technology, especially computer and telecommunications technologies, as a tool with the potential to improve people's lives, has been growing in the last decade. Computer and telecommunications technologies have become part of the daily functioning of businesses and educational institutions in the U.S. over the last twenty years. This rapid expansion of technologies into key sectors, while beneficial in many ways, raise's sobering concerns about equitable access to technology in underserved communities and sectors. This paper critically reviews strategies and research programs developed to address these inequalities and ensure the effective use of technology in less-advantaged groups.

The digital divide is more than digital. It is a sociological phenomenon reflecting broader contextual factors such as existing social, economic, cultural, and learning inequalities. Most of the studies reviewed in this report illustrate clearly that no single factor or contextual characteristic is responsible for these differences. Neither race alone, income alone, education alone, geographic location alone, or government policy alone sheds sufficient light to fully understand the access gap (see Wahl et al., 2000).

To date, the digital divide debate has turned on the concept of access, that is, providing access to those who have no computer or telephone and thus cannot enter the Internet realm at school or home. The concept of "access" encompasses the acquisition of hardware and software as well as complex uses of software for design and production. Between these two extremes, which represent both physical and expressive access, lie other dimensions of access: quality and affordable hardware and software, tools with rich educational content and/or fun activities, and technical and educational support.

This literature review specifically examines the research on the effectiveness of strategies to increase access in different U.S. communities.[1] Issues include not only how different groups and communities access hardware, but also how they organize and interpret activities and social interactions around technology, their own perceived control over the use of advanced computer and Internet technologies, and why access to these

[1] This focus on the U.S. is a somewhat artificial limitation, as both the new technologies and the global marketplace render domestic boundaries problematic and often irrelevant.

technologies is seen to be important. The report also aims to understand barriers to, concerns about, and perceptions of technology use, and to identify viable research models for furthering our understanding of these issues.

THE NATURE OF DIGITAL DIVIDE RESEARCH

Research on the digital divide has taken three primary forms:

- Policy studies tracking access to networked technologies along ethnic and economic lines
- Theoretical considerations about the societal impact of the digital divide
- Examinations of the relationship between patterns of use, online content, and the expressed needs of underserved populations.

POLICY STUDIES ON ACCESS

A substantial amount of research has been produced which looks at the status of the technology access gap in different U.S. communities. These studies demonstrate the inequalities of technology access in different informal institutional settings in relationship to variables such as race/ethnicity, education, geography (e.g., urban v. rural, etc.), income, age, and disability.

The findings, consistent across studies, show that the digital divide between the "haves" and "have-nots" has been widening since 1989 (Anderson et al., 1995; Katz & Aspden, 1997). While computer penetration has increased nationwide, the divide is still significant based on race, income, and other demographic characteristics (National Telecommunications and Information Administration, 1998).

DEMOGRAPHIC CONSIDERATIONS

Race/Ethnicity

Members of underserved communities with a majority of Hispanic, African-American, and Native American families are less likely to have home access to a computer and the Internet than their white counterparts (Babb, 1998; Novak & Hoffman 1998, Hoffman & Novak, 1999; Cooper & Kimmelman, 1999; National Telecommunications and Information Administration [NTIA] 1999a; NTIA, 1999b, 2000; Benton Foundation, 1999). Controlling for income and education, Novak and

Hoffman (1998) found that Hispanic, African-American, and Native American households have the lowest percentage of home computers. They also found that whites were significantly more likely to own and use a home computer than were African Americans even when controlling for educational differences.

The National Telecommunications and Information Administration's 1999 study found that between 1994 and 1997 the gap between the technology haves and have-nots increased, with African-Americans and Hispanics lagging behind whites in home computer access. For individuals living below the poverty line, this gap is even more pronounced. Babb (1998) looked across seven different data sets and found that even after adjusting for income, African Americans and Hispanics were less likely to own computers.

Hoffman and Novak (1999) conducted a more fine-grained analysis of disparities in computer access among different ethnic and socioeconomic groups, primarily focusing on differences in Web usage and access between whites and African Americans at different points in time. In this research, Hoffman and Novak conclude that "while previous research has shown that inequalities in Internet access in schools persist (Education Testing Service, 1997; Sax et al., 1998), our results suggest that inequalities in Internet access at home may be may be even more problematic" (p. 43). Their research confirms what other researchers have found (Babb, 1998; Cooper & Kimmelman, 1999), namely, that gaps between whites and African Americans around the use of the Web appear to be *increasing* over time. They believe that we are in a very early phase of understanding why such disparities exist, particularly considering the fact that the rate of cable and satellite dish penetration is increasing in African-American homes. They conclude, "Research is necessary to understand what motivates individual-level adoption of home computers and related technologies, as well as Internet adoption... " (p. 43).

Age, Ethnicity, and Points of Access

According to Hoffman and Novak (1999), young people's access to the Internet translates into usage. They found no differences between white and African-American students for frequency of Web use when students had a computer at home. However, among students without a home computer, white children were much more likely than

African Americans to have used the Web. White students were also more likely to have used the Web at locations other than home, work, or school.

Income

Income level is a determining factor in computer and Internet access. The Benton Foundation (1998) found that advances in telecommunications are increasingly isolating those living in poverty by further separating them from the kinds of jobs, educational opportunities, and technological tools they need in order to participate in the information economy. In 1998, "80 percent of families making more than $100,000 have computers. By contrast, of those families making less than $30,000 a year, only 25 percent have computers" (Benton Foundation, 1998, p. 3). The National Telecommunications and Information Administration [NTIA] 1999 study found that between 1994 and 1997, the gap in Internet access between economic haves and have-nots was even more pronounced than the gap in access by ethnicity. It found that of American families making over $75,000 a year, 60 percent have Internet access, while only 20 percent of families making under $35,000 a year have access. Although Americans without ready access to the Internet at home or at work are making use of public resources, this practice has had a limited effect in alleviating the gap in Internet use between rich and poor (NTIA, 1999b).

Novak and Hoffman (1998) show that income explains home computer ownership more fully than race. However, they also find that blacks in households with income below $40,000 were far less likely to have Internet access than whites at that income level (1998). Furthermore, the 1999 NTIA report suggests that the combination of race and income is key to understanding the digital divide because the information-rich are wealthy and of Anglo or Asian heritage, while the information-poor tend to be poor and African American or Latino.

Education

According to the NTIA's study (1999b), Americans with college degrees are highly likely to have computer and Internet access at home or work. The Internet-use pattern between Americans at the highest and lowest education levels widened by 25 percent from 1997 and 1998.

Locale and Income

Although there is still a disparity between urban and rural Internet connectivity at the state level (Strover & Lon, 1999), information have-nots are disproportionately found in rural areas and inner-city poor neighborhoods (NTIA, 1995). Moreover, access inequities are most clearly evidenced by the fact that, for a variety of reasons, both the rural and inner-city poor lack the same level of access to network technologies that predominate in largely white, middle-class, and suburban America (Schon, Sanyal, & Mitchell, 1999).

Telephone access remains limited in Native American, rural Hispanic, and African-American communities (see NTIA, 1995, p. 2; Anderson et al., 1995; Benton Foundation, 1998). Moreover, those who lack direct access to telephone service include 50 percent of homes headed by single women with children, 21 percent of those living in public housing, and 43.5 percent of families who depend entirely on public assistance (see Hammond, 1997; Benton Foundation, 1998).

FAMILY COMPUTER STUDIES

Descriptive studies of computer use in the home are relatively rare (National Research Council, 1998). The HomeNet Project (Kraut et al., 1996; Kiesler et al., 1997), however, documents the use and effects of household computers of more than 100 families in Pittsburgh. The project provided families from diverse demographic backgrounds with a computer, modem, extra telephone line, software, online support, and access to an evening telephone help desk. In addition, each family member above age 8 interested in having Internet access was provided with his or her own email account. The preliminary findings from this field experiment suggest the following:

- "Even with hardware and software designed for ease of use, personal training, and personal support, people found the technology hard to understand and use. Significantly, many of those who stopped (or never started) use blamed themselves rather than the technology for their problems.
- Generational effects persist even when both older and younger generations have the same access to the same technology. People in the household under the age of 19 use the computer more than those older than 19.

- Household income and educational levels are not valid as predictors of Internet use when all the people compared have adequate technology and support" (National Research Council, 1998, pp. 1-2).

The above studies show that no single factor or background characteristic is responsible for the access deficit. The 1999 NTIA report suggests that Internet access is biased by several variables, including income, race, education, family structure, and geography, with income and race emerging as the two most prominent indicators of the divide.

THEORETICAL CONSIDERATIONS ON THE SOCIETAL IMPACT OF THE DIGITAL DIVIDE

Another strand of inquiry surrounding the digital divide is represented by the work of Donald Schon and his colleagues in the Department of Urban Planning, the Department of Architecture, and the Media Laboratory at MIT. In the spring of 1996, they convened a colloquium on "Advanced Information Technologies, Low-Income Communities, and the City." The proceedings of this conference have recently been published in a book, *High Technology and Low-Income Communities* (Schon, Sanyal, & Mitchell, 1999). This conference grew out of the ideas of three prominent MIT-affiliated individuals, each of whom brings a particular point of view to the question of the role of technology in society. Mitch Kapor, who upon leaving the Lotus Corporation joined the MIT faculty, believes that while technology has the potential to act as a great leveler of opportunity, it is also a dramatic amplifier of inequality. For Kapor, inequality is most clearly evidenced by the fact that both the rural and inner-city poor lack access to network technologies at the same levels that predominate in largely white, middle, and suburban America. The work of Nicholas Negroponte, founder of MIT's Media Lab, is grounded in the belief that digital technologies will profoundly and progressively reshape every facet of our lives. Melvin King, a member of MIT's Department of Urban Planning, initiated a program to bring community activists from low-income urban communities for a year-long fellowship at MIT. The fellows work to bring technology to underserved urban areas as a key strategy for stimulating economic development and community empowerment.

Drawing on a wide range of theoretical perspectives, including economic, urban planning, and sociological analyses, the proceedings of the conference document historical, social, and economic problems faced by inner-city neighborhoods. The colloquium papers suggest that the problems associated with the digital divide are embedded within cultural and economic conditions. Proposed solutions entail dealing with fundamental issues such as economic opportunities, education, and geographic isolation. These issues continue to drive inequalities in the abilities of traditionally underserved individuals to take full advantage of the capabilities of information and communications technologies.

Working from a similar approach, Lentz, Straubhaar, LaPastina, Main, & Taylor (2000) have recently produced a critical and analytical view of public Internet access. These researchers are interested in how policies and institutional practices structure access, and how patterns of access are influenced by the knowledge base of the local communities. Attempting to move beyond questions of physical access, they ask: "Even when public access to the Internet is *not* a barrier in minority communities, what social and cultural structures may continue to keep certain people from using public access technology?" (p. 2). They seek to understand how specific institutional policies – e.g., rules, constraints, and allocation of resources or opportunities – enable or restrict access.

Researchers assert that the level of access to information depends on the user's assets (education, family, socialization patterns, social networks, peers, and occupational experiences.) The issue of socialization is exemplified by the responses of teenage users at the Montopolis Neighborhood Center in Austin. One boy said he did not think he would be using any computers for his job after night school because his adult family members did not use computers at their jobs and were still financially stable (identified through material possessions). In fact, none of the young users at this center saw computers as a means of enhancing their job skills. This is because the environment in which they were raised does not stress the importance of computer skills. Their parents and peers do not use computers, and their schools do not provide enough computers for the students. The message from the community is that computer skills do not lead to well-paying jobs or a better education (Lentz et al., 2000).

Along similar lines, Bruce and Hogan (1998) argue that computer technologies are "actors in social systems" that function in a larger social context. According to these authors, new tools afford new literacy skills, and various challenges. The recurring theme in these studies is that the issue of access needs to be clarified in terms of sociological, economic, and political factors. Lack of access to networked technology will result in a substantial segment of society having neither the skills nor the means to participate in the progressively more "knowledge-based" U.S. economy.

PATTERNS OF USE, CONTENT, NEED, AND ACCESS

Throughout the last decade the community technology movement has been developing ways in which advanced computer and Internet technologies can be used to address community needs. Although much still needs to be learned about the actual benefits, outcomes, and impact on the people that community technology centers (CTCs) serve, there does exist a growing body of work in this area (Henríquez & Ba, 2000; Children's Partnership, 2000; Wahl et al., 2000; Daley, Irving, & McGuire-Rivera, 1999; Westat, 1999; Schon, Sanyal, & Mitchell, 1999; Blanton, Greene, & Cole, 1999; Baker et al., 1999; Servon & Nelson, 1999; Birenbaum et al., 1998; Melchior, Thorstensen, & Shurkin, 1998; Chow, Ellis, Mark, & Wise, 1998; Chung, 1998; Mark et al., 1998; Breeden, et al., 1998; Mark, Cornebise, & Wahl, 1997; Attewell & Battle, 1997; Katz & Aspden, 1997; Keisler et al., 1997; Kraut et al., 1996; Kanfer & Kohlar, 1995; Biskon et al., 1991).

COMMUNITY ACCESS STUDIES

Access for Community Needs

A Commerce Department report, *How Access Benefits Children* (1999), compiles 11 case studies of diverse community access programs across the country that connect young people to the world of information through the Internet. The report, describing how children are learning, playing, working, and communicating as they use the Internet, found that networking tools offer kids opportunities to form an array of meaningful and rewarding relationships, and also that kids are using information technology to express themselves artistically, to make connections across social and geographic boundaries, to

contribute to their communities, and to prepare for the world of work (Daley, Irving, & McGuire-Rivera, 1999).

In 1998 and 1999, the Department of Commerce commissioned Westat, an independent research and consulting firm, to evaluate the Telecommunications and Information Infrastructure Assistance Program (TIIAP – now known as the Technology Opportunities Program), which funded a variety of community and school networking projects from 1994 to 1996 (Westat, 1998, 1999).[2] Westat found with all efforts involving multiple collaborators, that commitment and follow-through on the part of the project partners are key components of successful program implementation. In addition, common barriers to successful implementation include: inadequate technology infrastructure; underutilization of the technology; lack of buy-in from stakeholders and end users; staff turnover; lack of time to engage with the technology.

Community Technology Centers

Various case studies and surveys have found that underserved communities are benefiting from access to information technology and networking that rebuilds their communities, but they have a long way to go in terms of integration of technology into their current programs and/or community needs. Evaluations of Community Technology Centers (CTC's), such as community networks and other after-school programs such as the Boys and Girls Clubs, show that integration of technology into community building can, however, progress rapidly.[3]

Community Technology Centers' Network (CTCNet) brings together more than 400 community technology centers that provide access to computers and related technologies to people who typically lack such access. Evaluation studies find that CTCNet (through its affiliated centers) has been very successful in providing technology access to individual participants and their communities (Chow, Ellis, Walker, & Wise, 2000; Chow, Ellis, Mark, & Wise, 1998; Mark, Ellis, Chow & Wise, 1998; Breeden, et al., 1998; Mark, Cornebise, & Wahl, 1997). A long-term research study of 12 of its community technology centers, found that the CTC members use the technology to "send

[2] "Urban, rural, and initiatives that had demonstrated their capacity to remain operational well beyond the TIIAP grant period" (Westat, 1999, p. 2).
[3] CTCNet, Cleveland Free-Net, Great Lakes Free-Net, Worth County Free-Net, Austin Free-Net, National Capital FreeNet, etc.

and receive e-mail; prepare professional-looking résumés, cover letters, and other documents; search the Internet for information and entertainment; or simply relax by playing games on a computer" (Chow, Ellis, Walker, & Wise, 2000, p. 27). The centers provide a meaningful and challenging learning environment as well as a sense of community. Chow, Ellis, Walker, & Wise also found that CTCs' access to technology helps their members learn of new employment opportunities.

Using a qualitative approach, Mark, Cornebise, and Wahl (1997) studied five CTCs representing an array of participants (adults and children), a variety of services (e.g., public access, literacy, job training and employment, youth programs) and settings (e.g., a large public library, a cable access center, a stand-alone community center), as well as a diversity of geographic locations. They identify and categorize the wide range of (primarily positive) individual and community impacts evident at the chosen CTC sites. The beneficial impacts identified include an increase in job skills and access to employment opportunities, an improved outlook on learning and educational goals; technological literacy seen as a means to achieve individual goals, new skills and knowledge, increased civic participation, and social and community connections.

In a national survey of 817 people at 44 community technology centers, Chow, Ellis, Mark, and Wise (1998), as well as Mark, Ellis, Chow, and Wise (1998), studied the impact of CTCs affiliated with CTCNet. Chow (1998) found that women and people of color make up the majority of centers' users. They further found that 71 percent of survey respondents indicated that being able to use email at a technology center was important to them; 94 percent expressed positive feelings about their community technology center; 65 percent said that they took their center's classes to improve their job skills and did improve their job skills; and 30 percent used the center's Internet access to look for jobs. A majority of users said an important reason for coming to the center was to learn about local events and local government services. A large majority (85 percent) said they were satisfied or very satisfied with their center's social atmosphere.

Promising Practices for CTCs

In a different look at the CTCNet, Breeden, Cisler, Guilfoy, Roberts, and Stone (1998) conducted five case studies of family-oriented centers in low-income communities serving diverse age groups (children, youth, and adult) whose members were interested in

exploring new technologies and acquiring specific skills (such as English literacy, office computer applications, and using the Internet). The researchers focused on examining what is working and where the gaps are in community technology programs, with recommendations for improving and sustaining such programs. Success factors identified in the study for these programs include:

- Strong leadership
- Grounding in community strengths and needs
- Respect for people served
- Broad inclusiveness and diversity
- Support for existing community institutions
- Generous amount of time spent on planning and thorough design of program activities
- Well-trained staff and volunteers
- Thoughtful, up-to-date curriculum
- Inviting physical facilities
- Expert support
- Commitment to an evaluation program (see Breeden et al., 1998).

Other research is beginning to focus on the systemic and programmatic factors that enable CTCs to thrive. The Vstreets research group (Penuel & Kim, 2000) has identified several trends in promising practices from interviews and observation in CTCs around the country. These include:

- The learning opportunities need to be shaped by the needs and characteristics of the population served.
- Hiring staff members who are as connected to the center users as they are to the community's resources is important.
- Updating equipment and evaluating the effectiveness of the programs is important to sustaining and improving community technology programs.
- As the Westat study of TIIAP (1999a) found, building community partnerships is fundamental to success. These partnerships will help make the transition between the evidence of success and the day-to-day practices of running the programs.

These promising practices can help centers increase the skills of their participants and provide a network within the community that connect their participants to one another. This network can not only help the participants with exposure to opportunities, it can also link the centers with other centers to share practices that are most effective for both center evaluation and participant learning.

During the CTCNet Annual Conference in June 2000, a focus group of CTCNet staff members was convened by the University of Michigan discussed common practices and beliefs among community technology centers. The four main topics discussed were: how CTC staffers go about finding information, what types of information they most often seek, the barriers they confront in identifying information resources, and recommendations for making information more readily available to a wide range of centers. The overarching theme was the CTCs' need for a widely available knowledge base (Sandor & Scheuerer, 2000).

Community technology center staff want information that is reliable, current, comprehensive, and focused on content rather than aesthetics. They want information on financial opportunities, local resources, best practices / lessons learned, and evaluation resources. The sources most often used are:

- Human information sources (other CTC staff members and supporters)
- The World Wide Web
- Email
- Printed resources.

Common barriers identified when seeking information are difficulties:

- Finding people or organizations that have the expertise in the subjects related to the needs of the CTC
- Sharing information with other CTC's
- Searching the Web
- Organizing information.

And finally, ideas for making information more readily available for CTC's include:

- Identifying expertise in the community technology movement
- Facilitating CTC mentoring by creating a virtual mentoring program matching veteran CTC staff with newcomers

- Providing a community technology virtual reference librarian who responds to both telephone and email inquiries
- Organizing more network opportunities for face-to-face networking
- Documenting CTC practices (Sandor & Scheuerer, 2000).

Community Access and Workforce Development

In recent years increasing use of information technology (IT) has provided an impetus for studying the impact of advanced computer and Internet technologies on individuals, communities, and businesses (see; John Heldrich Center for Workforce Development at Rutgers and Center for Survey Research and Analysis at the University of Connecticut, 2000; Schon, Sanyal, & Mitchell, 1999; Baker, Jeffers, & Light, 1999; Benner, Brownstein, & Dean, 1999; National Research Council, 1998; AAUW, 1992, 1995, 1996, 1998, 1999; Sadker & Sadker, 1995; Sanders, 1995). The fundamental issue in this area of research is the mismatch between the number of IT workers needed in every industry and the inability of specific populations to fulfill those needs due to a lack of basic literacy, technology, and employability skills. Underserved communities are unable to attract, retain, and develop IT businesses because of their lack of access to modern telecommunications facilities as well as their shortage of well-trained workers. Another challenge in the workforce development field is a mismatch between the workplace's skill requirements and young job applicants' work skills. "Kathleen Cotton reviewed 63 documents on employability skills and reports that employers' dissatisfaction with young job holders is not primarily due to inadequate technical knowledge and skill, but rather the non-technical, employability skills, categorized here as basic skills, as in math and writing, higher-order thinking skills such as problem-solving and decision making, and social skills and traits such as dependability, positive attitude, and cooperativeness" (in Baker et al., 1999, p. 26).

Looking at promising practices in youth development and career preparation using technology and media, researchers at EDC / Center for Children and Technology studied 23 organizations,[4] including "school-based programs; community-organization-based

[4] The Computer Clubhouse; Area Learning Center; Educational Video Center; Maine Career Advantage; Manufacturing Technology Partnership; Mt. Edgecombe High School; etc.

programs; programs using a variety of media and technologies; geographic and demographic diversity; and programs that participate in interagency partnerships" (Baker et al., 1999, p. 2). Using a conceptual framework grounded in youth development, work preparation, and technology and media, they reviewed the literature on these three topics as well as documents provided by participating sites; they also analyzed survey questionnaires and in-depth telephone interviews. In addition they visited five of the participating sites. From this work, five categories of best practices were identified:

- A focus on the roles of participants and adults. Programs use young people as mentors and teachers to their peers, to younger children, and to adults; engage adults as facilitators, role models, and co-explorers; engage teachers in providing professional development to others; provide professional development for teachers and staff to support participants in these new roles.
- Preparation for the workplace. Programs enable young people to develop standard industry skills that focus on real work for real audiences; engage young people in working in teams; build strong relationships with business and industry; involve industry in the program; recruit business and industry partners; exhibit participants' work to potential and current partners; give partners focused roles; and provide young people with work-site mentors.
- Instructional context and environment a priority. Programs teach skills that are not technology-specific; enable young people to use technology and media as a vehicle for self-expression; provide a variety of technologies and media for young people's self-expression; provide young people with forums for sharing their work; employ a student-centered, project-based pedagogy; integrate technology into other program areas; and link to community colleges and universities.
- Importance of personal growth and sense of community. Programs offer young people a welcoming, family-like environment; engage young people in working together; help participants develop a sense of ethics; and use teamwork to facilitate personal growth and develop interpersonal and other skills.
- Focus on reaching underserved youth. Programs give priority to underserved youth when selecting participants; recruit girls and young women; and develop a staff that reflects participants' communities (Baker et al., 1999, pp. 28-41).

Common Barriers for CTCs

A recent study on the digital divide focuses on the relationship between online content and the needs and requirements of low-income Americans. This is the first national study to focus on the expressed needs of underserved communities and to systematically examine the ways in which existing Web resources are and are not meeting these needs. Conducted by the Children's Partnership (2000), the research is based on focus groups with low-income Internet users, interviews with community technology leaders, and a content analysis of 1,000 websites. The study concludes that four significant barriers affect use: lack of local information; literacy barriers; language barriers; and lack of cultural diversity in Internet resources. Specifically, the report states:

- General information exists on topics of interest but is not accessible because of the style of writing.
- Most online content at a basic literacy reading level targets children.
- Most sites have no multicultural content.
- One of the most difficult access issues is for the adult respondents to obtain practical employment information such as local job resources or job listings for entry-level positions.
- In a Web-search exercise, most users did not find the information they were asked to look for; nor did they find the Web material understandable or easily organized, nor the portals assigned easy to use (Children's Partnership, 2000).

The report makes a number of recommendations targeted at policy, philanthropic, and business leaders, and it strongly endorses the need for additional research and development that can be used to create a knowledge base for community and national efforts.

Web design and disabilities: Another group that faces barriers posed by lack of accessible content is the disability community. Just as the physical environment presents barriers to access for people with disabilities, the design of Web environments (e.g., images, Java applications, search forms, tables, and frames) also poses limitations. Napili (1999) outlines the Web as both a barrier as well as a potential tool for community building for blind and low-vision users. The Web has great potential to provide current

information to blind people – digital information can be more accessible than print materials, more portable than Braille, and more available on the Web than in Braille or large-print books. For those with mobility problems, the Web makes home shopping convenient and helps connect them to the rest of the community. There are still, however, a great number of barriers to Web access for the blind and low-vision users. For example, Web designers seldom describe their images, nor do they design elements to be heard rather than seen; typing can be difficult, especially the typing of URLs; the extensive use of acronyms is particularly difficult for people who depend on hearing rather than seeing information. The physical organization of webpages, which often start with advertisements and menus unrelated to the main content of the page, make using them difficult for the blind. Napili believes that these difficulties can be overcome if Web designers become mindful of accessibility issues for the disability community (Napili, 1999).

CONCLUSION

While the research community is gaining some insight into how information and communications technologies are supporting the needs of underserved communities, important questions remain about how community organizations can best make use of existing research and how additional data can be collected to enable programs to continue to grow, innovate, and refine their technology initiatives. Although community-based technology programs are expanding quickly, rigorous research documenting both effective program design and outcomes lags behind. Questions remain about the kinds of conceptual frameworks and practical tools that will genuinely help community organizations to determine whether their programmatic efforts are meeting their goals. We still have much more to learn about how underserved communities actually make use of the computer and Internet in their daily lives.

Some research issues and areas needing attention are:

- The primary barriers to improving community technology programs. These might include poorly understood relationships between program design and outcomes, lack of impact data, inadequate dissemination channels or methods, high turnover of staff in the field, the rapid pace of technology development, and many other factors.

- How to address these barriers and link research to practice. We need to understand which approaches are most effective with which audiences, and when to use them.
- The opportunity costs for community-based organizations that try to implement technology programs. For example, could they have greater impact if they chose not to use technology for a particular purpose (such as literacy) and implemented another kind of program? Put another way, when does using information technology produce the biggest "bang for the buck"?
- How a center or program defines and sets boundaries on its mission and goals, so that it is not "spread too thin" or unfocused.
- How existing "successful" access programs can be adapted by community-based organizations. For instance, we need to examine the experience of those states and municipalities that have experimented with E-rate and other federally driven telecommunications deployment programs in providing access to their underserved communities.
- Research that empirically investigates the impact of technology on different cultures and cultural identities.
- A more detailed understanding about how meaningful content can be created in different settings and by different groups. What staff resources, technology tools, motivational supports, and other factors are required? What influences the user's perception of "meaningfulness"?
- Partnerships and collaboration as key to the successful implementation of many community technology centers. What makes a good partnership, and how can center staff become more skilled at developing and managing partnerships?
- Improving the professional skills of center staff. Peer-to-peer mentoring and shared reflective practice appear to be promising strategies. What do we know about improving skills generally, and about using peers in particular?
- How to sustain improvement of programs. Centers must adopt a culture of continuous learning, and funders must be persuaded that this culture is worth funding (rather than funding only "pilot programs" or brand-new innovations).
- Learners in the disadvantaged community. How do community technology programs, and the informal learning opportunities they provide, impact achievement,

motivation, and self-image? What are the differences between highly structured programs (with specific curricula and measurements of progress) and less structured programs (in which people are free to learn or explore on their own)?

- Patterns of home and community computer use in different socioeconomic and ethnic contexts in terms of individuals' personal needs and interests. Studies should include the following: What is the purpose of the computer? Do people know how to operate their computers? Do they need to share the computer with others at home? Do they go to technology community centers to access certain software applications, high-end machines, or other hardware devices not available at home? Do they seek out the opportunities for socializing or the supportive coaching available at technology centers? Does computer use substitute for other activities, and if so how? How does computer use affect family dynamics, children's educational performance, and adults' employment activities? (See Mark et al., 1998; National Research Council, 1998.)
- Access to opportunities through the use of technology by *age, gender, and/or disability* within specific socioeconomic and ethnic groups. The 54 million Americans with disabilities represent a community with specific obstacles to technology access: visual and hearing disabilities; physical disabilities; speech disabilities; language, learning, or cognitive disabilities; etc. Most of their access issues go beyond hardware needs, and the focus of their advocates has been on quality and universal access through design, especially in assistive technologies.
- Interdisciplinary and statistical research on the social and economic impacts of information technology on underserved communities' access to jobs in general, and to IT jobs in particular (National Research Council, 1998).
- Research on youth development organizations use of technology and media to engage young people in career preparation and the transition to employment.
- How to scale up existing successful after-school programs for the benefit of diverse community organizations with different degrees of expertise with technology, research, and commitment to the improvement of young people's learning.

Methodological challenges complicate the examination of most of the above research questions (Mark et al., 1998; Melchior et al., 1998). The diversity of site characteristics — such as goals; population targeted; funding, technical, and human resources; and reasons for wanting access to computers and the Internet — renders generalizing across sites or other variables difficult. The research reviewed above indicates that technology is used differently by individuals as well as by communities, and has different impacts due to such variables as age, gender, ethnicity, income level, geographic location, and program content. Quality access would thus be usefully thought of as a local and particular issue.

Other challenges to studying outcomes of the use of information technologies include:

- "A tendency to support the development of theoretical models to predict what *will be* or *might be* the case, rather than pursue empirical studies of what actually *is* happening now.
- A tendency to fund studies of cutting-edge applications, which tend to be located in large, dynamic (and resource-rich) settings. What one observes in the largest, most resource-rich, and most committed settings is *not* a good predictor of the typical effects of a technology in the larger world.
- A tendency to direct money into prototyping new applications, and to rely on the authors of the prototypes to do the impact assessment or performance evaluation themselves (or not do an evaluation at all).
- A tendency to discount findings that demonstrate negative or null impacts of IT on the grounds that such impacts simply reflect early versions, or start-up problems, which will disappear when the next generation of machinery or software comes online" (Attewell & Battle, 1999, p. 1).

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