Community Technology Centers and the Digital Divide: Implications for Computing Educators

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Abstract

Although the advent of information and communication technology (ICT) has created immense positive impact on society, it exasperates socioeconomic inequality. As ICT is becoming more intertwined with social, economic, educational, and political opportunities, the groups of people who do not have access to the ICT can be put in a disadvantaged socioeconomic position. This phenomenon is commonly known as the "Digital Divide". One of the solutions promoted by both the United States Government and a number of private organizations to bridge the Digital Divide Problem is the establishment of Community Technology Center (CTC). This study examines the effects of CTC establishments on the Digital Divide problem in the United States. Specifically, the socioeconomic variables examined in this study include family annual income, race/origin, and educational attainment. The information presented in this study will be valuable to policy makers, community leaders, social workers, community developers, and city officials who are directly involved in designing initiatives to bridge the Digital Divide. Social scientists, lobbyists of special interest groups, educators, and individuals interested in philanthropic activities will also find the results of this study useful.

Keywords: Digital Divide, Community Technology Centers

1. INTRODUCTION

In the last thirty years, the number of interconnected networks of computers via the Internet has grown exponentially. According to Pant and Hsu (2000), the size of the World-wide-web (Web) is doubling every 53 days or so. With the size of the Web expanding at such a rate, Internet traffic is expected to expand more than tenfold over the next few years, reaching more than 100,000 giga-bits per second in 2003 (Dobrushin 2000). At the same time, fiber optic technology, giga-hertz computers, hand-held computing and communication devices, as well as more sophisticated computer software, are providing more and more individuals with the abilities to engage in communication anytime and anywhere.

Driven in large part by the growth of the Internet, the nation's economy has become increasingly dependent upon information technology (U. S. Department of Commerce 1998). In North America, the volume of e-transactions is projected to surpass one trillion dollars by 2002 (Forrester Research 2000). This volume is estimated to reach about $6.8 trillion in 2004. A reason for this dramatic growth is inherent in the increasing dependence on online access that has become the fabric of living in a digital world (Castells 2001).

Rapid advances in the field of information and communication technology (ICT) are also shaping our society continuously and in ways that were considered unfathomable prior to the millennium (Builder 1993). As a new medium, the Internet can empower individuals and society as a whole. This effect of the Internet on society is in many ways comparable to that of the

freedom of the press. The "Digital super highway" is different from the technology era that preceded it, the information era is disseminating power (Builder 1993). Put simply, members of society who have access to the Internet can expect to have tremendous opportunities in democratic communication, personal advancement, as well as economic success. Conversely, individuals and groups that lack this access are not able to benefit from these opportunities and may be put in a disadvantaged position in the society. The disparity between those that have access to the information superhighway with others that do not is commonly called the "Digital Divide."

An Introduction to the Digital Divide

The term "Digital Divide" refers to an imaginary divide between those persons who have access to new technologies and those who do not (National Telecommunication and Information Administration [NTIA] 1997). According to a research of literatures related to the Digital Divide, this term was used as early as 1989 (Eweni, Koong & Liu 2000). Interest in the growing gap between the "information rich" and the "information poor" in the United States took root in 1995. In that year, the National Telecommunication and Information Administration (NTIA) released a report called "Falling Through the Net" (NTIA 1995). However, the amount of published works on the topic did not become significant until 1996. Since then, a growing number of studies have been done by the United States Government (NTIA 1997, 1999, 2000, 2001), private organizations, and research companies like CyberAtlas (1998), Forrester Research (2000), and Gartner Group (2000).

Even though the principal ingredient in the Digital Divide problem is Internet access, the issues and outcomes associated with this problem are diverse and complex. In reality, there is more than one Digital Divide. There exists other less obvious divides among those who already have Internet access. The Digital Divide can be categorized in the following ways (Gartner Group 2000):

- "Haves" and "Have Nots". The primary issue associated with this First Digital Divide is fair and equal access to educational and economic opportunities afforded by the Internet.
- "Haves" and "Have Hads". The principal issue associated with this Second Digital Divide is the acclimation process in which the user can gain familiarity and comfort levels to engage in online behavior.
- "Haves" and "High Speed Haves." Central to this third Digital Divide is the type of transmission medium called "broadband".

Most research has identified a number of demographic variables that are related to this problem. The variables identified included race, gender, and class (Gates 2000; Goldsborough 2000; Olsen 2000; Roach 2000; Trotter 2000).

2. STATEMENT OF THE PROBLEM

While it is true that race, gender, and class are established variables associated with the Digital Divide, the significance of each attribute, their associated sub-elements, and their direction and magnitude of change deserve deeper study. Given limited resources and often competing socioeconomic objectives, remedial policies should always be implemented according to established priorities. After all, this problem is actually a complex one. Some of the more recent and pressing concerns are indicated below:

- The gap between minorities and Whites has gotten wider. Between 1997 and 2001, White computer users grew from 57.5 to 70 percent, a growth of 12.5 percent. During the same period, Black computer users grew from 43.6 to 55.7 percent, a total of 12.1 percent or 0.3 percent less than Whites. Hispanic computer users grew from 38 to 48 percent, a mere 10 percent change or 2.5 percent less than Whites (NTIA 2001).
- Minorities continue to trail White users in the area of Internet use. Between 1997 and 2001, White Internet users increased from 25.3 to 59.9 percent. Black users increased from 13.2 to 39.8 percent. Hispanic users only grew from 11.0 to 31.6 percent (NTIA 2001).
- The gap between the most wired and least wired states can be rather large. Among the states in the Southern Growth Policies Board (SGPB), Virginia, reported about 47.3 percent of its households with computers. Mississippi has only 26.2 percent. In the area of Internet connectivity, Virginia and Mississippi were again respectively the most wired and least wired state in the SGPB. Here the percentages were 28.7 and 13.6 percent respectively (Bohland, Papadakis & Worrall 2000).
- Certain classes of children are in danger of being left further behind by the Digital Divide. Over 90 percent of children from households with annual income of about $75,000 have computer and Internet access. Only about 20 percent of children from households with annual income under $20,000 were found to have computers and Internet access. The gap is some 70 percent. The difference in computer and Internet access between children with parents holding doctoral degrees and those with just a 10^{th} grade education is even worse. The gap is almost 80 percent (Becker 2000)

All the studies cited above are alarming. This problem is actually more serious than the lack of books for poor families was 100 years ago because those without access to this technology will not have the requisite skills to compete in the digital society (Johnson 2000; Riley 2000). Such big differences in access to computer and Internet technology, given a person's race, gender, and

class, should not be happening in a country of abundance. Moreover, the large variation in access among the different states is definitely hard to understand in a country known for its technological leadership. As Castells (1999) asserts that within the informational dualism:

> It cannot be seriously argued that a democratic society can live peacefully on the basis of the systematic exclusion of one-quarter to one-third of its people, even confining them spatially in implicit apartheid style. (p. 34)

Obviously, sound governmental policies and community involvement are critical for minimizing or eliminating this problem. Most of all, root causes will need to be identified and priorities must also be placed on solving this complex problem if the existing trends and magnitudes are to be reversed.

3. STATEMENT OF OBJECTIVES

A number of federal agencies and philanthropic organizations have responded to the growing digital disparity by implementing a number of community-based initiatives. One of the highest profile initiatives that was provided by the Federal Government, sponsored by Housing and Urban Development (HUD) and Department of Education (DOE), is the Community Technology Centers (CTCs). The primary objective of this initiative is to provide computer and Internet access to underserved populations. Included with the hardware and Internet is also training programs that are aimed at increasing technological literacy. A number of studies have discussed the positive impacts of CTCs on individuals and communities (Mark, Cornebise, & Wahl 1997; Chow, Ellis, Walker, & Wise 2000). However, there is a lack of information about the influence of CTCs on the Digital Divide phenomena at large.

The objective of this study is to examine the effects of CTC occurrences on the Digital Divide phenomena. Specifically, this study examines the relationship between the occurrences of CTCs and selected socioeconomic variables that are related to the Digital Divide in the United States. The four commonly accepted socioeconomic variables are family annual income, race/origin, educational attainment, and poverty levels (Novak & Hoffman 1998; Gartner Group 2000; NTIA 2001).

The result of this study should be valuable to federal and state policy makers, community leaders, social workers, community developers, equity researchers, and city officials who are interested in bridging the Digital Divide. Administrators of charity organizations engaged in helping the disadvantaged, civic-minded philanthropists, and expert lobbyists for the advancement of high risk and challenged individuals will also find the results of this study useful to their cause.

4. DATA GATHERING

The variables used in this study were selected based on commonly accepted parameters published in literature on the Digital Divide (Novak & Hoffman 1998). Data relating to the three digital divide variables and poverty levels are identified from various government reports that were published in the National Telecommunication and Information Administration (NTIA) as well as the United States Census Bureau. The NTIA reports covered the period 1995 through 2001. The United States Census Bureau data were obtained from the 2001 Population Survey Supplement. The list of the variables and their official definitions are presented below:

- Digital Divide socioeconomic attributes. These variables deal with the percentage of Internet usage by individuals in the categories of income level, race/origin, and educational attainment.
- Number of CTC occurrences in each of the 50 states and the District of Columbia. The data set contains the number of organizations that managed one or more CTCs.
- The Digital Divide data was obtained from the Current Population Survey (CPS) provided by the Bureau of the Census. Although services provided by CTCs are normally targeted at the digital "Have Nots" populations (U. S. Department of Housing and Urban Development n.d.; Servon & Nelson 2001), this study was restricted to the following targeted segments which included sectors of the digital "Haves" for comparison purpose.

Income levels selected included those families whose yearly household income is less than $15,000.00 and an annual household income of $75,000.00 and above. This approach was consistent with the works reported by Dickard (2002). Race/Origin categories included all ethnic groups that were contained in the NTIA Reports. The race groups were Black, White, Asian American and Pacific Islander, and Hispanic. All educational attainment levels contained in the NTIA 2001 Report were included in this study. The five categories were (a) less than High School, (b) High School Diploma/GED, (c) Some College, (d) Bachelor's Degree, and (e) Beyond Bachelor's Degree.

Data pertaining to Internet usage for each of the 50 states and the District of Columbia were extracted using a comprehensive search engine called Federal Electronic Research and Review Extraction Tool (FERRET). The Web address for retrieving the data set is http://ferret.bls.census.gov/cgi-bin/ferret. FERRET is an easy-to-use public tool that is made available by CPS for individuals who are interested in getting governmental Census related data.

The data set relating to the number of CTC occurrences was obtained from two of the three main databases that provided state-by-state CTC information. The three databases that provide some form of CTC information

are: Digital Divide Network's Get Connected database, CTCNet's database, and the Housing and Urban Development's Neighborhood Network database. However, one of the problems associated with the use of these databases is inherent in the way their data set is organized. These databases only provided a list of CTC organizations rather than a list of centers. Each organization might operate one or more than one CTC. It was therefore practically impossible to obtain the number of CTCs for each state from these databases. Furthermore, the CTCNet's database also contains organizations that are directly or indirectly related to CTC.

To circumvent the difficulty in obtaining an accurate count in the number of CTCs, only the Get Connected database and Neighborhood Network database were selected. The numbers of organizations operating CTCs instead of the numbers of CTCs were used for the present study. Organizations from each database were manually counted and compared. Duplicate organizations were eliminated to avoid double counting. Using this methodology, the total number of organizations obtained would thus be a better representation of CTC initiatives in the United States. In addition, Get Connected database and Neighborhood Network database are also the two major sponsors of CTC initiatives in the United States.

5. METHOD OF ANALYSIS

Even though the original number of Internet users and CTC occurrences was included as one of the analyses, attention was not focused on this statistic generated because the analysis may not be accurate. A large number of Internet users may not necessarily be a CTC occurrence causal factor. It could be that the state is a heavily populated state and vice versa. To prevent this bias, attention was focused on the relationship between CTC occurrences and percent of Internet users. Also, to minimize bias, CTC occurrences per population segment studied was used to assess a more accurate form of the causal relationship. The null hypothesis tested was:

> H1: There is no relationship between the number of CTC occurrences and the socioeconomic variable examined.

The Pearson correlation was the major statistical technique used for analyzing the data set and for testing the null hypothesis because it has the statistical power to test for relational strength and goodness-of-fit in data sets (Carver & Nash 2000). In using the Pearson correlation, all computed p-values that were 0.10 and below were considered significant. In this study, correlation values (r) that are at least 0.75 were considered strong, 0.50 to 0.74 were accepted as moderate, and 0.25 to 0.49 were counted as acceptable. The "2-tailed" p-values were used for reporting outcomes because the hypothesis was formulated as two-sided alternative hypothesis (Carver & Nash 2000). Finally, the 1700 CTC occurrences were treated as the predictor variables. The number of Internet users in the respective socioeconomic groups from all the 50 states plus the District of Washington were used as the dependent attributes.

6. FINDINGS

Four major types of socioeconomic status of the population studied were used to convey the demographic profile of the targeted groups examined in this study. These four commonly accepted socioeconomic status variables used in the official governmental reports are total population, race/origin, family income, and education attained. In the analyses related to family income, this study included only the lowest income group (less than $15,000) and the highest income group ($75,000 and above). Such a selection was used to examine for possible effects of the income spread on CTCs, if any. Moreover, this approach was also consistent with a related study that was reported by Dickard (2002). All four ethnic groups, White, Black, Asian American or Pacific Islander, and Hispanic, were included in the analyses related to race/origin. Consistent with the methodology used in the study by Novak and Hoffman (1998), the education attainment variables consisted of five major groups. They are less than high school, high school diploma/GED, some college, bachelor's degree, and beyond bachelor's degree.

As can be seen in Table 1, there are some very distinctive trends about the Internet use that is evident in the socioeconomic data.

- Slightly over half of the population-at-large is found to be Internet users.
- Only 25 percent of families with less than $15,000 in income are Internet users. This percentage jumped to about 79 percent when the income level was $75,000 and above. In other words, the difference in the Internet use between these two income groups was a whopping 54 percent.
- Even though Asian Americans and Pacific Islanders represent the smallest ethnic group in the general population, they constitute the largest group of Internet users. The lowest Internet users groups were from the Hispanic and Black sector.

Data pertaining to education attainment also showed that it was a related socioeconomic variable. As individuals attain more education, more were found to indicate that they are Internet users. In fact, the difference between the highest educated group and the group with the least education can be fairly dramatic. The difference was about 71 percent.

Table 1 Demographic Information about Socioeconomic Variables Used

Population	Internet Use (thousands)		Internet Use (%)
	Internet Users	Total	
Total Population	142,823	265,180	53.9 %
Family Income			
Less than $15,000	7,848	31,354	25.0
$75,000 and above	44,547	56,446	78.9
Race/Origin			
Black	13,237	33,305	39.8
White	111,942	186,793	59.8
Asian American & Pacific Islander	6,452	10,674	60.4
Hispanic	10,141	32,146	31.6
Education Attainment*			
Less Than High School	3,506	27,484	12.8
High School Diploma/GED	22,847	57,386	39.8
Some College	28,321	45,420	62.4
Bachelor's Degree	24,726	30,588	80.8
Beyond Bachelor's Degree	13,633	16,283	83.7

Source: U.S. Bureau of Census, Current Population Survey Supplement, September 2001. Note [*]: Ages in this category were different from those used in other categories.

The relationships between CTC occurrences and family income are presented in Table 2. As can be seen in Table 2, with the exception of one case, the rest of the correlation coefficients were not strong. The correlation values between total number of CTCs occurrences and percentage of Internet users ranged between –0.24 and -0.088. While it is true that the p-value was significant at the 0.10 level, the correlation value was only marginally acceptable (less than 0.25). None of the relationships between CTCs per particular segment occurrences and percentage of Internet users were significant. The correlation values were from a low of -0.002 to a high of 0.037.

Table 2 Relationship between CTC Occurrences and Family Income

	Total Number of CTC Occurrence		Number of CTC Occurrence per Population Segment	
Family Income $15,000 or less				
	p-value	r	p-value	r
Number of Internet Users	<0.0001	0.713	0.1940	-0.185
% of Internet Users	0.0841	-0.244	0.9911	-0.002
Family Income $75,000 & above				
	p-value	r	p-value	r
Number of Internet Users	<0.0001	0.759	0.198	-0.183
% of Internet Users	0.5400	-0.088	0.989	0.002
Gap between Income Group $15,000 or less and $75,000 and above				
	p-value	r	p-value	r
Number of Internet Users	<0.0001	0.755	0.745	-0.047
% of Internet Users	0.1610	-0.199	0.796	0.037

The respective relationships between the percentage of Internet users in the four race/origin categories and CTC occurrences are presented in Table 3. In at least two of the four cases, the correlation values between the percentage of Internet users by race/origin and CTC occurrences per population segment studied were relatively strong. In particular:

- The correlation between the percentage of Black Internet users and CTC occurrences per population was 0.413. The p-value was significant at the 0.01 level of alpha.
- The correlation between the percentage of White Internet users and CTC occurrences per

population was 0.425. The p-value was also significant at the 0.01 level of alpha.

- The correlation between the percentage of Hispanic Internet users and CTC occurrences per population was 0.533. The p-value was also significant at the 0.01 level of alpha. Details about the respective relationships in Table 3 are presented below:

Table 3 Relationship between CTC Occurrences and Race/Origin

	Total Number of CTC Occurrence		Number of CTC Occurrence per Population Segment	
Race/Origin – Black				
	p-value	r	p-value	r
Number of Internet Users	<0.0001	0.563	0.0070	-0.380
% of Internet Users	0.2850	-0.153	0.0032	0.413
Race/Origin – White				
	p-value	r	p-value	r
Number of Internet Users	0.007	-0.381	0.300	-0.148
% of Internet Users	0.423	-0.115	0.002	0.425
Race/Origin – Asian American & Pacific Islander				
	p-value	r	p-value	r
Number of Internet Users	<0.0001	0.574	0.099	-0.234
% of Internet Users	0.6080	-0.073	0.980	0.004
Race/Origin – Hispanic				
	p-value	r	p-value	r
Number of Internet Users	<0.0001	0.572	0.1590	-0.200
% of Internet Users	0.1940	-0.184	<0.0001	0.533

Table 4 Relationship between CTC Occurrences and Educational Attainment

Educational Attainment	Total number of CTC Occurrence		Number of CTC Occurrence per Population Segment	
Less than High School				
	p-value	r	p-value	r
Number of Internet Users	<0.0001	0.726	0.167	-0.196
% of Internet Users	0.5270	-0.091	0.003	0.407
High School Diploma/GED				
	p-value	r	p-value	r
Number of Internet Users	<0.0001	0.782	0.285	-0.152
% of Internet Users	0.6260	-0.070	0.047	0.282
Some College				
	p-value	r	p-value	R
Number of Internet Users	<0.0001	0.711	0.322	-0.141
% of Internet Users	0.3060	-0.146	0.047	-0.279
Bachelor's Degree				
	p-value	r	p-value	r
Number of Internet Users	<0.0001	0.757	0.306	-0.146
% of Internet Users	0.7530	0.045	0.714	0.053
Beyond Bachelor's Degree				
	p-value	r	p-value	r
Number of Internet Users	<0.0001	0.814	0.210	-0.178
% of Internet Users	0.3530	-0.133	0.302	0.147

The last set of NTIA socioeconomic variables analyzed was related to the level of educational attainment of the Internet Users and CTC occurrences. The five groups are less than high school, high school diploma/GED, some college, bachelor's degree, and beyond bachelor's degree. Initially, there were only 2 cases that showed correlation coefficients that were statistically significant. When regression analyses were conducted on the two cases and the scatterplots and standardized residuals were examined, it was discovered that the data distribution has one outlier. That outlier was from the data set relating to the District of Columbia. This set of data was removed and all the tests were replicated with only data from the remaining 50 states.

Three cases were found to have statistically significant correlation. In one of the cases, the correlation changed from a negative value to a positive one. The correlation between the percentages of Internet users with less than high school and CTC occurrences per population was 0.407. The p-value was significant at the 0.01 level of alpha so the null hypothesis was rejected. The correlation between the percentages of Internet users with high school diploma/GED and CTC occurrences per population was 0.282. The p-value was significant at the 0.05 level of alpha. As a result of the significance of p-value, the null hypothesis was rejected.. The correlation between the percentages of Internet users with some college and CTC occurrences per population was –0.279. The p-value was significant at the 0.05 level of alpha so the null hypothesis was rejected.

7. CONCLUSIONS AND IMPLICATIONS

Several major relationships were identified between the number of CTC occurrences per population segment studied and the socioeconomic variables examined. With the exception of two of the seven cases, the rest of the relationships between the criterion variable and the predictor variable were linear and direct. A number of major implications obtained from the identified relationships should be of importance to educators.

First, the Digital Divide is a real phenomenon. Based on the demographic data studied, the number and percent of Internet users can be quite different among the respective groups that were classified by race, education levels, and family income. Faculty members of institutions that serve predominantly minorities as well as urban and other poverty stricken area students will have to find ways to bridge the gap.

Second, CTCs were found to be an effective initiative for reaching certain socioeconomic sectors. Faculty members may want to use the assistance provided by HUD and DOE for setting up CTCs in affected communities. In addition to helping the targeted groups of people, such grants can also provide employment opportunities for faculty and staff. Grants can also be obtained from agencies such as NASA, NSF, and USDA. Once the CTCs are established, it can lead to other matching grant opportunities from private and philanthropic organizations.

Third, the two statistically significant negative relationships found between CTCs occurrences and certain socioeconomic groups were most disturbing. Not only are CTCs initiatives not effective, they are actually creating a negative effect. This is one area that faculty members can study why CTCs fail and what better strategies can be used to help the affected groups. Perhaps the outlier discovered in this study, the lack of success by CTCs in the District of Columbia, is the key to the puzzle. Second, this study can also be extended to include secondary variables such as age groups and availability of support staff. Such an assessment may help future advocates and sponsors to better operate as well as to place CTCs where they can actually be effective.

Finally, CTCs are merely facilities. Resources in the form of new hardware, software, and personnel must be added constantly. Some of the reasons contributing to the existing lack of successful results from CTC initiatives may be related to the areas of resources, management, and leadership. This is definitely one area which computing faculty members and students can play a critical role by offering their expertise to train the CTC staff as well as volunteers

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