Who's Wired and Who's Not
Excerpts from Forthcoming Article
(including tables omitted from published version)

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Children's Access to Computers at School

Over the past decade and a half, the number of computers in American elementary and secondary schools and classrooms has been steadily increasing. Yet, despite technology infrastructure-building efforts throughout the 90's, most schools still have a way to go before they meet most reasonable definitions of a well-equipped building – one that permits a seamless integration of computer technology into the learning activities of most classes. For this article, I defined eight benchmarks related to the density of various computer technologies, and then, using data from our Teaching, Learning, and Computing: 1998 (TLC-1998) national study, I explored what proportion of schools nationwide met each of these benchmarks as of that year. Key factors in this assessment included the number of students per computer, the type of computers present, connection of computers to a "local area network" (or LAN), and connection to the Internet. In 1998, a majority of schools met only one of the eight benchmarks—having a majority of their computers connected to a local area network. Fewer than 20% of the schools met four other criteria: having at least one computer of any kind for every four students enrolled, one Pentium or Power Macintosh computer for every six students, one CD-ROM-equipped computer for every six students, and having at least half of all instructional rooms connected to the Internet by a high-speed, direct connection. Overall, only 15% of schools met even a majority of those benchmarks. (See Table 1.) Almost certainly, more schools have attained these benchmarks in the past two years, but the number that now are "well-equipped" in most of these ways is still most likely no more than 25%.

TABLE 1: TECHNOLOGY ACCESS BY SCHOOL LEVEL

	Elem-entary	Middle School	High School	All
At Least 1 Computer for Every 4 Students	10%	29%	33%	18%
At Least 1 Pentium/Power-Mac for Every 6 Students	7%	14%	14%	10%
At Least 1 CD-ROM-Equipped Computer for Every 6 Students	11%	27%	17%	15%
50% of Computers LAN-Connection	50%	64%	63%	55%
50% of Rooms with LAN-Connection	34%	46%	30%	35%
School Has High-Speed Internet Access	24%	35%	45%	30%
At Least 1 Internet-Accessible Computer per 12 Students	24%	39%	41%	30%
50% of Rooms with High-Speed Internet	16%	17%	22%	17%
Majority of 8 Criteria Met	12%	21%	23%	15%

In our survey, middle and high schools were generally more likely to meet these benchmarks than were elementary schools (averaging above 20% compared to 12% for elementary schools). In particular, three times as many middle and high schools had a 1:4 ratio of computers to students as did elementary schools (31% vs. 10%). High schools were far more likely to provide faster Internet connections and connections to a greater percentage of their computers than elementary schools. In contrast, elementary schools were roughly comparable to schools serving older students in terms of connecting classrooms and computers to local area networks. The data suggest that school leaders

regard computing in secondary schools to have somewhat greater priority than it has for younger students.

Socio-economic differences show up rather clearly for *most* of those measures of adequate technology infrastructure. Although schools with two-fifths or more of their students eligible for Chapter I subsidies are only slightly less likely to have a 1:4 computer-to-student ratio than schools with very few students from poor families, socio-economic differences are huge with respect to Internet access. As of 1998, prior to the federal government's e-rate subsidy program, schools with more than 40% of students eligible for Chapter I were about half as likely as schools with few poor students to have a high-speed (T1) Internet access, to have at least one Internet-accessing computer for every 12 students, or to have one-half of their classrooms Internet connected.[1] Overall, the poorest schools met only one-third the number of benchmarks (8%) as did schools with the fewest poor students (23%). They are perhaps two years behind schools with students from average-income families which are, in turn, two years behind schools with high income clientele in meeting the technology presence standards shown.

Frequency of Computer Use at School

Even though schools' computer facilities are less than ideal, close to half of all students use computers at school in some way at least several times per week. In fact, data from the 1997 Current Population Survey suggests that, on the basis of parents' estimates, nearly twice as many school-aged children use computers at school several times per week than use them at home. (See Table 2.)[2]

TABLE 2: STUDENTS' FREQUENCY OF COMPUTER USE AT HOME AND AT SCHOOL, OCT. 1997

			School Use			
			Non-User	Low Frequency (up to once per week)	High Frequency (several times per week or daily)	Total
Home Use	Non-User		15%	12%	27%	54%
	Low Frequency	(up to 1-2 days/wk)	3%	5%	8%	16%
	High Frequency	(3+ days/wk)	4%	7%	18%	29%
	Total		23%	23%	54%	100%

Source: Data analyzed from the October 1997 Current Population Survey, U.S. Census Bureau.
Universe: School-aged children, aged 6-17 plus persons 18 or 19 years of age attending high school.

Overall, Table 2 indicates that as of late 1997, more than one-third (35%) of school-aged children had relatively little regular experience with computers, either at home or at school; 11% used computers frequently (several times per week) but primarily at home; 36% got their frequent experience primarily at school (though with probably a more

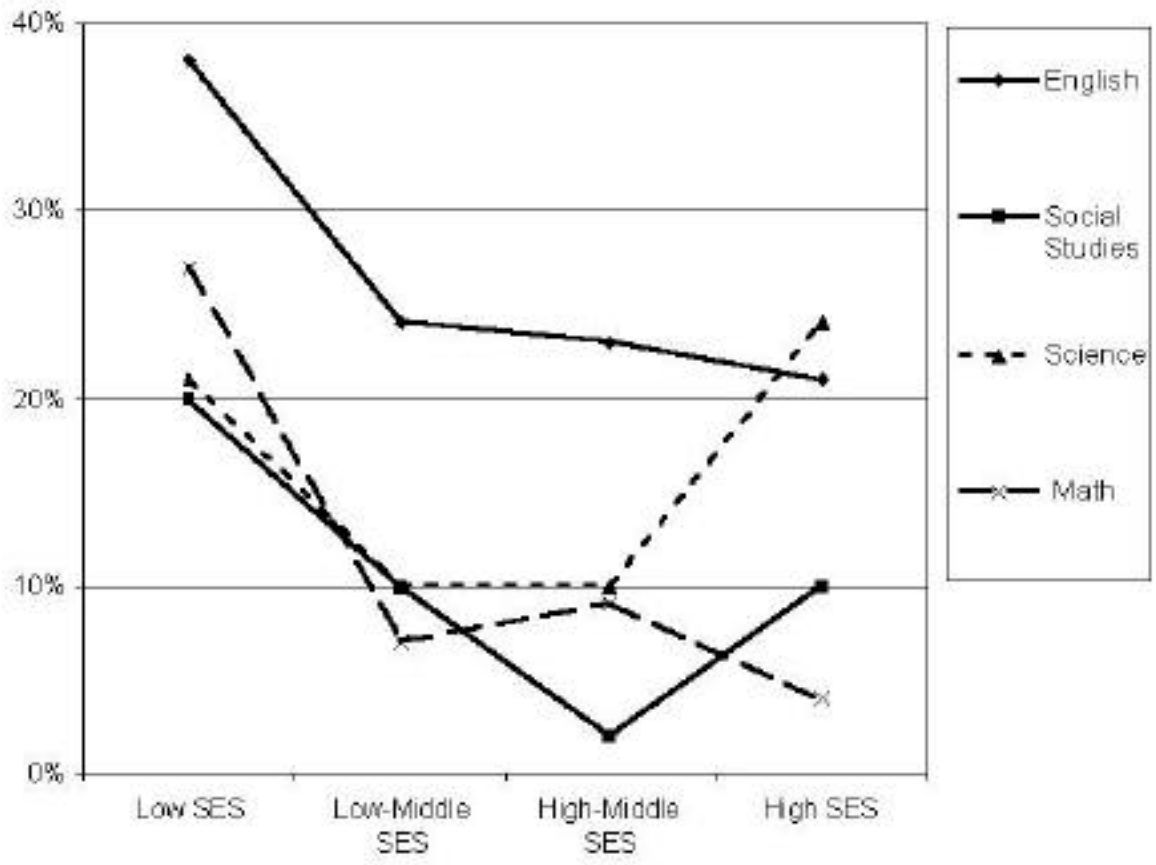
modest upper limit than prevails among the active home computer users); and 18% had frequent opportunities to use computers at both home and school.

Over the course of a school year, most students get a substantial computer experience in at least one of their courses. Using a criterion of "use by a typical student *on more than 20 occasions* during the school year," our data indicate that, across all subjects, between one-fifth and one-fourth of the classes that students take in middle and high school could be termed "frequent computer-use classes."[3] Since most students take 5 or 6 classes each year, typically one of those classes would meet this "frequent use" criterion.

Besides "computer classes," where computers are the subject matter themselves, high school classes that are most likely to include frequent computer use are in applied areas like business and vocational education. Among the regular academic subjects, English teachers are more likely than teachers of other academic subjects to include frequent (e.g. weekly) computer experiences during class time, but they are less than half as likely as business or vocational teachers to do so (26% vs. 59%). Among high school science, social studies, and math teachers, only about one in ten gave students frequent opportunities to use computers during the 1997-98 school year. Thus, in high school, a student's opportunity to use computers in a substantial way is relatively limited if his schedule is composed primarily of regular discipline-bound academic courses. It is the curricular flexibility given to teachers of applied courses and academic courses outside of the mainstream that enables them to provide their students with opportunities to use computers in a major way.

It is interesting to note that the proportion of teachers who report weekly use of computers by their students is not lower in economically disadvantaged schools than elsewhere; in fact, among secondary teachers it is somewhat *higher* For three of the four main academic subjects (English, social studies, and math) frequent computer use was more often reported by teachers working in low-income schools than teachers from any other socio-economic quartile. (See Figure 1.)[4]

FIGURE 1: PERCENT OF SECONDARY ACADEMIC TEACHERS REPORTING FREQUENT COMPUTER USE, BY SUBJECT AND SOCIO-ECONOMIC QUARTILE



Is this a healthy sign that teachers in lower socio-economic communities are *at least as likely* to be using computers on a regular basis with their students as teachers from wealthier communities? Perhaps that depends on whether the way that they have their students use computers, in fact, does facilitate learning.

Like other studies conducted in the 1980s,[5] we found that computers are used in different ways in higher socio-economic communities than in lower class ones. While the most common use of computers in low-SES secondary schools in is mathematics (as shown in Table 3), the focus of that use is predominantly for repetitive practice of less complex aspects of the subject. Meanwhile, among the higher-SES student bodies, the most common high-frequency computer-use subjects are science and computers, which account for more than 40% of all high frequency computer experiences in high -SES schools. In contrast, in low-SES (high poverty) schools, those two subjects comprise only 12% of the high-frequency computer experiences; yet they may provide some of the more sophisticated applications of technology found in secondary schools.

TABLE 3: DISTRIBUTION OF HIGH FREQUENCY COMPUTER USE CLASSES IN MIDDLE AND HIGH SCHOOL BY SCHOOL SOCIO-ECONOMIC STATUS

	Socio-Economic Quartile				
	High SES	High-Middle SES	Low-Middle SES	Low SES	All Secondary
English	15%	22%	20%	23%	20%
Computer Ed	19%	20%	21%	4%	16%
Science	22%	10%	9%	8%	13%
Business Ed	8%	9%	19%	10%	11%
Math	4%	9%	6%	24%	10%
Social studies	4%	3%	4%	8%	5%
Vocational	10%	13%	4%	6%	8%
Other	17%	14%	17%	16%	15%
Total	100%	100%	100%	100%	100%

In terms of the objectives that computer-using teachers have for their students' use of computers, teachers in high poverty elementary and middle schools are more likely than others to select "remediation of skills," "mastering skills just taught," and learning to work independently" as objectives for computer use. Teachers in high SES schools, in contrast, are more likely to use computer work to teach students to present information to an audience and (at middle and high schools) to analyze information. (See Table 4.)

TABLE 4: RELATIONSHIP BETWEEN SCHOOL SOCIO-ECONOMIC STATUS AND TEACHER'S OBJECTIVES FOR COMPUTER USE, BY SCHOOL LEVEL (CORRELATION COEFFICIENTS ABOVE |.10| ARE SHOWN)

	Elementary	Middle Grades	High School
Information gathering	-	-	-
Written expression	.16	-	–.13
Reinforcement of skills	–.25	–.15	-
Computer skills	.11	-	-
Analyzing information	-	.11	.15
Learning to collaborate	-	-	-
Remediation of skills	–.23	–.17	-
Learning to work independently	-	–.11	–.15
Presenting information to an audience	.13	.12	.10
Electronic communication	-	-	-

The TLC–1998 results show clear evidence that computer-using teachers of high-achieving classes use a very different mix of software than do computer-using teachers of low-achieving classes. Drill and practice exercises are used substantially more by teachers of low-achieving classes, while spreadsheet/database software and electronic mail software are the two types of software used more by teachers of high-achieving classes. (See Table 5.) It also appears that in general, the more salient a type of software is to exemplary instructional practice in a given subject, the more that high-achieving

classes were favored in how frequently students had an opportunity to use that type of software.

TABLE 5: DIFFERENCE IN SOFTWARE USE BETWEEN TEACHERS OF LOW AND HIGH ACHIEVING CLASSES (EFFECT SIZE STATISTIC)

	Games for practicing skills	Simul-ations or explor-atory environ-ments	CD-ROM refer-ence	Word Pro-cessing	Presen-tation software	Graphics oriented printing	Spread-sheet or Database	Multimedia authoring tools	WWW Browser	E-mail
Self-contained	**–.22**	–.05	.07	.15	.04	**.31** [b]	**.47** [b]	.13	.20	**.33** [a]
Social studies	**–.69** [a]	–.05	.06	.08	**.34**	**–.34** [a]	.15	**.30** [b]	**.44** [b]	**.54** [b]
English	**–.59**	–.18	.16	**.50** [b]	–.03	.20	–.08	.08	**.24** [b]	–.06
Science	–.19 [a]	–.02	–.07	.25 [c]	.16	.09	**.21** [c]	.07	**–.24** [b]	**.34**
Math	**–.38** [a]	**.24**	–.09	.08	.09	.06	.18	.01	.04	.12
Mixed academic	**–.21** [b]	**.43** [b]	**.31** [a]	**.59** [b]	.15	**.24** [d]	.16	.13	–.01	.15
Computers	**–.52** [b]	–.14	**–.51** [b]	–.02	**.42**	**.25** [b]	**.63**	.00	–.19	.19
Business & Vocational Ed.	**–.50**	.08	–.01	**–.31** [a]	**–.37**	**.55**	.00	.15	**–.34**	.09
Total	**–.45**	.02	–.01	.15	.14	.17	**.20** [a]	.09	.11	**.25**

Positive differences indicate greater use by teachers of high-achieving classes.

a = frequency of use by teachers of average-achieving classes closer to that of high (teachers of lower achieving students are different).

b = frequency of use by teachers of average-achieving classes closer to that of low (teachers of higher achieving students are different).

c = curvilinear (more frequent use with averaging-achieving classes).

d = curvilinear (less frequent use with averaging-achieving classes).

Universe: Teachers that use computers either with their selected class or with another class. Probability and Purposive.

Children's Access to Computers at Home

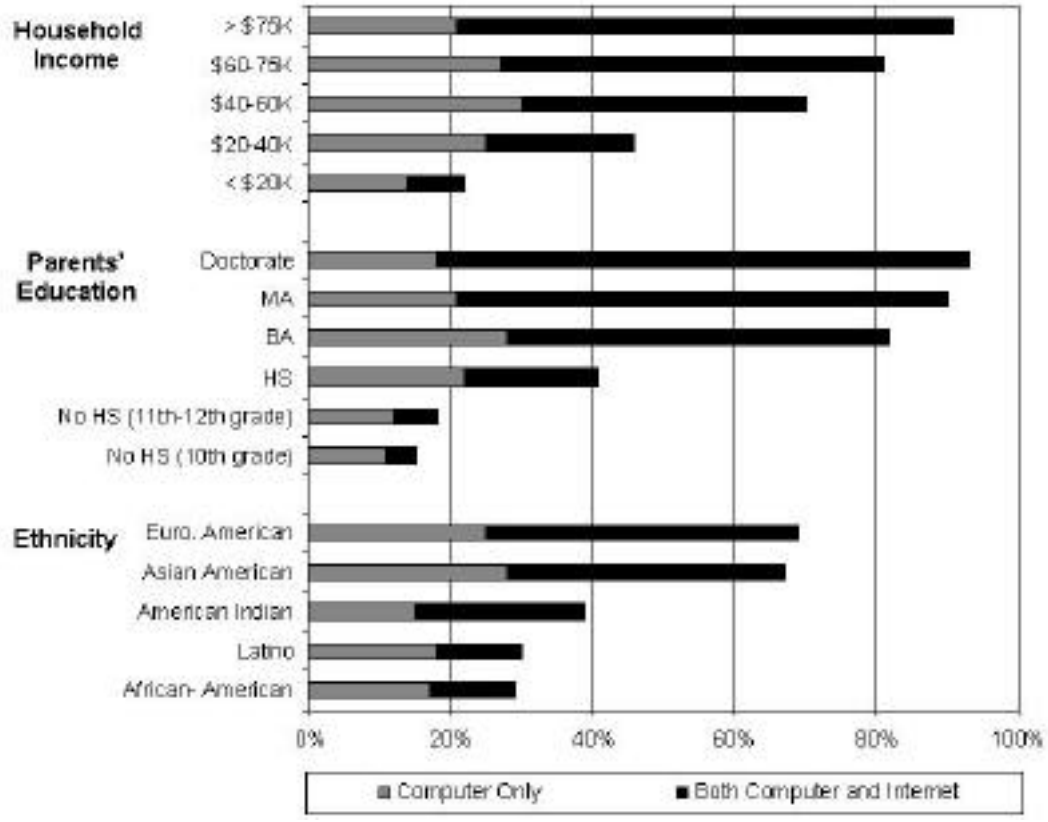
As of 1998, just about the same percentage of homes had computers as teachers' classrooms did: A computer was present in homes of 57% of children and adolescents[6] and in 51% of 4th through 12th grade classrooms.[7] However, a child or teenager has to share a home computer with just a few family members, whereas students in typical classrooms have to share one or two computers with many other students.[8] Both of these factors suggest that children who have computers at home have more home access than they have at school.

Income and education differences in home computer access

Socio-economic differences in home computer access are of gigantic magnitude. At the end of 1998, only 16% of children living with parents who did not graduate high school had home access to a computer compared to 91% of children with a parent having at least a Master's degree. (See Figure 2.) Family income and parent education play a roughly equivalent role in determining the likelihood of a child having a computer or Internet connection at home. On the income side, only one in twelve children living in families whose combined incomes were under $20,000 per year had home Internet access

in 1998, while children living in a family with more than $75,000 in income had better than a 2-to-1 chance of having home Internet by then.[9] The combined effects of family income and parent education are almost determinative. For example, among children whose parents had less than a high school education and where family income was under $20,000, only 11% had a home computer. In contrast, for children in families with over $75,000 incomes and at least one parent with a Master's degree, 95% had a computer at their home and 80% had Internet access as well.[10]

FIGURE 2: CHILDREN'S ACCESS TO HOME COMPUTERS AND THE INTERNET, BY FAMILIES' INCOME, EDUCATION, AND ETHNICITY, DECEMBER 1998



Children in other demographic categories are also less likely than their peers to have access to a computer or the Internet at home. In particular, fewer than 3 of 10 black or Hispanic youngsters have a computer at home and only one in eight had home Internet access as of December, 1998. (See Table 6.) Children living with only one parent, or neither parent, are also disadvantaged with respect to home access as are children of blue-collar or service employed workers. Table 6 also shows that computers are less common in children's homes both in small families and when there are many mouths to feed, in Southern states, and in central cities and non-metropolitan areas. Table 7 in contrast, lists the demographic group where at least two thirds of children have a computer at home.

TABLE 6: GROUPS WITH LIMITED ACCESS TO COMPUTERS OR THE INTERNET

	Percent with Neither	% with Computers only	% with Computers & the Internet
Maximum Parents' Education: 10th grade	85%	11%	4%
Maximum Parents' Education: 11th-12th grade dropout	82%	12%	6%
Household Income under $20,000	78%	14%	8%
Black children	72%	17%	12%
Latino children	71%	18%	12%
Parent(s) employed in blue collar or service occupations	70%	18%	12%
Not living in a two-parent household	65%	19%	17%
American Indian children	60%	15%	24%
Maximum Parents' Education: High School Graduate	59%	22%	19%
Central City residents	56%	19%	26%
Household Income $20-$40,000	54%	25%	21%
Children in 6-person-plus households	53%	22%	25%
Parent(s) employed as skilled craft workers	52%	26%	22%
Children in 3-person-and-under households	51%	22%	27%
Resident in the Southern States	50%	20%	29%
Children aged 6-8	49%	22%	29%
Non-Metropolitan location	49%	25%	26%

* A very small number of children in homes with the Internet accessed through their television set are excluded from these percentages.

TABLE 7: GROUPS WITH A HIGH PERCENTAGE OF ACCESS TO BOTH COMPUTERS AND THE INTERNET

	Percent with Neither	% with Computers only	% with Computers & the Internet
Maximum Parents' Education: Professional or Doctorate Degree	7%	18%	75%
Household Income over $75,000	9%	21%	70%
Maximum Parents' Education: MA degree	10%	21%	69%
At least one parent in managerial or professional occupation	19%	25%	55%
Maximum Parents' Education: BA degree	19%	28%	54%
Household Income $60-$75,000	19%	27%	54%
White, non-Hispanic children	31%	25%	44%
Children in two-parent households	33%	25%	42%
Suburban location	35%	24%	42%
Children in 4-person households	37%	24%	40%
Household Income $40-$60,000	30%	30%	40%
Asian-American children	33%	28%	39%

Controlling even for family income and parent education, white children have at least a 10 percentage point greater likelihood of having computer or Internet technology present than African American or Latino children (with roughly equivalent family income and parent education). Only for African American and Latino children in high income homes with parents having advanced degrees does technology access meet or exceed the level available to European American children. (See Table 8.)

TABLE 8: PERCENT OF CHILDREN WITH COMPUTER AND INTERNET AT HOME, BY ETHNICITY, FOR SELECTED RANGES OF PARENT INCOME AND EDUCATION

		% with Computers only				Among those with computers, % with the Internet also			
Family income	Ethnicity	Not graduated high school	High school grad or some college	College graduate	Advanced degree	Not graduated high school	High school grad or some college	College graduate	**Advanced degree**
under $20,000	Black or Hispanic	.08	.16			.18	.24		
	Anglo	.17	.36			.25	.41		
$20-40,000	Black or Hispanic	.16	.30	.55		.27	.34	.47	
	Anglo	.25	.53	.74		.42	.47	.54	
$40-60,000	Black or Hispanic		.49	.62			.43	.53	
	Anglo		.72	.84			.57	.65	
$60-75,000	Black or Hispanic		.57	.60			.45	*	
	Anglo		.79	.87			.64	.71	
over $75,000	Black or Hispanic		.71	.77	1.00		.66	.59	.87
	Anglo		.88	.92	.95		.72	.76	.84

* Insufficient number of cases.
Source: Analysis of December 1998 Current Population Survey.

Similar results were obtained through multiple regression analysis. (See Table 9.) The negative effects of being African American were a little larger than for being Hispanic (e.g., betas for having a computer at home = –.20 for African Americans; –.16 for Hispanics). Two interpretations of these findings are plausible. One is that different ethnic groups have different cultural values that make computers more relevant to some than others. The other is that economic factors that are not measured by current income might enter into computer acquisition decisions; i.e., accumulated personal wealth.

TABLE 9: MULTIPLE REGRESSION ANALYSES OF HOME COMPUTER ACCESS AND INTERNET ACCESS BY DEMOGRAPHIC PRE DICTORS

	Dependent Variables					
	Presence of Home Computer			Presence of Internet, Given Home Computer		
	Standardized beta coefficient	t value	Zero-order correlation coefficient	Standardized beta coefficient	t value	Zero-order correlation coefficient
Family income	.30	34.8	.52	.16	13.8	.27
Maximum parents' education	.22	29.3	.47	.15	13.9	.25
Black or Hispanic	–.16	–24.0	–.38	-.09	-8.9	-.16
Southern state	-.05	–8.4	–.10	–.01	–0.6	–.01
Two-parent family	.03	3.7	.30	.02	2.2	.14
Suburban location	.03	5.0	.18	.04	3.7	.10

Source: Analysis of December 1998 Current Population Survey.

Variations in the Quality of Home Computer Facilities

Having a computer with Internet access is not a sufficient measure of the quality of home computer access. In addition, having more than one computer in a household must certainly contribute to access. Full functionality of a home computer cannot be realized without other features being present – for example, a hard disk drive, a CD-ROM player, a printer, a modem, and a mouse or similar pointer control.

Not only do children in demographic groups differ in whether they have a computer present at home, but even among children who *do* have a computer at home, some groups are much more likely to have one that meets our standard for functionality. Again, income and occupational differences manifest themselves, even among children whose families own computers. Fewer than one-third of children whose parents were not high school graduates, but who had a home computer anyway, had a computer that met the five criteria we employed to measure functionality. In contrast, two-thirds of the children in computer-present households where at least one parent had a bachelor's degree had a computer that was broadly functional.

When one combines the issue of mere presence of a home computer with the criterion of hardware functionality, some of the socio-economic differences become monumental. As of 1997, among four groups - African American children, children not living with any parent who graduated high school, children in families with under $20,000 in income, and children in blue-collar households – only one in ten had a broadly functional computer at home and fewer than one in 25 had two computers present. In contrast, a *majority* of homes of children with college-educated parents or parents in managerial or professional jobs had a computer that met all five criteria for functionality. In addition,

nearly one-fourth more than one computer at home.. (See Figure 3 and 3rd and 4th columns in Table 10.)

FIGURE 3: DEMOGRAPHIC GROUPS WITH HIGH AND WITH LOW LIKELIHOOD OF HAVING A BROADLY FUNCTIONAL COMPUTER OR MULTIPLE COMPUTERS (AS A PERCENT OF CHILDREN IN THAT DEMOGRAPHIC GROUP)

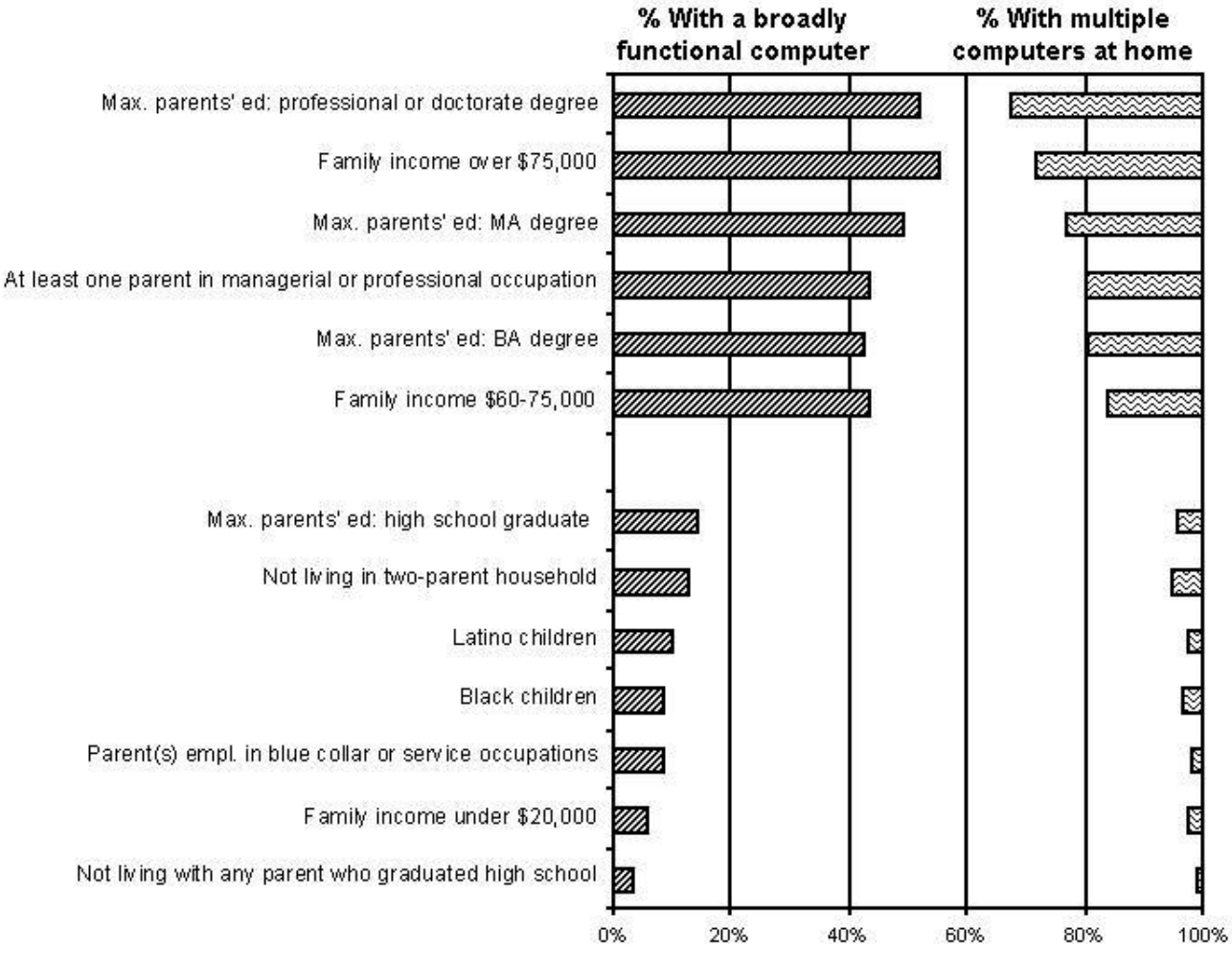


TABLE 10: DEMOGRAPHIC GROUPS WITH LOW AND WITH HIGH LIKELIHOOD OF HAVING A BROADLY FUNCTIONAL CO MPUTER OR MULTIPLE COMPUTERS (AS PERCENT OF CHILDREN WITH A COMPUTER AT HOME; AND AS PERCENT OF ALL CHILDREN IN THAT DEMOGRAPHIC GROUP

	Percent Among Children With a Computer at Home		Percent Among ALL Children in that Demographic Category	
Demographic Category	% with a broadly functional computer	% with multiple computers at home	% with a broadly functional computer	% with multiple computers at home
Not living with any parent who graduated high school	30	9	4	1
Parent(s) employed in blue collar or service occupations	40	8	10	2
Black children	38	14	10	4
Family income under $20,000	37	14	7	3
Maximum parents' education: high school graduate	45	13	17	5
Family income $20-40,000	46	14	21	6
Latino children	50	14	12	3
American Indian children	50	15	22	7
Parent(s) employed as skilled craft workers	49	17	19	7
Not living in a two-parent household	47	19	15	6
Non-Metropolitan location	51	16	23	7
Family income $60-75,000	67	25	52	19
Maximum parents' education: BA degree	66	29	51	23
At least one parent in managerial or professional occupation	66	31	52	24
Maximum parents' education: MA degree	70	34	59	28
Family income over $75,000	74	38	66	34
Maximum Parents' Education: Professional or Doctorate Degree	71	45	62	39

Access to home computers and the degree of functionality of those computers is also highly correlated with parent's work-based experience. Among children whose two parents both use computers at work, 83% have a computer at home, whereas among children whose parents do not use computers at work only 31% have a computer at home. Similarly, among those who have computers at home, children whose father and mother both use a computer at work are more likely to have one that meets our standard for broad functionality than children whose parents do not use a computer at work (70% vs. 47%), and they are more likely to have multiple computers at home (33% vs 14%).[11] Of

course much of that difference is because higher income and better educated parents are more likely to use a computer at work.

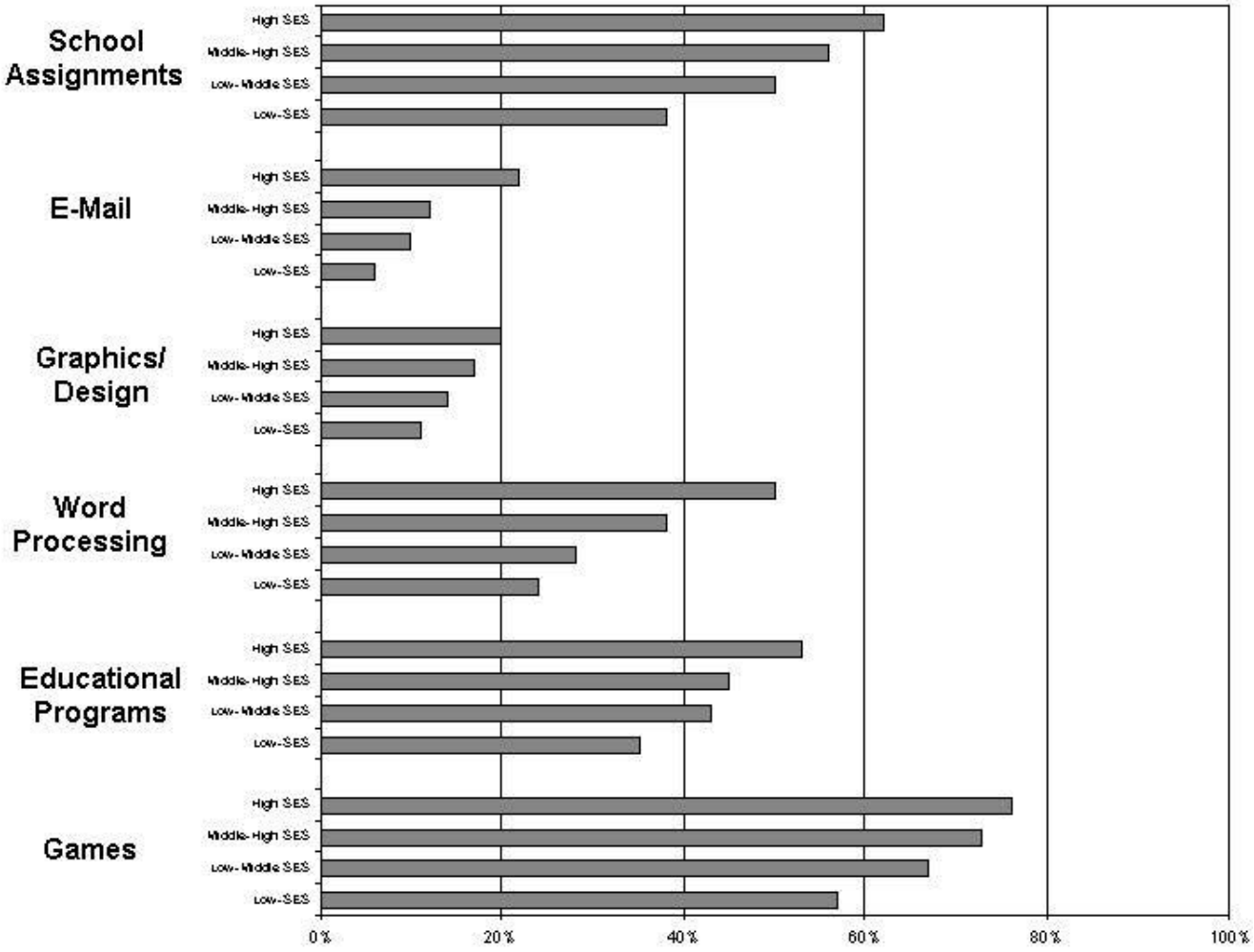
How Computers Are Used at Home

The 1997 CPS survey data indicate that when a computer was present in the home, nearly nine out of ten children used it to some extent. With slightly more than half of all children's homes having a computer, this translates to about 45% of school-aged children being "home computer users." A slightly higher percentage of adolescent and pre-adolescent youth use home computers (49%) than younger children do. Between one-fourth and one-third of teens and children (a majority of those whose families own computers) are “regular users” of home computers, using one at least three days per week. On the other hand, only about one in ten children were said by their parents to use computers at home essentially every day. However, the amount of use and types of activities children use their home computers for varies by socio-economic background.

Socio-economic status is strongly related to kids’ computer involvement, even among computer-owning households

We saw earlier that children and teens from families with less income and less educated parents were much less likely to have a computer in their home and to have one with many features. It is also true that, even among computer-owning families, children whose parents have less income and less education are less likely to *use* their family’s computer in various ways. For each of the six applications the CPS survey asked about, successively more advantaged students were more likely to be using their family’s home computer for that application. Figure 4 shows the pattern when family income and parent education are combined into a socio-economic status (SES) index and then all children are divided into four comparably sized groups from “low” to “high” SES. Numerically, the largest differences between low and high SES children in computing-owning families was in terms of word processing. One-half of the “high-SES” children used word processing, but only 24% of the “low-SES” children did, even though all of them had computers at home. Proportionally, the largest difference was for use of electronic mail. Nearly 4 times as many high-SES children used that application as did low-SES children, again even though all had computers at home. (Internet connectivity, however, was NOT the same for those two groups.) If we considcr ALL children in each SES group, regardless of whether they had computers at home, the SES differences in use of various home computer applications becomes enormous. For example, among all low-SES children, fewer than 4% (one in twenty-five) were reported to use word processing at home, compared to 44% of all high-SES children.

FIGURE 4: PERCENT OF CHILDREN WITH HOME COMPUTERS PRESENT WHO WERE REPORTED TO USE DIFFERENT TYPES OF SOFTWARE, 1997, BY SES



Children's Use of the Internet at Home

Despite the recent growth and media attention surrounding the Internet, as of the end of 1998, only one-third of school-aged children lived in households with home Internet access, and less than one-fourth of all children were reported to use the Internet from home in some way. Moreover, to an extent greater than for stand-alone software, Internet use was limited not only by household access, but by a child's age. While 85% of adolescents 12 and up used their household's Internet access, that was true of only 53% of children aged 9 to 11 and 35% of younger children (6-8).

FIGURE 5: INCREASES IN INTERNET USE OF HOME COMPUTERS FOR E-MAIL AND WEB SEARCHING, 1997-1998, BY AGE GROUP (PERCENT AMONG CHILDREN WITH COMPUTER IN THEIR HOME)

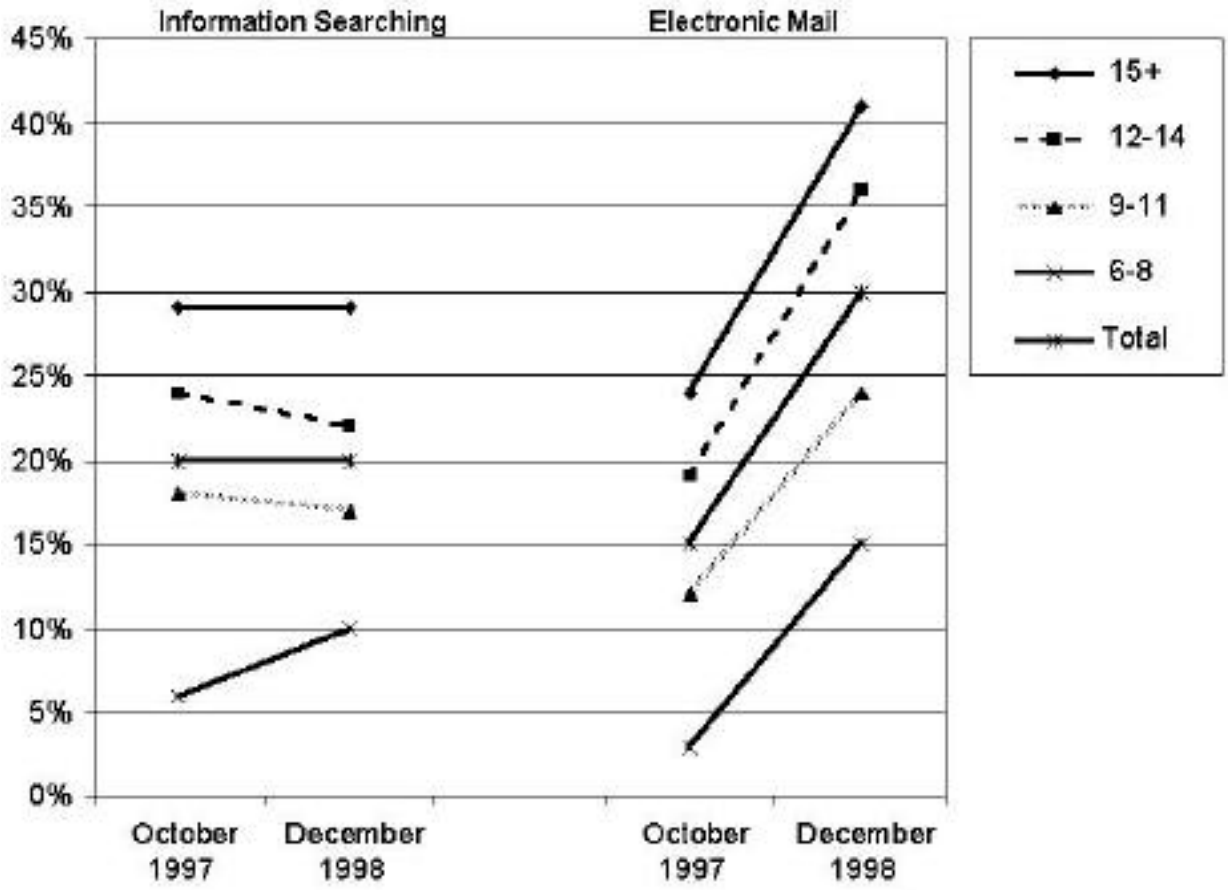


TABLE 11: INCREASES IN USE OF HOME COMPUTERS FOR E-MAIL AND WEB SEARCHING, 1997-1998, BY AGE GROUP (PERCENT AMONG CHILDREN WITH COMPUTER IN THEIR HOME)

Age Group	Electronic Mail		Information Searching	
	Oct. 1997	Dec. 1998	Oct. 1997	Dec. 1998
6-8	3%	15%	6%	10%
9-11	12%	24%	18%	17%
12-14	19%	36%	24%	22%
15+	24%	41%	29%	29%
Total	15%	30%	20%	20%

Universe: school-aged children with a computer in their household.

As shown in Figure 5 and Table 11, electronic mail in particular is increasingly becoming a major activity of youth with access to home-based Internet. Between 1997 and 1998, e-

mail was in much more rapid ascendancy than information retrieval aspects of World Wide Web use. The fraction of children using e-mail from home doubled during that period (from about 8% to 17% of the school-aged population; 15% to 30% among computer-owners) whereas the percentage of kids reported to use home Internet access to "search for information" did not change between the two surveys.

Factors Affecting Use of Home Computers

Which of the factors we have been considering make it more likely that children and adolescents will take advantage of their home computer access? That is, among the age of the child, the child's family socio-economic status and ethnic-cultural background, the physical computing environment of the home, and family members' experience with computers outside the home, which have the largest effects on children's use of home computers, net of others? Several measures of children's use were examined as outcomes:

- how often they used a home computer;
- how many of the five most common "productive" applications they used at home (word processing, e-mail, Web-based information-searching, educational programs, and, more generally, use of the home computer for school assignments);
- how many of seven more specialized computer applications they used (graphics and design work, recordkeeping, desktop publishing, databases, spreadsheets, connection to a school computer, and 'other');
- and, for each of five types of software individually (computer games, word processing, e-mail, information-searching, and educational programs), whether or not they used that type of software.

These analyses were based on more than 11,000 children in the 1997 CPS survey reported to have a computer in their homes.[12] The results of the standardized multiple regression analysis are shown in Table 12. As discussed below, results indicate that the age of the child is most strongly predictive of the measures of use listed above, but that the parents' socio-economic-status, the level of functionality of the home computer, and the out-of-home use patterns of other family members were also predictive of how children used home computers, net of one another.

TABLE 12: MULTIPLE REGRESSION ANALYSIS OF VARIABLES PREDICTING VARIATIONS IN CHILDREN'S USE OF HOME COMPUTER

	Frequency of Home Computer Use	Breadth of Use Across Major Apps.	Use of Specialized Software	Use of Computer Games	Use of Word Processing	Use of E-Mail	World-Wide-Web Info. Searching	Use of "Educa-tional" Programs
	(never to daily: 9 point scale)	(0 to 5)	(0 to 7)	(yes/no)	(yes/no)	(yes/no)	(yes/no)	(yes/no) (only ages 6-14)
Age Group (4 groups)	.15	.26	.19	–.11	.34	.22	.20	---
Parent SES (income and education)	.05	.12[c,d]	---	---	.12[c,d]	.07	.09	---
Disadvantaged minority (yes/no)	---	---	---	–.07	---	---	---	---
Broad functionality of computer (yes/no)	.14[c,d]	.19[c,d]	.06	.11	.05	.18[d]	.20[d]	.15
Number of computers in home	.06	.07	.06[d]	---	---	.08[c,d]	.10	---
Variety of parent uses of computer at work	---	.14[b,c]	.12[c,d]	.07	.11	.08[b]	.10[b]	.13
Frequency of child's use of computers at school	.17	.11[a]	.05	.10[a]	.05	---	---	.10
Total frequency of home computer use by siblings	.12[b]	.07	---	.11[b]	.06	---	---	---
Multiple correlation	.33	.47	.26	.27	.42	.36	.38	.27

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Notes:

Only standardized regression coefficients at or above ±.05 are shown.

Age groups were analyzed separately and where beta coefficients were at least .03 greater than for all children, this is shown by:

a indicates coefficient was larger for ages 6-8 than for all children overall,

b larger for ages 9-11,

c larger for ages 12-14,

d larger for ages 15.

For seven of the eight criteria for computer use, the age of the child made the largest or second-largest difference of any of the "input" factors. Generally, older children used computers more than younger ones. The exceptions were that younger children were somewhat more likely to play computer games, net of other factors, and age was not related to use of putatively educational software (below age 15).

Other than age-of-child, the next most sizable predictor of children's home computer use was the quality of home computer hardware environment, or what has been referred to in this article as the "broad functionality of the home computer." How many computers are in the home also seems to play a role, but is generally secondary to how broadly functional a single computer is.

The pattern of experience of family members, particularly children's parents, also has an important effect on children's home computer use. [13] However, different components of that experience are differentially important for children of different ages and for different aspects of home computer use.

Children's siblings and their own school experiences also appear to have measurable importance in some aspects of children's home computer use. The sibling effect appears to be strongest on children in the age range of 9 to 11. For these upper elementary students, who may have more limited peer contacts than secondary students, having computer knowledgeable siblings may facilitate recruitment into computer activities. In addition, children's own experiences with computers at school appears to impact how frequently they use computers at home, and for the youngest children studied, whether they use their family's home computer to run educational software, other basic applications, and even computer games.

In the multiple regression model, parent socio-economic status was found to have a sizable prediction coefficient only for two outcomes: whether a child uses a home computer for word processing and the overall breadth of their use of computer applications, especially for children in secondary schools (ages 12 and up). However, SES is much more powerful as a causal factor because it is itself linked to parent opportunities to use computers at work and to having a broadly functional computer at home. What the regression results show is that even beyond the effect of SES on those forces, it still plays a residual role in affecting children's home computer use.

Endnotes:

[1] The comparisons here are with schools having 10% or fewer students eligible for Chapter I services. The percentages of schools having a T1 connection were 23% vs. 42%; for a 1:12 Internet-connected-computer-to-student-ratio, 17% vs. 44%; and for having half of the school's classrooms having a high-speed Internet connection, 12% vs. 29%.

[2] See below, note no. 6 for details on the Current Population Survey (CPS) that was analyzed for this article. Of course, the high-frequency home users may have used computers much more intensively than the high frequency school users did. (For example, it would not be unreasonable to estimate that the very highest-frequency home users use computers for twice as many hours on a given day as the high-frequency school users.) It is also quite possible that parents over-estimated their children's school computer use. However, on balance the CPS comparison between home and school use looks reasonable. The 1998 Roper Youth Report, for example, found that 60% of interviewed teenagers (aged 13 to 17) used computers at least once at school during the previous *month*, roughly midway between the CPS percentage for "several times a week" or more (54%) and the percentage for any use at all at school (69%). The Roper 1998 Youth Survey involved at-home in-person interviews with nearly 1,200 girls and boys aged 6 to 17. http://www.roper.com/news/index.htm. Our own TLC–1998 survey of teachers cannot shed light on this question for secondary students because, being teacher-based, it was not possible to know which combinations of teachers individual students were likely to have and, thus, what total school-based computer experience they had. However, for the 4th and 5th grade teachers in the TLC survey who taught self-contained classes, 43% indicated that a typical student in their class used a computer during class on more than 20 occasions (roughly, weekly, up until the point of the survey) and students in 23% of those teachers classes had used computers at least twice-weekly. Those figures are below the numbers for the high school students reported by parents, but then the students are also 5 or 6 years younger as well.

[3] This is likely to be somewhat of an overestimate. Teachers were invited to discuss the one class in which they felt most accomplished as a teacher. They may not have used computers as extensively in other classes they taught. Thus, if computer use is correlated with feeling accomplished (either because of its effects on students or because computers were selected as an instructional vehicle in classes that otherwise make teachers feel accomplished), then the sample of classes would be biased upwards in terms of computer use.

[4] Figure 1 represents school-level socio-economic-status (SES) by a factor score that incorporates data on the percentage of families whose income makes the school eligible for Chapter I subsidies as well as three other measures: the principal's estimate of the percentage of families with a parent in a managerial or professional occupation, the principal's estimate of the percentage of students with limited proficiency in English, and an index, provided on the sampling data tape, that characterizes the socio-economic status of the neighborhood zip-code where the school is located. This combined SES factor-analysis based index was determined to be somewhat superior to one based solely on Chapter I eligibility because of its greater sensitivity to differences among school populations in the middle- to upper-end ranges of socio-economic-status.

[5] For example, H. J. Becker & C. W. Sterling (1987), "Equity in school computer use: national data and neglected considerations," *Journal of Educational Computing Research*, 3, 289-311.

[6] Children and adolescents are defined as school-aged children ages 6 to 17, plus those who were still in high school at ages 18 or 19. The source of data for most of the information about home computer access and use comes from two of the Current Population Surveys (CPS) of U.S. households conducted monthly by the U.S. Census Bureau. The October, 1997 CPS survey included a supplement on home computer presence and use and is valuable in spite of its age because of the size and comprehensiveness of the survey. The December, 1998 CPS included a supplement on Internet use and thus provides somewhat more recent information on this one highly volatile aspect of computer use. The methodology of the CPS surveys is described in http://www.bls.census.gov/cps/computer/1998/smethodocz.htm. For this analysis, from the 1997 survey we extracted data on 23,026 children ages 6 to 17 plus 18 and 19 year-olds still attending high school, and from the 1998 survey, data on 23,337 children of similar ages. The NTIA report of the 1997 CPS survey is available as McConnaughey, J.W. and Lader, W. (nd). *The digital divide: A survey of information 'Haves' and 'Have Nots' in 1997*. Washington, DC: US. Department of Commerce, National Telecommunications and Information Adminstration. (Publication also known as "Falling through the Net

II: New Data on the Digitial Divide"). For the NTIA report of the 1998 survey, see National Telecommunications and Information Administration. (July, 1999*). Falling Through the Net: Defining the Digital Divide.* Washington, DC: U.S. Department of Commerce.

[7] If K-3 teachers, who were not surveyed in the TLC study, had classroom computers in the same proportion as 4th through 6th grade elementary teachers, the overall percentage of teachers with at least one computer in their classroom, as of 1998, would rise to 59%—slightly higher than the percentage of children's families with a computer at home.

[8] In 1998, the average person-to-computer ratio in children's computer-owning households was 3.9 household members per computer; based on my analysis of Current Population Survey data. In contrast, in classrooms with any computers at all the mean student-to-computer ratio was about 14 students per computer in the TLC survey.

[9] Although income is shown as annualized amounts, actual reports were weekly income summed for both parents, when both are present in the child's household. Education is the maximum years of school completed by either parent living in the household.

[10] Multiple regression analysis of these two variables predicting home computer presence produces somewhat larger beta coefficients for family income than for parent education (.36 vs. .26). If one limits one's attention to the question of whether a child's household will have Internet, given that it has a home computer, then neither family income nor parent education are quite as strong predictors as before, but again income appears somewhat more important (.20 vs. .16). These results differ from findings reported in the Roper-Annenberg study which claimed that neither SES nor parent computer expertise was strongly related to whether a computer-owning family had Internet access. Instead, that survey pointed to the parent's work-related Internet access as the primary determinant of home Internet access among computer-owning households. For example, they found that the percentage of parents reporting that they use the Web at work at least every few days was twice as high among Internet-accessing households as other computer households (41% vs. 19%). Turow, J, "The Internet and the Family: The View from Parents; The View from the Press." University of Pennsylvania, Annenberg Public Policy Center. 1999. In contrast, our analysis of the CPS survey found that, among children with a computer at home, those who also had the Internet had parents with more education and income, but parents who were not more likely to be Internet users at work. Differences in how work-based Internet use was measured may be responsible for these conflicting findings.

[11] Where one parent uses a computer at work, children have intermediate levels of home computer access: 65% have a computer at home; of those that do, 60% have a broadly functional computer and 24% have multiple computers.

[12] Table 12 summarizes the results of the standardized multiple regression (beta) coefficients linking each contextual factor with each aspect of home computer use. More properly, the dichotomous dependent variables should be examined using logistic regression, but for comparability with the other dependent variables, the more traditional least squares procedure was employed for all.

[13] For a number of reasons only one variable was examined for each member of a child's family: the parents' use of computers at work, the child's own use of computers at school, and the child's siblings' use of computers at home. It is likely that the attribution of "impact" belongs as much to the people involved as to the context in which their use of computers is measured.