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Trends in Access to Computing Technology and Its Use in Chicago Public Schools

2001–2005

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Introduction

In September 2002, the Consortium on Chicago School Research at the University of Chicago released *Educational Technology: Availability and Use in Chicago's Public Schools.* That report looked at technology[1] access and use of technology among teachers and students in the Chicago Public Schools (CPS) in 2001. In the 2002 report, we showed that the availability of technology in the CPS was at a low level and that there was a particular absence of Internet access in the classroom. Most teachers had not substantially integrated technology into students' coursework. Furthermore, technology was not evenly distributed across schools; even within the same school, the use of technology varied widely among teachers and students.

Just after we released that report, CPS implemented several major technology initiatives, such as wiring many classrooms for Internet access and distributing more than 6,000 laptops to principals, teachers, and technology coordinators.[2] By 2002, the state of Illinois had updated technology standards for all Illinois teachers.[3] At this time, there was optimism that these efforts would substantially improve technology integration into classrooms and the professional work of teachers and principals. In this report, we examine changes in technology access and use in schools since 2001. Although this report is not a direct assessment of the 2001–02 initiatives, it provides an indication of the extent to which technology access and use for principals, students, and teachers changed during the time of these initiatives. We would expect that technology use has increased substantially not only because of CPS initiatives and Illinois technology standards but also because computer use has continued to increase in U.S. households and businesses since 2001, becoming a regular part of people's daily lives both at home and at work.

The 2002 report presented a model of the supports that were needed to propel technology integration forward in schools. In that report, we found that school leadership was a key component. Schools were unlikely to make strides integrating technology into their curriculum without pressure from leadership. Furthermore, beyond needing basic hardware and software, students and teachers used technology more frequently in schools that had high-quality professional development around technology embedded within a professional community, as well as good human resource support for technology. These were unlikely to develop unless school leaders made them a priority. But while the 2002 report showed that principals' leadership around technology was necessary to promote technology use and access among teachers and students in schools, it did not examine principals' own use of technology or their perceptions of the barriers that exist to technology integration in their schools.

In this report, we provide an examination of how principals are using technology in their work and how principals' perceptions of barriers to technology integration in their schools have changed over time. We also explore ways in which these perceptions mirror teachers' and students' reports of technology in the schools. In addition, we show how students' access to computers at home and at school changed since 2001, and the degree to which they are using technology in their school assignments. Finally, we show how teachers' access to technology in the school, their use of technology in their own work, and their integration of technology into students' assignments changed from 2001 to 2003—the years of the laptop rollout in the high schools. Unfortunately, we did not ask teachers about their access to computers or their use of technology for their professional work in our 2005 survey, so we cannot report these trends after 2003. However, we can show the degree to which teachers were assigning students to use technology through 2005.

Major CPS Technology Initiatives from 2001 to Present

- **CPS Online Skills Assessment (COSA):** Provides basic technology training to all teachers based on the cumulative results of the assessment
- **CPSMail Rollout:** Offers users the ability to access email messages, calendars, and contact information from any Internet access point
- **eLearning Professional Development Management System:** Web-based professional development management system
- **Field Service Support Program:** Provides computer and network maintenance and support services for instructional computers throughout CPS
- **LAN Wiring Program:** Provides LAN infrastructure wiring to schools throughout CPS for the purpose of accessing the Internet, email services, etc., via the Wide Area Network
- **Laptop Distribution:** Gave more than 6,000 laptops to high school principals, teachers, librarians, and technology coordinators
- **School Web Hosting Program:** Offers web site hosting services to schools
- **Wireless NIC:** More than 140 schools will receive wireless networks, and more than 4,000 computers will be integrated into those wireless networks
- **Tech XL:** Offers a computer leasing program, field support services, and program management to schools

Introduction Endnotes

1 For simplicity, we use "technology" as shorthand for educational computing technology. By this we mean educational uses of computers, computer peripherals, the Internet, and computer software.

2 For simplicity, we use "laptop rollout" to refer to the CPS initiative in which more than 6,000 laptops were distributed to high school principals, teachers, and technology coordinators, from 2001 to 2003.

3 Technology Standards for All Illinois Teachers [24.120].

Chapter 1

Computing Technology among CPS Principals

The 2002 report showed that school leadership around technology played a crucial role in supporting technology integration within a school. In our case-study schools, which were used as exemplars of technology integration, the principals were committed to incorporating technology into their schools. Statistical models showed that teachers' perspectives of leadership around technology in their school were associated with the development of multiple supports for technology, including human resource capacity, professional development, and access to technology resources. With the exception of the case studies, however, evidence about leadership in that first report came solely from teachers' reports about leadership in their school, not from the principals themselves. Here we take a closer look at technology from the principals' perspective. First we examine how CPS principals' use of technology changed over time with the implementation of CPS technology initiatives. Then we examine the barriers to technology integration that principals perceive still remain in their schools.

The analyses that are presented in this report were done in two ways—first with just those principals who responded to the surveys in all three survey years, and again with all CPS principals responding in any survey year. The first type of analysis showed whether principals were changing their own practice over time, while the second examined change across CPS that may have occurred as a result of new principals in the system.[1] Both types of analyses showed similar patterns of change—CPS principals have greatly increased their use of technology over the last five years.[2]

Technology Is Now an Integral Part of Principals' Work

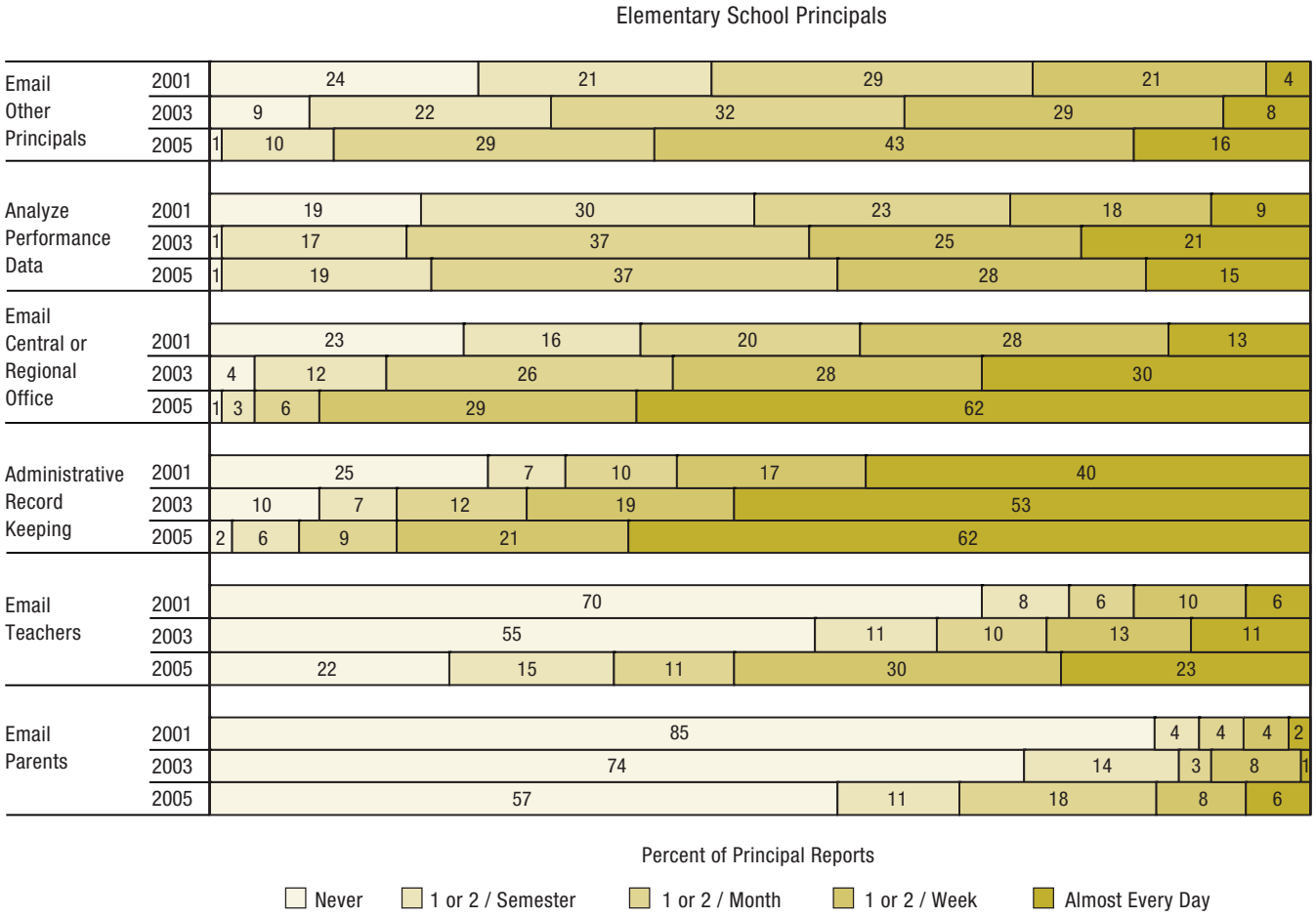
In 2001, most principals used email only to contact other principals or the central office, and few principals used email more than a few times a month (see Figure 1A and 1B). This changed substantially over the next four years. Almost 100 percent of principals now use email to contact other principals and the central office, and email is also used to communicate with teachers and parents. The percentage of principals who email their teachers more than doubled, so that more than three-fourths of elementary school principals and more than 90 percent of high school principals now email teachers at least occasionally. The percentage of principals who email parents nearly tripled by 2005. Still, emailing parents is not always possible. In 2005, 57 percent of elementary school principals still said they never emailed their students' parents. Only about 40 percent of elementary school students said they had access to the Internet at home in 2003, and the relatively low number of principals who emailed parents likely reflects this constraint.[3]

By 2005, principals also used technology more frequently for their own professional work, such as doing administrative record keeping and analyzing school performance data, compared to four years earlier. By 2005, 62 percent of elementary school principals used computers for administrative record keeping every day, while 98 percent did so at least occasionally. Among high school principals, there were only modest increases

FIGURE 1A

Principals Are Increasingly Using Technology to Communicate with Others

For each activity, please indicate how often you use computers or the Internet, either at home or at school, to complete the activity.



NOTE: Frequencies include only principals who participated in 2001, 2003, and 2005 surveys.

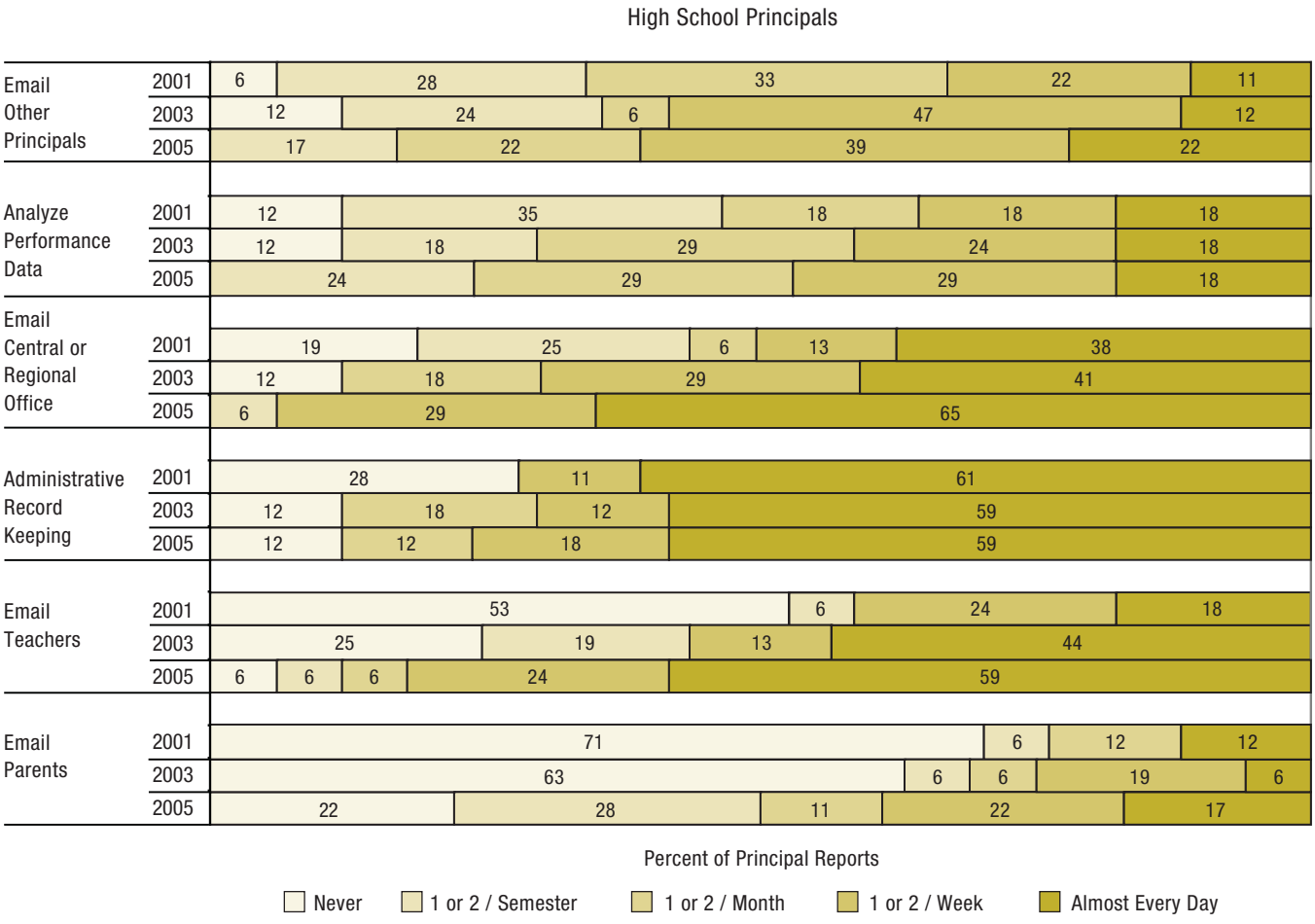
in computer use for administrative record keeping; however, almost 90 percent used computers for administrative record keeping at least occasionally, and almost 60 percent did so daily. In 2001, most principals were already sometimes using computers to analyze school performance data. By 2005, virtually all principals used computers to analyze school performance data at least occasionally, and almost half of principals analyzed performance data with computers at least weekly.

By combining principals' responses to all the questions on computer use, we created a measure of principals' overall technology use that allowed us to easily summarize general trends in computer use among principals over time. As shown in Figure 2, computer use that was average in 2003 (see the dotted line in the middle of the box in 2003) would have been considered exceptionally high in 2001 (corresponding to the top of the box in 2001). The same magnitude of increase occurred again from 2003 to 2005. Principals with the lowest levels of computer use in 2005 were just below what would have been considered average in 2001. Technology use among high school principals jumped slightly higher than technology use among elementary school principals. This likely corresponded with the laptop rollout at the high school level, which included high school principals. Overall, principals' use of technology to do their work changed dramatically over the span of four years.

FIGURE 1B

Principals Are Increasingly Using Technology to Communicate with Others

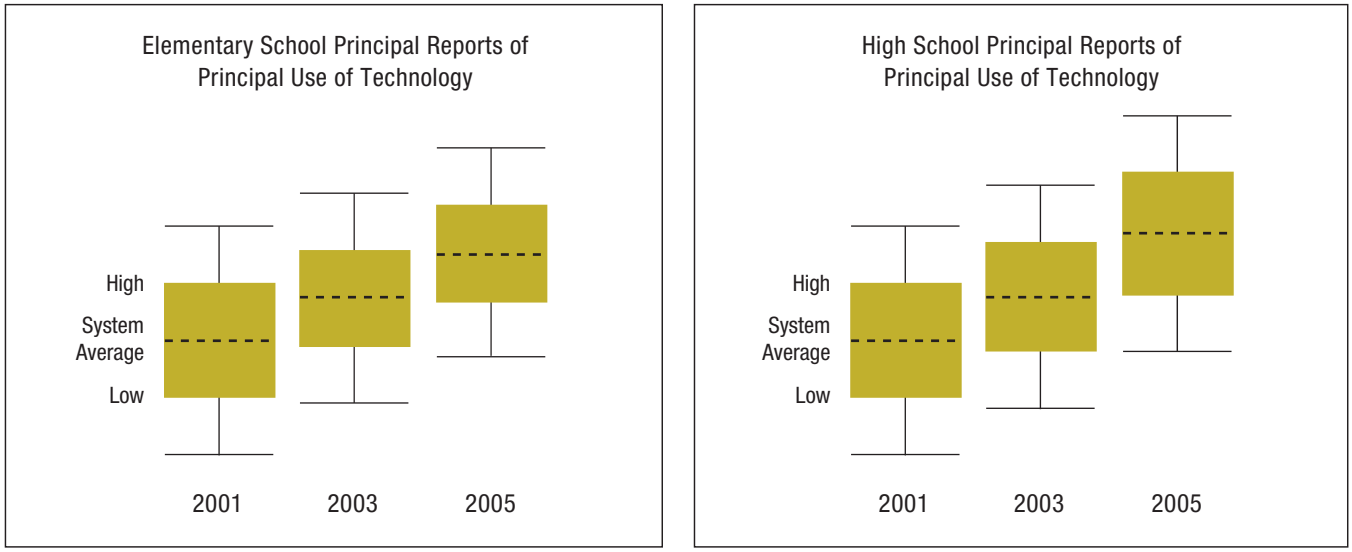
For each activity, please indicate how often you use computers or the Internet, either at home or at school, to complete the activity.



NOTE: Frequencies include only principals who participated in 2001, 2003, and 2005 surveys.

FIGURE 2

Principals' Use of Technology Has Risen Dramatically



NOTE: All principals were included for these analyses.

How to Interpret the Box Plot Trend Displays

The trend displays show the changes in technology use from 2001 to 2005 across the system. The dashed line on each box indicates the system average for that year. The box surrounding the system average indicates a range of two standard deviations around the mean (one above the system average and one below). Two-thirds of all principals/teachers/students fall within the range of the box for that measure. Extending out from the box are lines that end two standard deviations from the mean. These represent the extreme values (approximately the 2nd and 98th percentiles). For these system trend displays, standard deviations are calculated out of the total variation in responses (both individual and school level) to show how total variation in technology use and access has changed from 2001 to 2005.

These figures can show two possible types of change in technology. First, they can show an overall change in the system average from 2001 to 2005. This is represented by the up or down movement of the 2005 dashed line relative to the 2001 and 2003 lines. These figures can also show whether differences among the principals/teachers/students widened or narrowed between 2001 and 2005. This is represented by the size of the 2005 box relative to the 2001 and 2003 boxes. For example, a 2005 box that is smaller than the 2001 box suggests that there was a decrease in the difference among schools.

In Figures 9 and 10 (see pages 18 and 19), these figures also allow us to see how groups of schools, represented by the different type of lines, differ from each other compared to the total range of responses. Lines that are closer to each other represent more equity than lines that are spread apart.

Teachers Follow Lead of Principals in Integrating Technology

The previous report showed that the principals' support around technology played an important role in the availability and use of technology in their schools. In 2001, individual principals made unique efforts to promote technology use in their schools. We might expect that principals who used technology substantially would be most aware of its potential uses and promote technology integration in their schools. Principals' own use of computers had a positive relationship with teachers' professional use of technology and their assignment of technology to students when they were measured in 2001 (see Table 1).[4] Teachers used computers and the Internet more for their professional work, integrated technology into their curriculum more often, and had more professional development opportunities around technology if they were at schools in which principals also reported using technology more in their own work. These relationships from 2001 are consistent with the theory that principals' own comfort with technology affects the degree to which they support technology in their schools. The decline in the size of the relationships might have occurred because the system became more active in promoting technology, so that schools were not as dependent on the special efforts of principals to gain access to technology. However, these relationships may also partially exist because principals themselves are able to use computers more if technology is more readily available at their school. In fact, there was a positive relationship between principals' own use of computers and their students' and teachers' access to computers in all three survey years, particularly in 2001.

Principals Report Fewer Barriers as District Ramps Up Technology

In 2001, principals identified basic issues around infrastructure and networking as the biggest barriers to technology integration in the classroom (see Figure 3A and 3B). In 2001, for example, about half of principals said that infrastructure issues were a great barrier to technology integration, about 40 percent of principals identified the number of computers as a great barrier, and half of elementary school principals and 60 percent of high school principals identified networking issues as a great barrier. By 2005, basic issues of infrastructure, networking, and computer availability had improved in many schools. These improvements occurred largely between 2001 and 2003, and were largest in high schools—the time of the high school laptop rollout and E-Rate initiatives. Elementary school principals identified further improvements in 2005; however, high school principals identified an increase in problems around these basic computing infrastructure issues after 2003. Furthermore, while the majority of principals (76 percent of elementary school principals and 83 percent of high school principals) reported the computers in their school were in good working order in 2005, the improvements that occurred between 2001 and 2003 had deteriorated by 2005. This may represent the increase in the demand for computers in high schools. It also reflects the aging of the computers that had been distributed in 2001–02 and the surrounding issues around computer support, repair, and replacement.

TABLE 1

Correlations of Principals' Use of Technology with Technology Use among Teachers and Students

2001	Student Access	Student Use	Teacher Access	Teacher Professional Use	Teacher Assignment	Teacher Professional Development
2001 Principals' Use	.25***	.15*	.31***	.23***	.18**	.15*
2003 Principals' Use	.13*	.12*	.13*	.15*	.10	.09
2005 Principals' Use	.12*	—	—	—	.19**	.27§

* p-value <.05 ** p-value<.01 *** p-value<.001

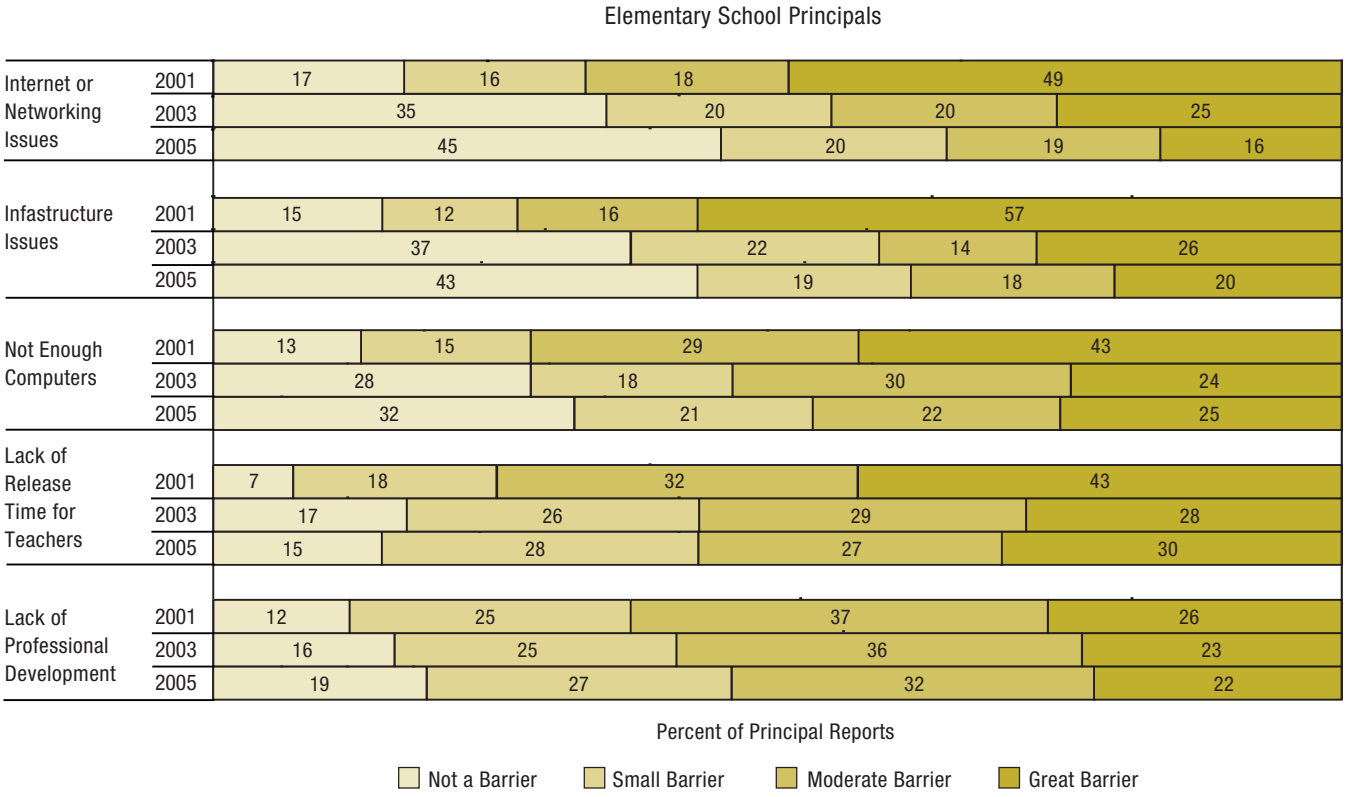
§ In 2005, Teacher Professional Development results include only high school teachers.

NOTE: All principals were included for these analyses.

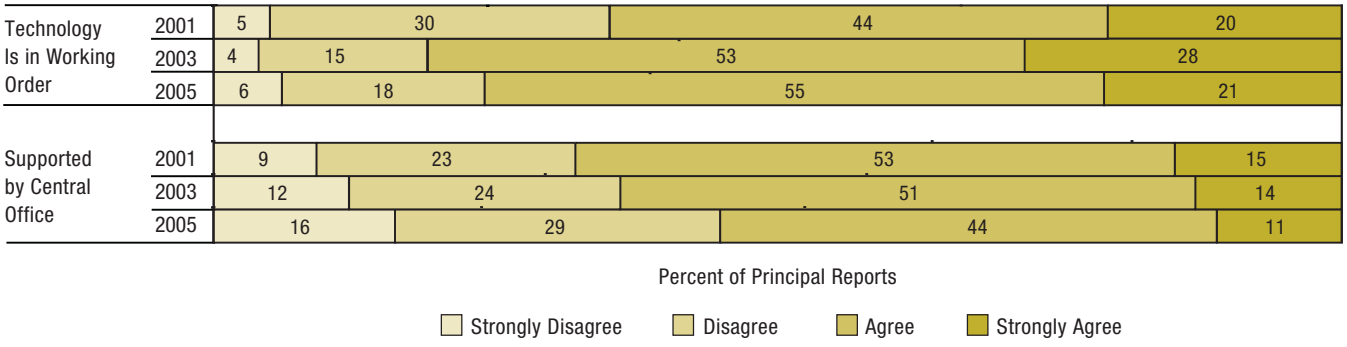
FIGURE 3A

What Barriers to Technology Integration Existed from 2001 to 2005?

Please indicate to what extent, if any, each of the following is a barrier to teachers' use of school computers or the Internet for instruction.



To what extent do you agree or disagree to the following statements?

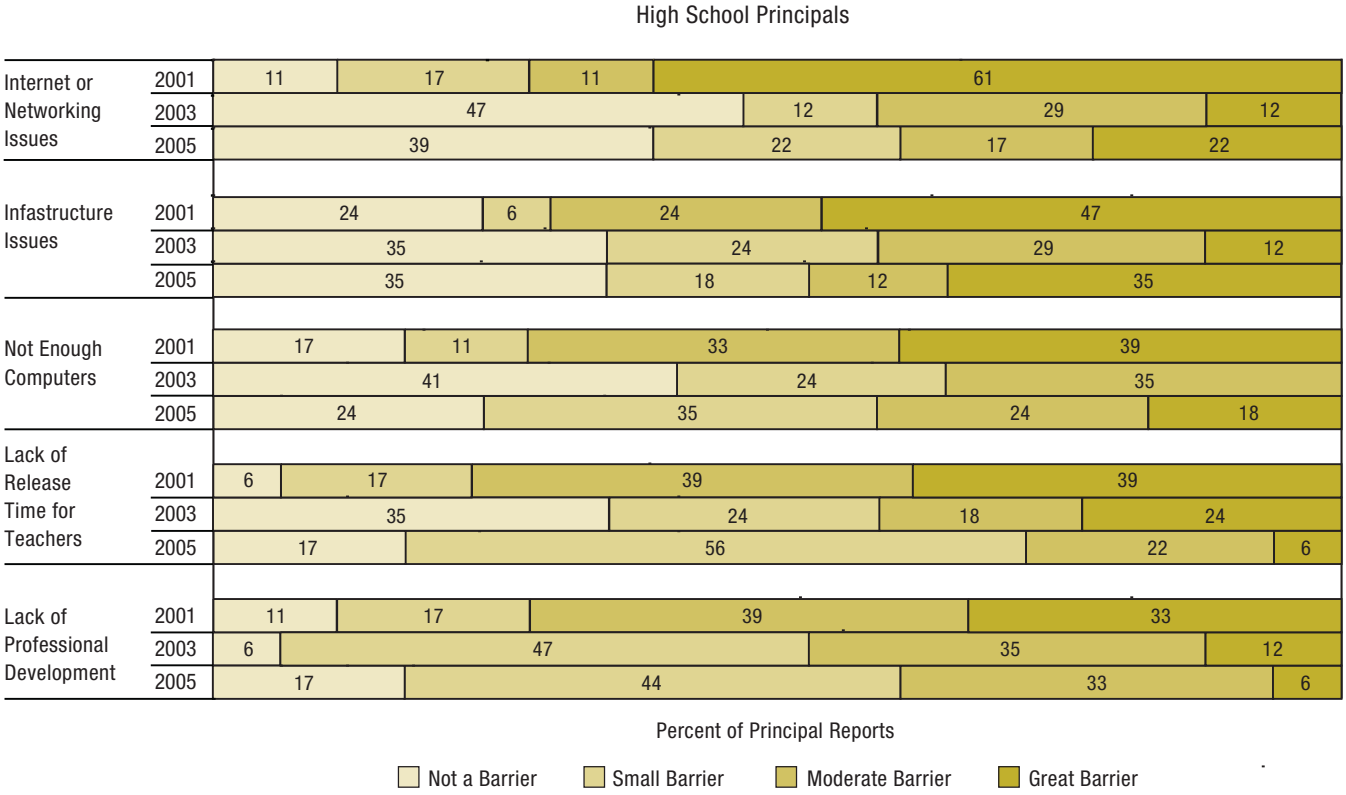


NOTE: Frequencies include only principals who participated in 2001, 2003, and 2005 surveys.

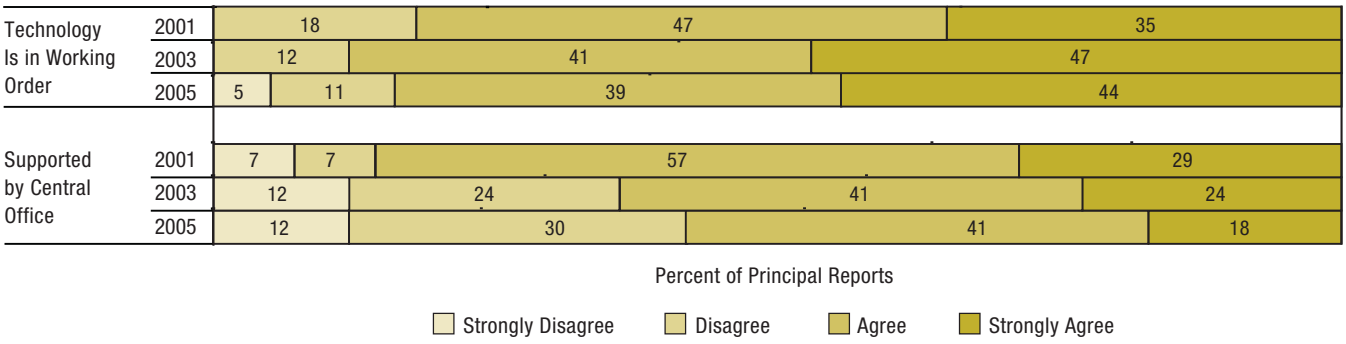
FIGURE 3B

What Barriers to Technology Integration Existed from 2001 to 2005?

Please indicate to what extent, if any, each of the following is a barrier to teachers' use of school computers or the Internet for instruction.



To what extent do you agree or disagree to the following statements?



NOTE: Frequencies include only principals who participated in 2001, 2003, and 2005 surveys.

Between 2001 and 2003, there were clear improvements in access to technology in CPS schools. However, access to computers still remained a problem in a number of schools in 2005. While only 25 percent of elementary school principals and 18 percent of high school principals identified the number of computers as a great barrier to technology integration in their school, almost half identified it as at least a moderate barrier. If teachers increasingly expect students to use computers for their class assignments, this problem might persist even if the total number of available computers rises.

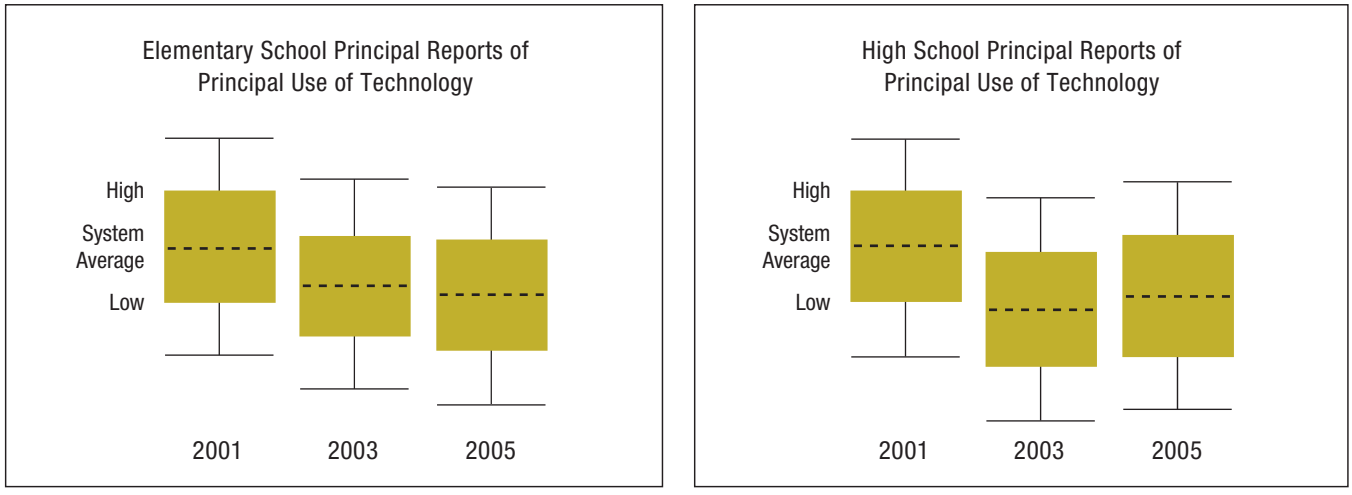
Because many of the issues around basic access to technology had improved by 2003, elementary school principals viewed a lack of release time (for teachers to learn, practice, and plan how to use computers) as the biggest barrier to technology integration in the school, closely followed by the lack of professional development. By 2005, more than half of elementary school principals said a lack of release time and a lack of professional development were at least moderate barriers. High school principals were much less likely to report a lack of release time or professional development as a great barrier than elementary school principals. The marked difference between high schools and elementary schools likely occurred along with the laptop distribution—it brought professional development opportunities and sparked greater interest in such opportunities.

One area of no improvement was in principals' perceptions of the support they received from the central office to integrate technology in their school. In 2001, 68 percent of elementary school principals and 86 percent of high school principals said the central office supported them in their efforts to integrate technology in their school. By 2005, only slightly more than half of principals felt supported by the central office. This finding is particularly surprising given the overall decline in barriers reported by principals. While these results may reflect decreases in the supports offered by the central office over the years, it could also be that principals expect more support as technology becomes more important in their schools.

Figure 4 shows the overall trends in principals' reports about barriers to technology integration using a single measure made by combining the items shown in Figure 3A and 3B. In 2003, principals reported fewer overall barriers to technology use compared to 2001. What would have been considered moderate reports about barriers to technology in 2001 (see the dashed line) would have been considered high reports in 2003 (see the top of the box). Yet, by 2005, elementary school principals reported only a slight decrease in barriers to the use of technology, and high school principals reported a slight increase in barriers to the use of technology in their schools, compared to 2003. This suggests that the momentum around technology initiatives in CPS between 2001 and 2003 did not sustain itself in the subsequent two years.

FIGURE 4

Barriers to Use of Technology Decreased in 2003



NOTE: All principals were included for these analyses.

Barriers Inhibit Teachers' Integration of Technology

Principals' reports about barriers to technology integration in their schools correspond with students' and teachers' reports of their use of technology in their schools (see Table 2).[5] In schools where principals reported fewer barriers, students were more likely to report high levels of access to and use of computers at school; also, teachers in those schools were more likely to report more access to and use of computers for their professional work, more incorporation of technology in their assignments, and more opportunities for professional development around technology. The strong relationships between principals' reports about barriers and teachers' reports about their use of technology suggest that principals' reports might be used to gauge the extent to which technology access and professional use might have changed among teachers after 2003, for which we do not have survey reports. If the relationships continued, it is likely that the improvements observed from 2001 to 2003 in teachers' use of technology slowed in the subsequent two years.

TABLE 2

Correlations of Principals' Perceptions of Barriers with Technology Reports from Teachers and Students

	Student Access	Student Use	Teacher Access	Teacher Professional Use	Teacher Assignment	Teacher Professional Development
2001 Principals' Perceived Barriers	-.32***	-.25***	-.47***	-.42***	-.39***	-.35***
2003 Principals' Perceived Barriers	-.28***	-.24***	-.46***	-.35***	-.38***	-.35***
2005 Principals Perceived Barriers	-.36***	—	—	—	-.12*	-.39*

* p-value <.05 ** p-value<.01 *** p-value<.001

NOTE: All principals were included for these analyses.

Chapter 1 Endnotes

1 When limiting our sample of principals to those who participated in all years, we cannot be certain that the same principal participated in all three surveys because our surveys are anonymous.

2 The frequency charts include only principals who answered the surveys in 2001, 2003, and 2005. The correlation tables and HLM analyses include all principals. Similar HLM results are obtained only if principals who participated in all years were included, indicating that the trends hold among a consistent group of principals and across all principals in CPS over time.

3 We do not know the percentage of students who had Internet access in their home in 2005.

4 For this part of the analysis, we looked at the correlations between student, teacher, and principal measures.

5 For this part of the analysis, we looked at the correlations between student, teacher, and principal measures.

Chapter 2

Trends in Computer Access and Use among Students

Employers increasingly expect workers to be computer literate. According to a 2005 Skill Gap Report, 40 percent of employers said employees will need strong computer skills over the next three years, and 56 percent of employees said they used a computer at work in 2003.[1] More than 80 percent of college educated persons said they used a computer at work in 2003. Students going to college now are expected to have computer skills, such as word processing, Internet use, and fluency with spreadsheets such as those created by Excel.[2] Some students may gain basic computer skills at home, and indeed there has been a moderate rise in use of computers in households since 2001.[3] Yet, there also has been a "digital divide" in access to computers in households, not only between families that are affluent and families that live in poverty but also among racial/ethnic groups. Because the vast majority of CPS students are low-income and racial/ethnic minorities, we need to be concerned about their exposure to computing technology at school. Access to computers at school is particularly important for students who do not have access at home.

Computer Access at School Insufficient for Many

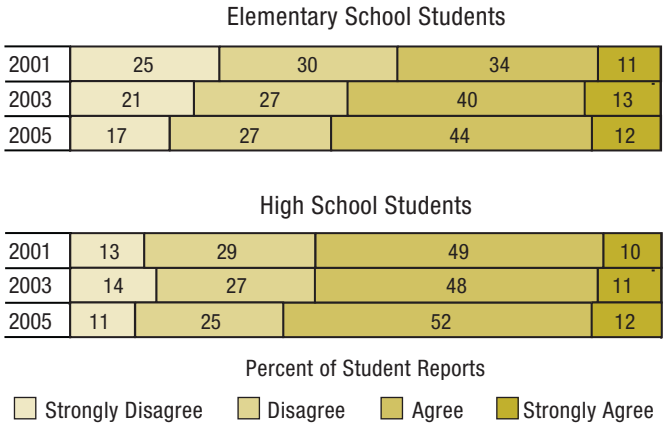
Students' reports about their access to computers at school improved only slightly from 2001 to 2005, with most of the improvement occurring among elementary school students (see Figure 5). In 2001, 42 percent of high school students (ninth and tenth grades) and 55 percent of elementary school students (sixth through eighth grades) reported that they were usually unable

to find a computer available at school to do their homework. In 2005, 36 percent of high school students and 44 percent of elementary school students still were usually unable to find a computer available at school to do their homework. The supply of technology at CPS schools seems to be just keeping up with student demand, particularly in the high schools. Yet, students are unlikely to use computers unless they have consistent access.[4]

FIGURE 5

Computer Access at School among Students

I can usually find an available computer to use for my homework at school.



Computer Use at School Is Infrequent

By 2005, the vast majority of CPS students—82 percent of elementary school students and 86 percent of high school students—used computers at school at least once during the academic year for class assignments. While these rates are high, they are below national rates of computer use at school from 2003, two years earlier. According to the U.S. Census Bureau, 90 percent of schoolchildren aged 10 to 17 used a computer at school in 2003. The discrepancy may partially exist because our survey question in 2005 specifically asked about computer use at school for classroom assignments, while the national rates asked about any type of computer use at school. Still, it is troubling that almost one-fifth of sixth-grade through tenth-grade CPS students reported never using a computer at school for their class assignments in 2005, given the high national rates in 2003.

As shown in Figure 6, students most frequently use computers for word processing or typing, followed by research on the Internet.[5] These were also two areas that showed substantial increases over time.[6] In 2001, nearly 30 percent of students never used computers at school for word processing or typing; by 2005, just 13 percent of elementary school students and 8 percent of high school students never used computers for word processing or typing. In 2001, about one-third of students never did research on the Internet at school; but by 2005, that number was down to less than 15 percent. While a change in question wording in 2005 may have influenced how students reported their use of computers for these activities, the increase is fairly steady across all three years.

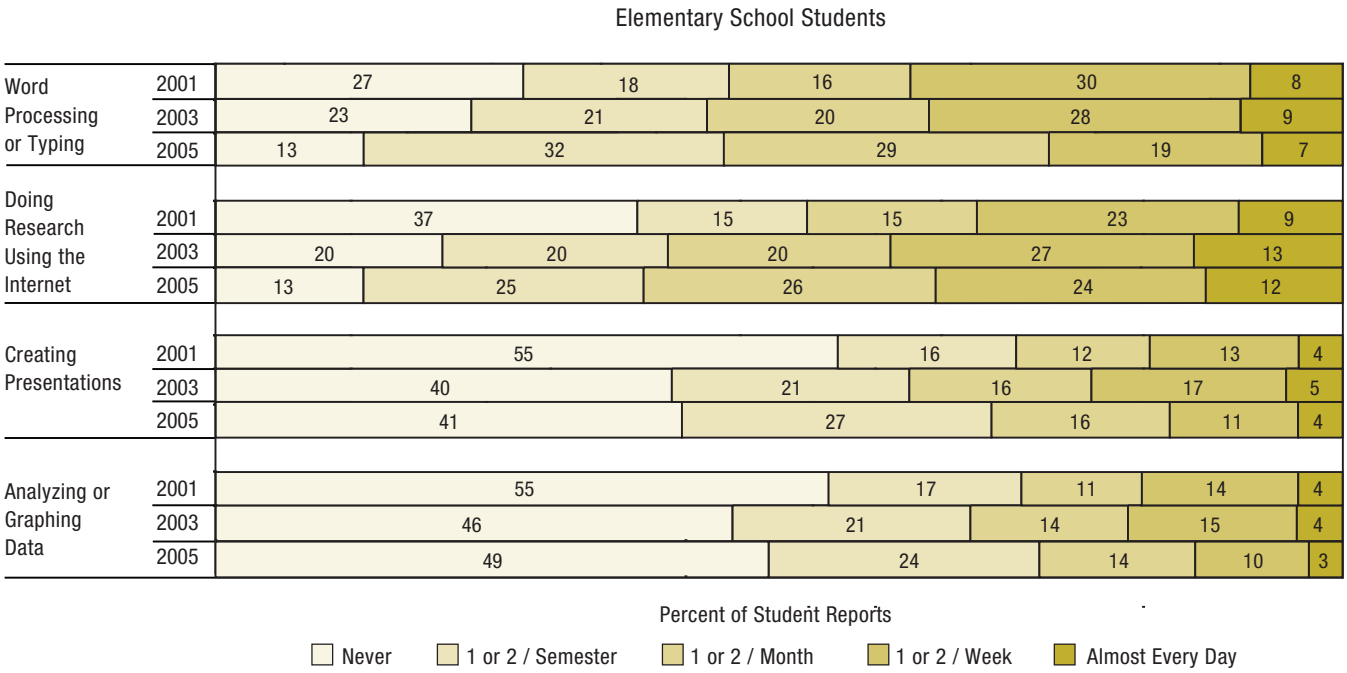
While occasional use of computers increased substantially from 2001 to 2005, there were few increases in students' reports of doing any task with computers once a week or more. As of 2005, only one-third of elementary school students did word processing or Internet searches more than once or twice a month. Likewise, only about one-third of high school students used computers for word processing more than once or twice a month, and just under half did Internet research more than once or twice a month. The one exception is that high school students were more regularly using the Internet by 2005. In general, more students were getting occasional exposure to computers, but computers were not used as a regular part of their schoolwork. This corresponds with general trends in teachers' reports of the assignments they were asking of students—while more teachers were occasionally asking their students to use computers for class assignments, few teachers asked their students to do so more than once or twice a month.[7] (See Chapter 3.)

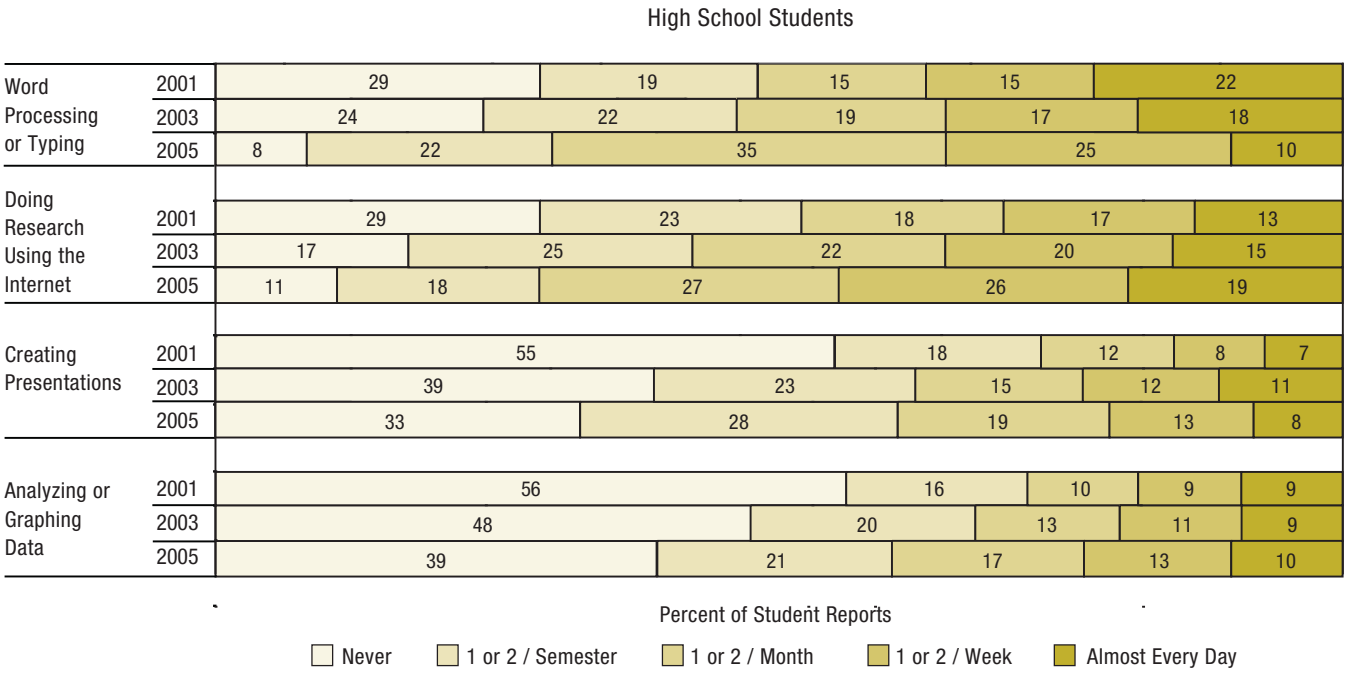
Across all survey years, students were much less likely to use computers for analyzing/graphing data or for creating presentations than for word processing or Internet research. In 2001, more than half of students said they never analyzed or graphed data or created a presentation at school with a computer. By 2005, 40 percent of elementary school students still were never creating presentations, and almost half were never using computers to analyze or graph data. More high school students were using computers for presentations and data analysis by 2005, but still about one-third of

FIGURE 6

Types of Computer Use for Class Assignments

*This school year, how often do you use a computer at school for the following things?**





** NOTE: In 2005, the question wording changed to: "This year, how often were you required to use a computer to do the following things?"*

high school students never did.[8] This is problematic in an age when many employers are seeking workers who are proficient with programs such as Excel or PowerPoint.[9]

Home Technology Use Increasing; Some Students Still Lack Access

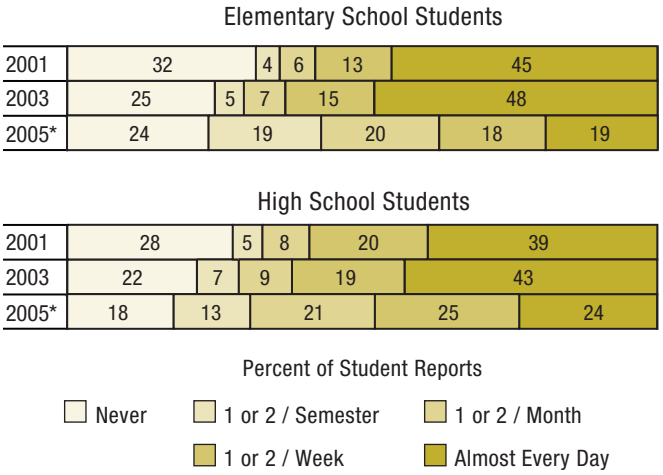
It is particularly important that students gain familiarity with computers at school if they do not have opportunities to use computers at home. In 2001, about 40 percent of sixth-grade through tenth-grade CPS students did not have a computer in their home, and about 60 percent did not have access to the Internet at home.[10] By 2003, just 21 percent of high school students and 24 percent of elementary school students said they did not have a computer at home, and about 40 percent of students in elementary and high schools said they did not have Internet access at home.[11] The increased access to computers and the Internet at home was accompanied by increased reports of students using computers at home. In 2001 about one-third of students said they never used a computer at home and by 2003 this had shrunk to one-fourth (see Figure 7). Thus, within two years, substantially more students had some access to a computer at home and were using a computer at home, although almost one-fourth of students still had to go outside their home to use a computer.

The 2005 survey did not ask students either whether they had a computer at home or how often they used a computer at home for general purposes. Therefore, we cannot determine exactly how many more students gained access to computers in their home in the subsequent two years. Instead, the 2005 survey asked students how often they used a computer at home to complete class assignments.[12] In 2005, one-fifth of students said they never used computers at home for classroom assignments (see Figure 7). This is only slightly smaller than the amount of students who reported never using computers at home in 2003, which may suggest only a small increase in access to computers at home in those two years. However, it also could be either that many students in 2003 were using computers strictly for entertainment purposes or that their computers had limited functions.

FIGURE 7

Students' Computer Use at Home

This year, how often have you used a computer at home?



** Question wording changed to only reflect computer use for class assignments*

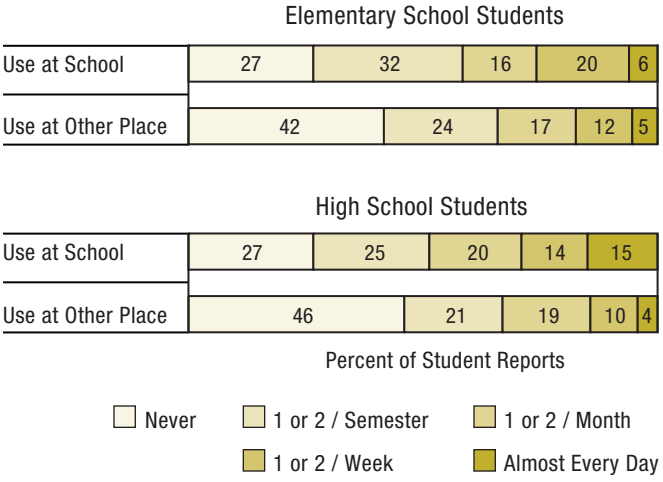
In both 2001 and 2003, almost half of sixth-grade through tenth-grade students said they used a computer at home every day (see Figure 7). Half of students reporting daily use of computers at home may seem like a large number; but, in 2001 and 2003, we did not know the extent to which students were using computers at home for academic versus entertainment purposes. Therefore, in 2005, we specifically asked students: "How often have you used a computer to complete class assignments?" Because of this change in question wording, there was a substantial drop in the percentage of students who reported using a computer at home every day. This change suggests that much of the everyday use reported in earlier years was for nonacademic activities, such as playing computer games or instant messaging. In 2005, about 20 percent of students said they used computers at home every day for class assignments; only about 40 percent of students in sixth-grade through eighth-grade and about half of high school students used computers at home once a week or more to do their class assignments.

In 2005, about one-fifth of students in sixth-grade through tenth-grade never used computers at home for their schoolwork. It is possible that students were not using computers at home because they did not have academic assignments, rather than because they lacked access. However, among those students in 2005 who

never used a computer at home for class assignments, most did use a computer at *school* for class assignments (73 percent of high school students and 73 percent of elementary school students), and more than half used a computer at a place other than home or school (e.g., a friend's house, community center, library, church) (see Figure 8). Only 3 percent of high school students and 4 percent of elementary school students said they never used a computer anywhere in 2005 for class assignments.[13] Thus, most CPS students used computers for class assignments at home, but the one-fifth of students who did not have access to a computer at home needed to have regular access to a computer elsewhere. This suggests that, despite increases in computer access in students' homes over the last five years, access to computers at school remains important for many CPS students.

FIGURE 8

2005 Computer Use among Students Who Do Not Use a Computer at Home



Chapter 2 Endnotes

1 The report is Deloitte (2006), "2005 Skills Gap Report—A Survey of the American Manufacturing Workforce," National Association of Manufacturers. In addition, Hartman, Bentley, Richards, and Krebs (2005) found knowledge of how to use technology to be an important office skill for administrative employees. According to the U.S. Census Bureau, in 2001, 54 percent of the employed population aged 18 years or older used computers at work and 39 percent used the Internet at work; by 2003, 56 percent and 42 percent (U.S. Census Bureau "Computer and Internet Use in the United States: 2003").

2 While we could find no studies that specify the general computer skills expected for undergraduate students, a scan of web pages and course requirements from various universities shows that computer skills are expected. Furthermore, enrollment in online courses requires familiarity with computers.

3 According to the U.S. Census Bureau, in 2001, 56 percent of households had access to a computer and 50 percent had access to the Internet; by 2003, 62 percent of households had access to a computer and 55 percent had access to the Internet. (U.S. Census Bureau "Computer and Internet Use in the United States: 2003").

4 In the 2005 survey, about 60 percent of students who never use computers at school also say that their school does not have enough computers for students to use and that it is difficult to find an available computer to use for homework. The same pattern was shown in the 2002 report (Hart, Allensworth, Lauen, and Gladden, 2002).

5 In 2001 and 2003, the activities asked about on the survey included: practice drills (for example, math problems, vocabulary, and spelling); analyzing or graphing data (in Excel, for example); word processing or typing (in Word, for example); creating presentations (in PowerPoint, for example); creating web pages; computer programming; doing research on the Internet; and corresponding with other via email or the Internet. In 2005, the activities asked about included: type written assignments, use of a program like Excel to analyze or graph data, use of a program like PowerPoint to create a class presentation, and use of Internet/online resources to locate information for class assignments. In this report, we focused on the four most common activities that were included on all the surveys.

6 The wording of the survey questions changed somewhat in 2005, and this could have affected students' responses. In 2001 and 2002, students were asked: "This school year, how often do you use a computer at school for the following things?" In 2005, students were asked: "This school year how often were you required to use a computer to do the following things?"

7 Elementary school teachers' analyses include kindergarten through eighth-grade teachers; high school teachers' analyses include ninth-grade through twelfth-grade teachers; and students' analyses include sixth-graders through tenth-graders.

8 It is possible that some students may do these types of assignments at home. However, it is more likely that students do not do these types of assignments at school, either because their teachers do not assign them or simply because the technology is not available to them.

9 Davis (1997); and Zhao and Alexander (2002). Zhao and Alexander focused on technology skills recommended for business students.

10 In 2001, we asked students: "Which of the following does your family have in your home *[a computer]*?" and "Which of the following does your family have in your home *[Internet access]*?" In response, 58 percent of high school students and 60 percent of elementary school students said they had a computer; and 42 percent of high school students and 40 percent of elementary school students said they had Internet access at home. In 2003, we asked students: "Do you have a computer at home?" and "Do you have Internet access at home?" In response, 79 percent of high school students said they had a computer, while 76 percent of elementary school students said they had a computer; and 64 percent of high school students said they had Internet access, while 59 percent of elementary school students said they had Internet access.

11 The 2005 survey did not contain a comparable question.

12 The question wording was changed to distinguish computer use for schoolwork versus for entertainment.

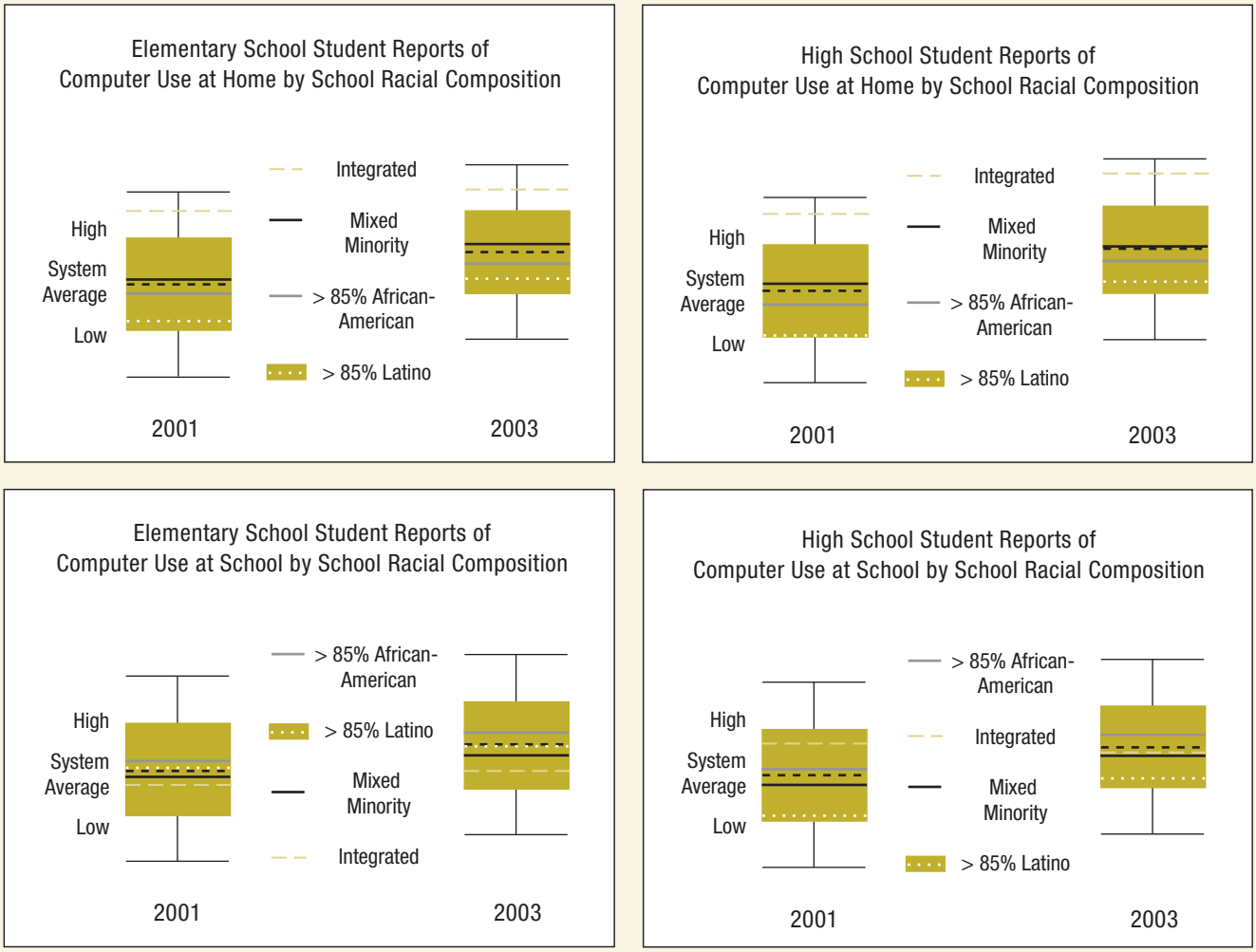
13 To get this percentage, we looked at students who said they never used a computer at home, never used a computer at school, and never used a computer any place other than home or school.

What Happened to the "Digital Divide" after 2001?

The 2002 report showed that there was a substantial racial "digital divide" among Chicago schools in students' use of computers and the Internet at home. Students attending schools that were predominantly African-American or Latino were much less likely to use computers at home than students attending integrated and racially mixed schools. This suggested that it was especially critical for schools predominantly serving racial/ethnic minority students to ensure their students were developing computer skills in school. The 2002 report showed that while elementary schools were not exacerbating the digital divide, they also were not compensating for it; use of computers at school was similar in predominantly African-American and Latino schools, compared to integrated and racially mixed schools. High schools, though, seemed to be exacerbating the divide for Latino students. Students who attended integrated and predominantly African-American high schools were much more likely to use computers at their schools than students at predominantly Latino high schools.

FIGURE 9

Students' Computer Use by School Racial Composition

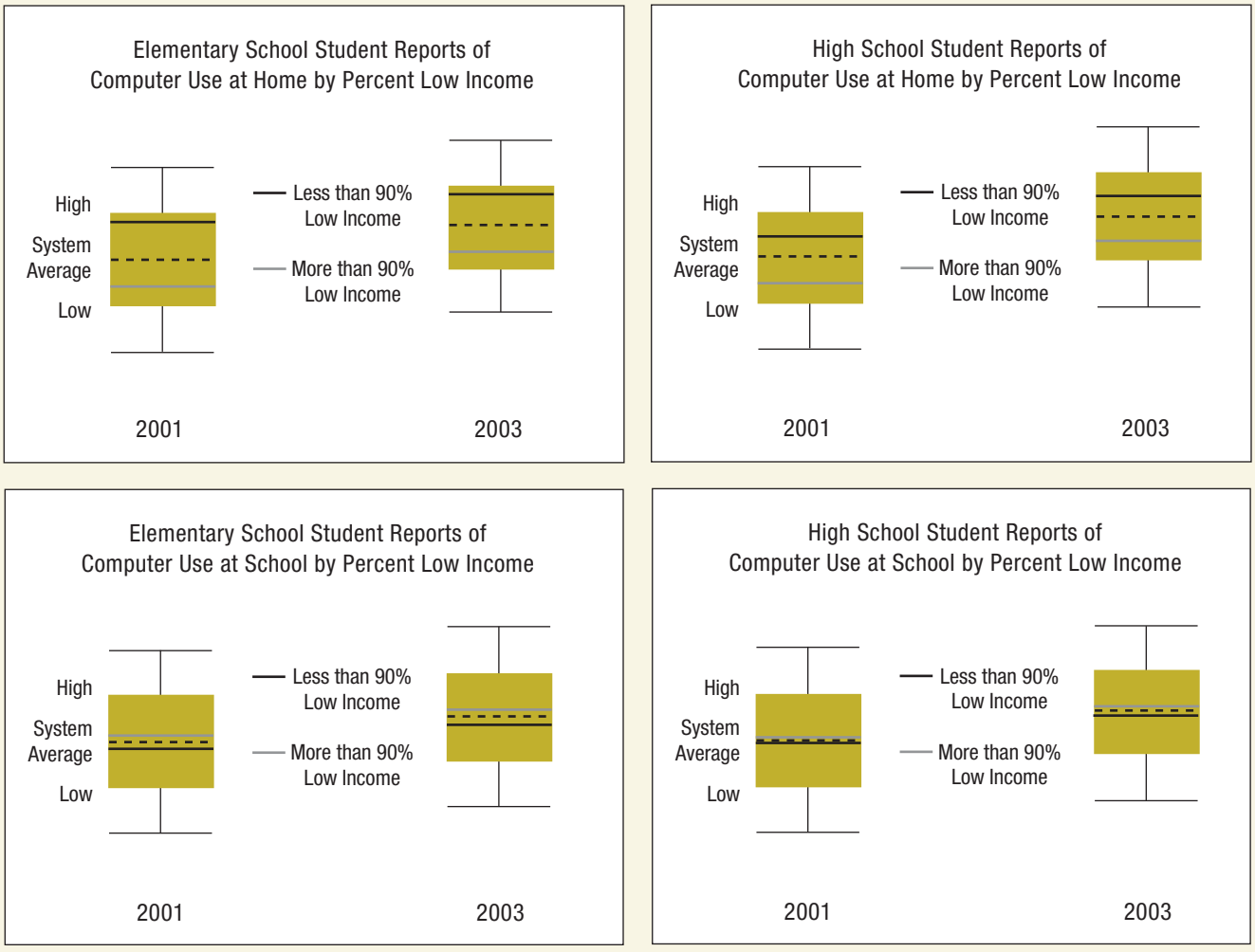


By 2003, differences across schools in the degree to which their students used computers at home had decreased, although students at integrated schools still used computers at home to a much greater extent than students at other schools (see Figure 9). While students at all types of schools were more likely to use computers at home in 2003 than in 2001, the largest increases occurred among students at predominantly African-American and Latino schools. There were also large differences in computer use at home by the poverty level of the student body (see Figure 10).[A] These gaps also decreased by 2003, although sizable differences remained.

Increases in computer use at school were much more modest than the increases in computer use at home. However, the largest increases were in schools that predominantly served African-American or Latino students. This suggests an improvement in the degree to which schools were compensating for unequal access at home. By 2003, in fact, elementary school students attending predominantly African-American schools were using computers at school more than students attending integrated schools. Students at predominantly Latino high schools were still the least likely to use computers at school, but the difference compared to other schools had

FIGURE 10

Students' Computer Use by School Poverty Level



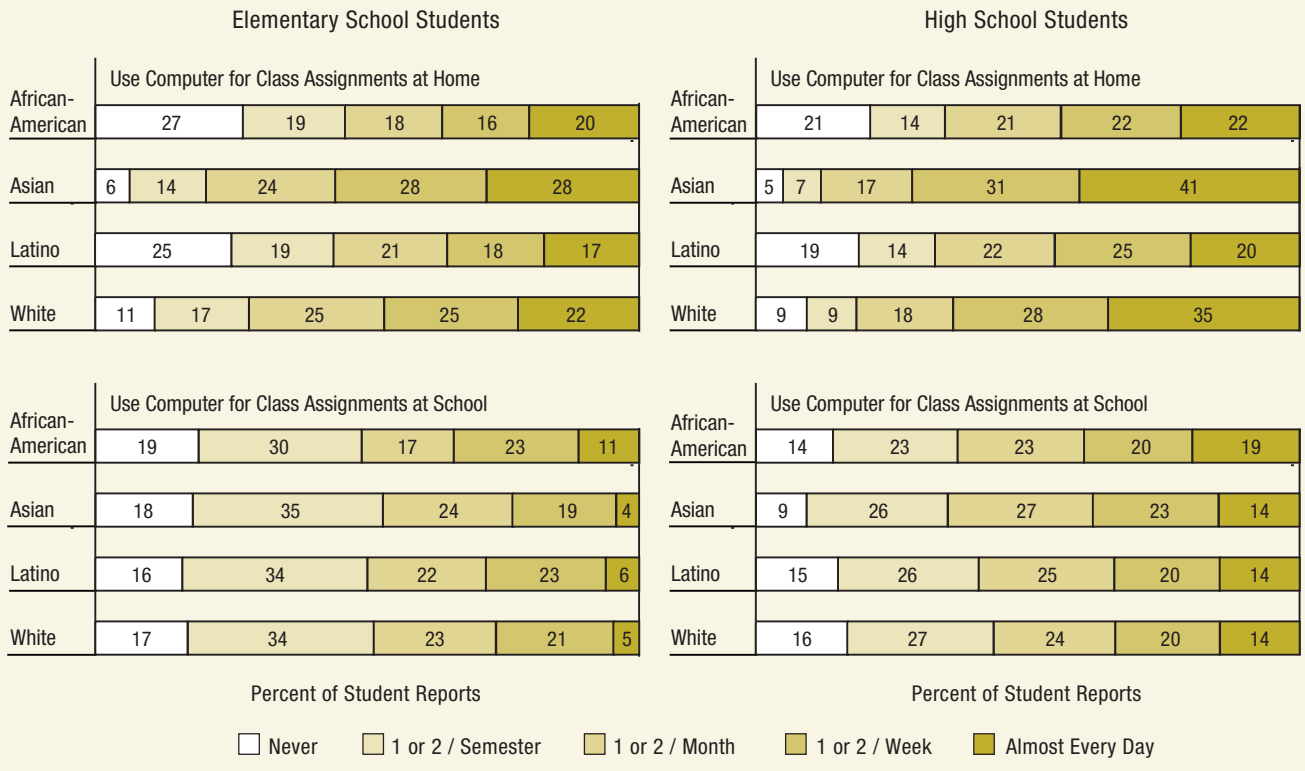
decreased. By 2003, therefore, high schools were no longer magnifying the digital divide by race to the same degree that they were in 2001.

In both 2001 and 2003, students at schools with very high poverty levels were only slightly more likely to use computers at schools than students at schools with less extreme levels of poverty; elementary schools were partially compensating for the digital divide, while high schools simply were not exacerbating it. Students at both types of schools used computers at school more in 2003 than in 2001, but the average difference between them remained about the same.

The survey data available in 2005 does not allow for an examination of equity in the 2005 school year with the general measures of access and use of computing technology (see "Measures Used in Analyses" in the Appendix). Instead, we can examine how often students used computers at home and at school for class assignments with two discrete survey questions. Not surprisingly, Figure 11 shows that a digital divide at home still existed in 2005. African-American and Latino students were less likely to report using a computer at home for class assignments compared to White and Asian students. However, there was a slight compensation in use of computers at school for African-American students and, to a smaller extent, Latino students. In both elementary and high schools, African-American students were slightly more likely than other students to use computers at school weekly or every day.

FIGURE 11

Computer Use at Home and School by Racial Composition in 2005



Sidebar II Endnotes

A A school is defined as predominantly low income if more than 90 percent of students are eligible for free or reduced-price lunch.

Chapter 3

Teachers' Use of Technology after the Technology Initiatives in 2001–02[1]

Beginning in school year 2001–02, CPS began a major initiative to improve teachers' access to computing technology by providing laptop computers and email accounts to all high school teachers. CPS also participated in the E-Rate Program, a federally funded program established to provide affordable telecommunications, internal connections, and Internet access to schools and libraries. Also by this time, the state of Illinois had updated technology standards for all Illinois teachers. As a result of these initiatives, by 2003 teachers should have reported better access to and more use of computers.

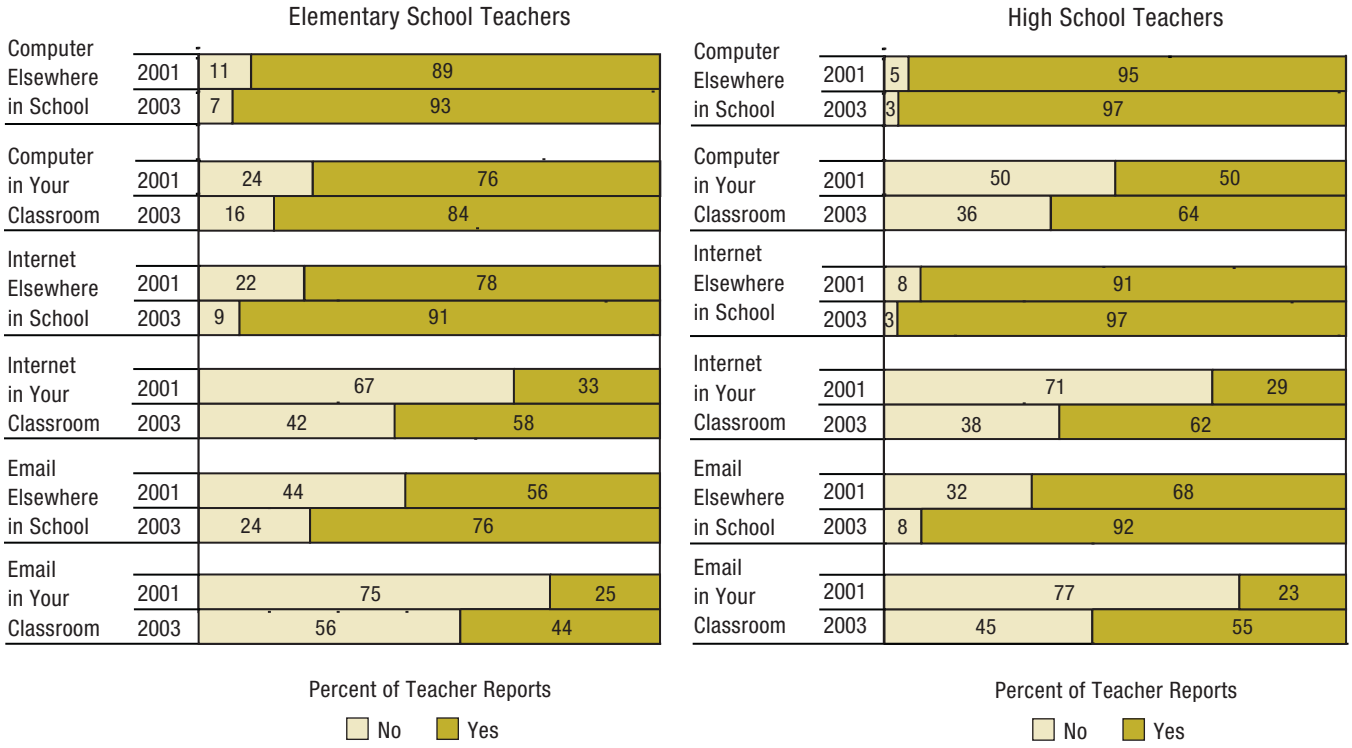
Teachers' Access Improved Considerably from 2001 to 2003

In 2001, the vast majority of teachers had access to computers somewhere in their schools,[2] but only about three-fourths of elementary school teachers and half of high school teachers reported access to computers in their classrooms (see Figure 12). By 2003, 84 percent of elementary school teachers and 64 percent of high school teachers had computers in their classrooms. While substantially more teachers had access to computers in their classrooms, the biggest improvement in access to technology was more Internet connections. By 2003, access to the Internet in teachers' classrooms practically doubled to about 60 percent. There was also substantial growth in teachers' access to email in their schools and in their classrooms. More teachers had computers in their classroom, and more classrooms were wired to allow for Internet connections.

FIGURE 12

Access to the Internet in Teachers' Classrooms Increased Substantially

Are the following available to you?



These teachers' reports match principals' reports of declining problems with lack of infrastructure, networking, and computers. The increase in access to technology throughout schools also corresponds with the increase in principals' use of computers for communication with other teachers and principals—broader access for teachers made email a feasible means of communication.

More Teachers Use Computers for Professional Work

Along with the rise in access to computers and the Internet, there was a substantial rise in teachers' use of technology for their own professional work. In the 2001 and 2003 surveys, we asked teachers the extent to which they used technology for different professional tasks, including creating instructional materials, gathering information for planning lessons, accessing model lesson plans, accessing research and best practices for teaching, and creating multimedia presentations for the classroom (see Figure 13). By 2003, teachers were more likely to report using computers for each of these. The most common way that teachers use computers is for creating instructional materials, and by 2003 all but about 10 percent of teachers did this at least occasionally. The biggest change from 2001 to 2003 was in accessing model lesson plans—in 2001 about 40 percent of teachers never used technology to access model lesson plans, but by 2003 that group decreased to about one-quarter.

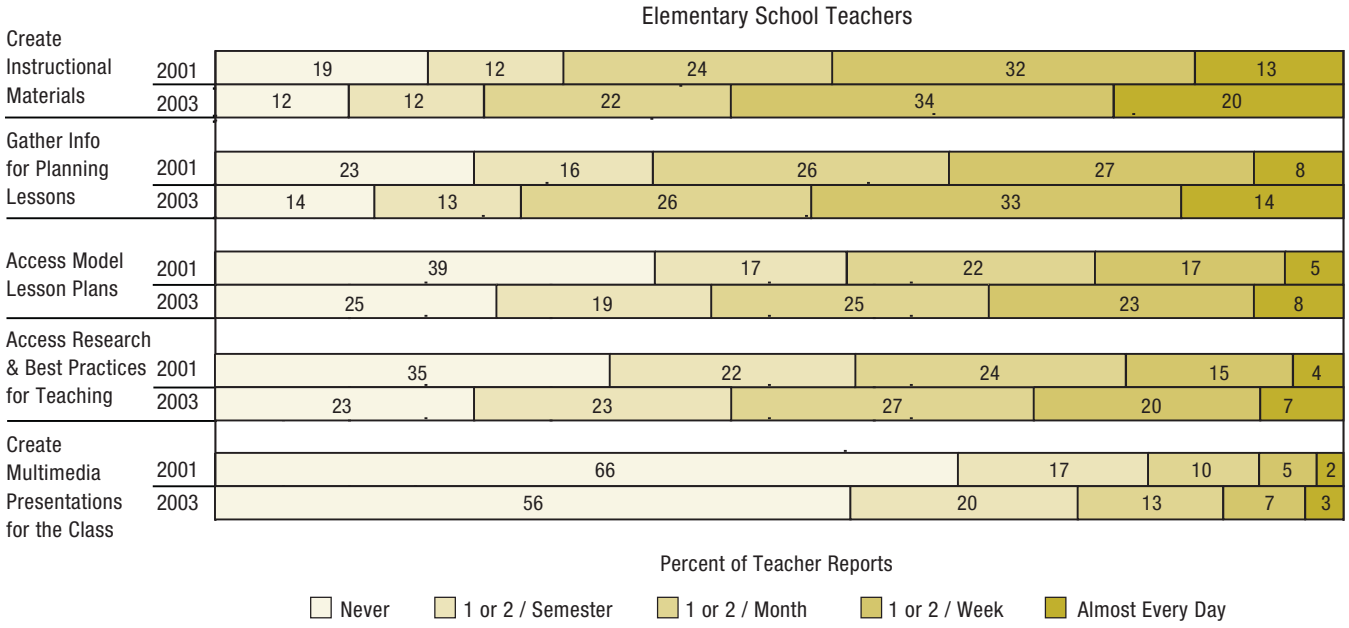
More Professional Use Does Not Translate into Technology-Rich Assignments

The 2002 report showed that teachers who used technology more in their own work were more likely to assign technology to their students. Thus, we might expect that the rise in computer use among teachers for their own professional tasks would result in more integration of technology into course assignments. However, teachers did not increase their assignment of technology to students at the same rate at which they increased their own use of technology. Instead, those increases were modest.

FIGURE 13

Teachers' Professional Use of Technology Increased

For each activity below, please indicate how often you use computers or the Internet to complete the following activity.



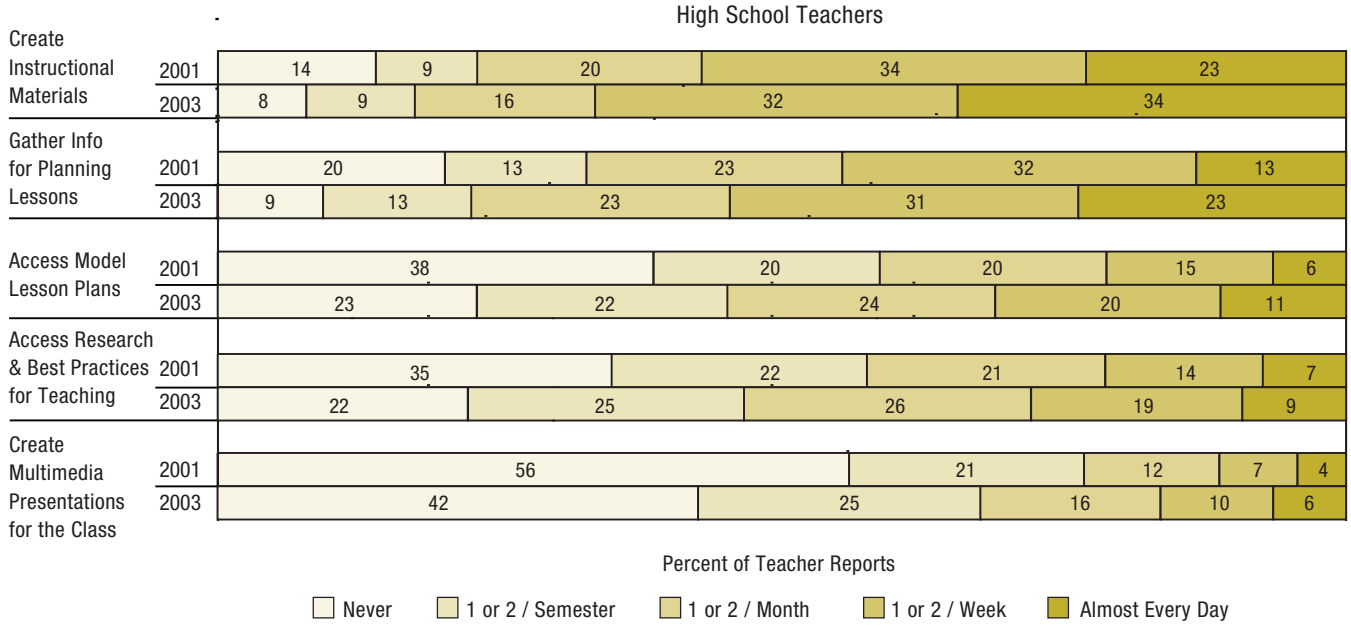
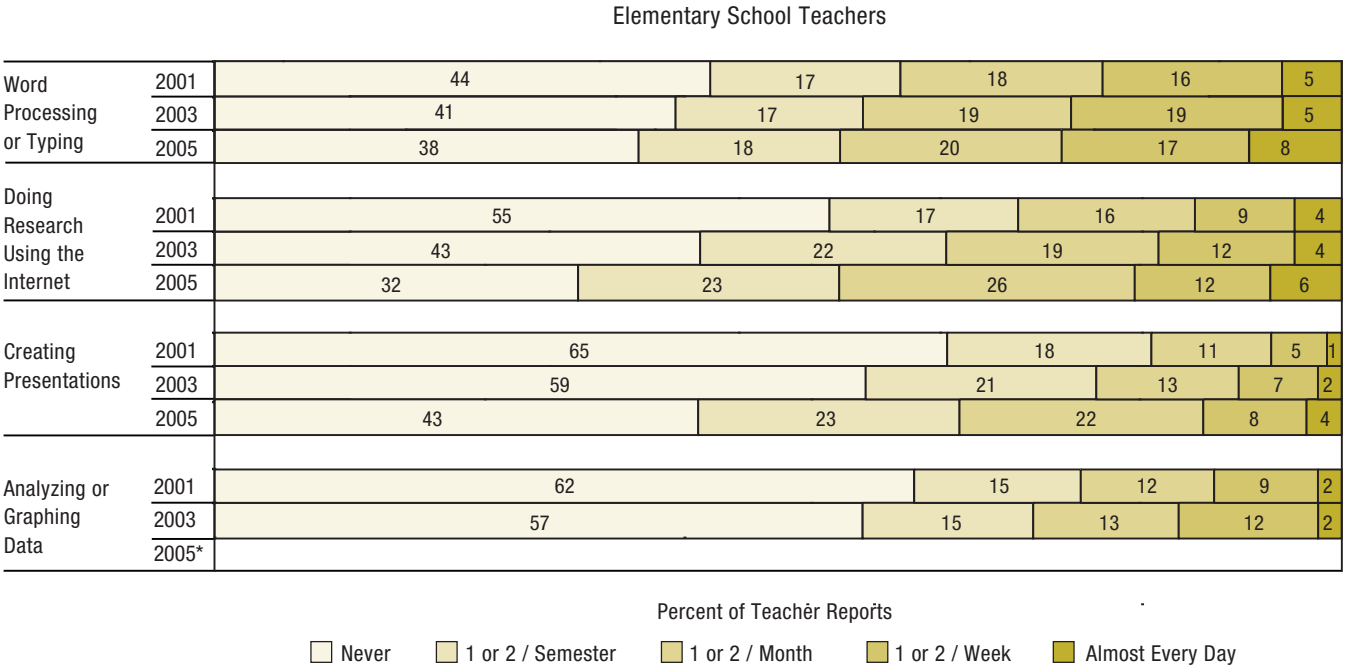
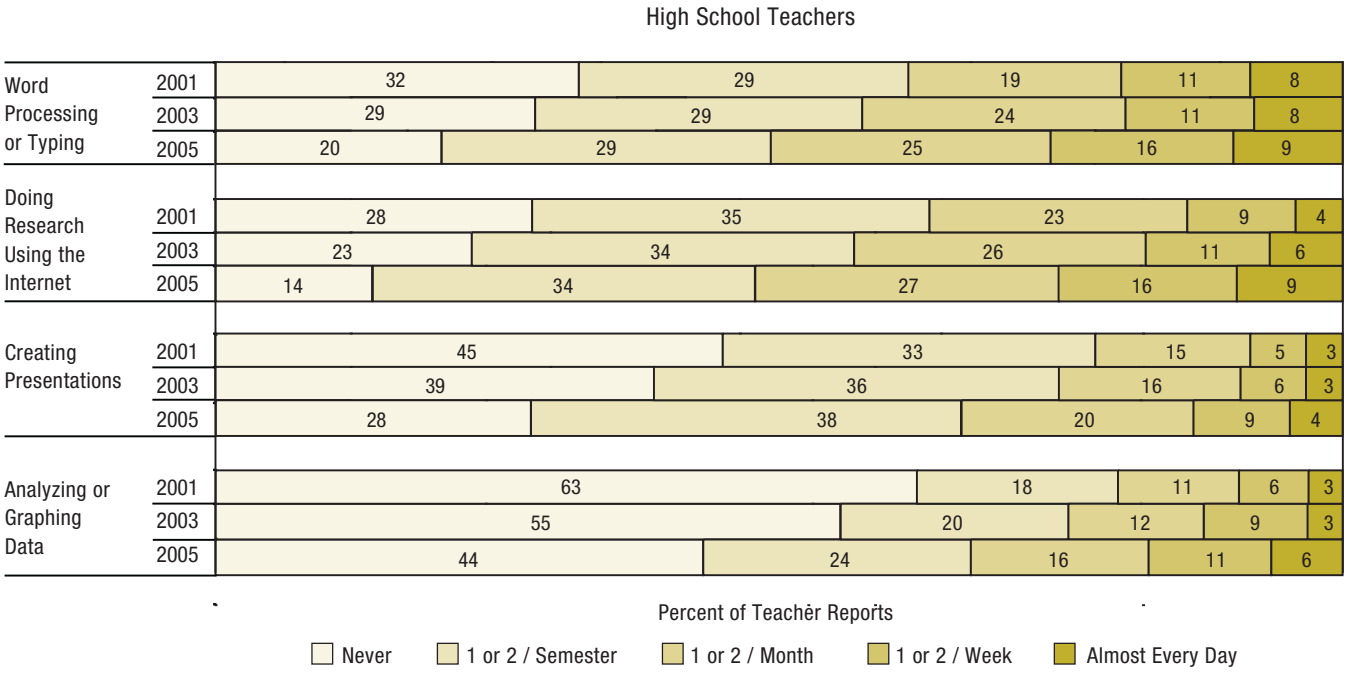


FIGURE 14A

Teachers' Assignment of Technology Increased

*Please indicate how often you ask the students in your TARGET CLASS to use computers in the following ways.**



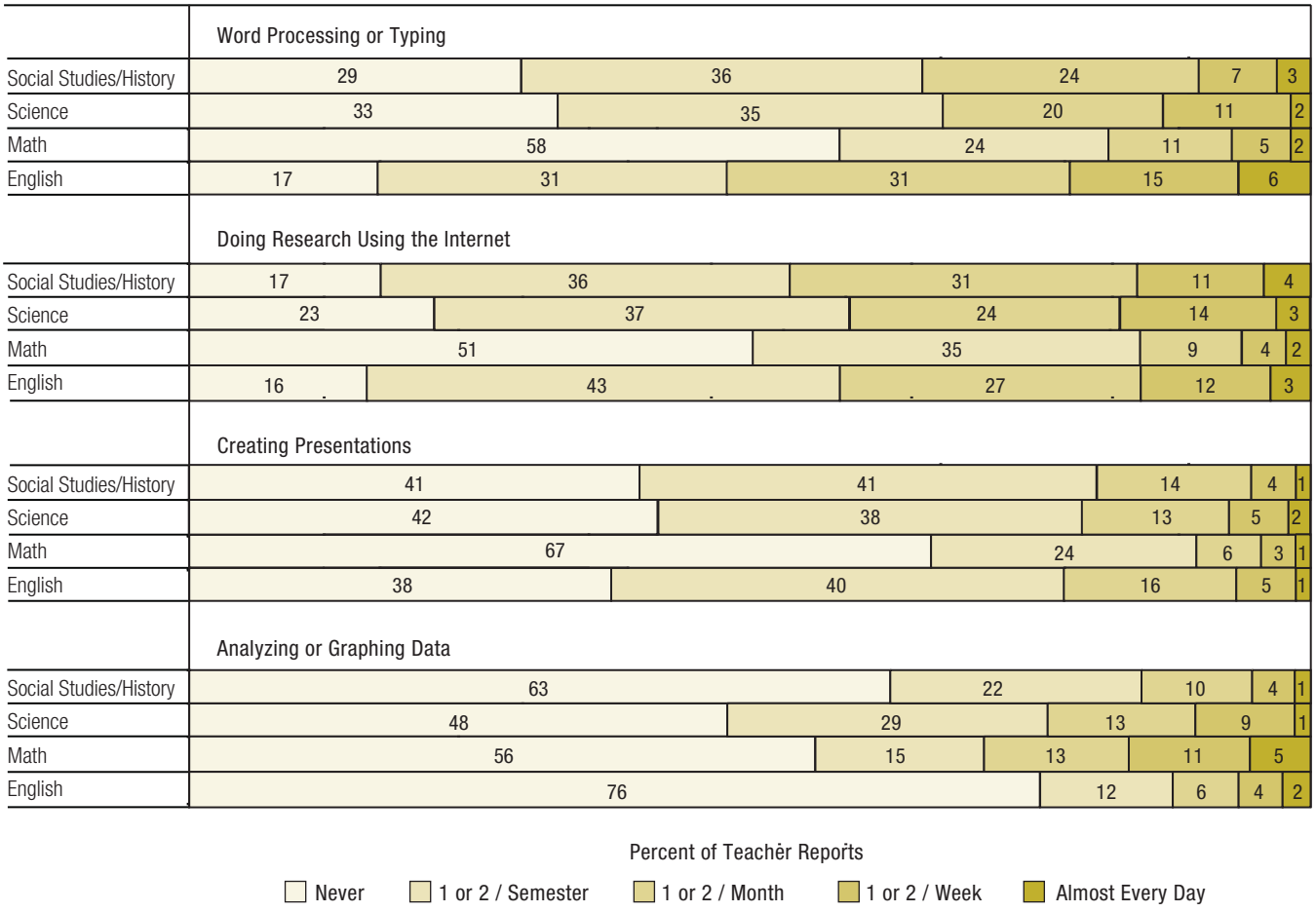


** NOTE: In 2005, among elementary school teachers, only teachers who taught reading or language arts were asked questions about teacher assignment of technology. Also, elementary school teachers were not asked whether they assigned students to analyze or graph data in 2005. In 2005, the wording of the question for high school teachers changed to: "In an average class, about how often do you ask students to use computers in the following ways?" In 2005, the response categories changed to "Never," "Once a Quarter," "Once or Twice a Month," "About Once a Week," "Several Times a Week," and "Almost Every Day." The "Once a Quarter" and "Once a Month" were collapsed into one category (Once or Twice a Semester).*

FIGURE 14B

High School Teachers' Assignment of Technology by Subject Taught in 2001

Please indicate how often you ask the students in your TARGET CLASS to use computers in the following ways.



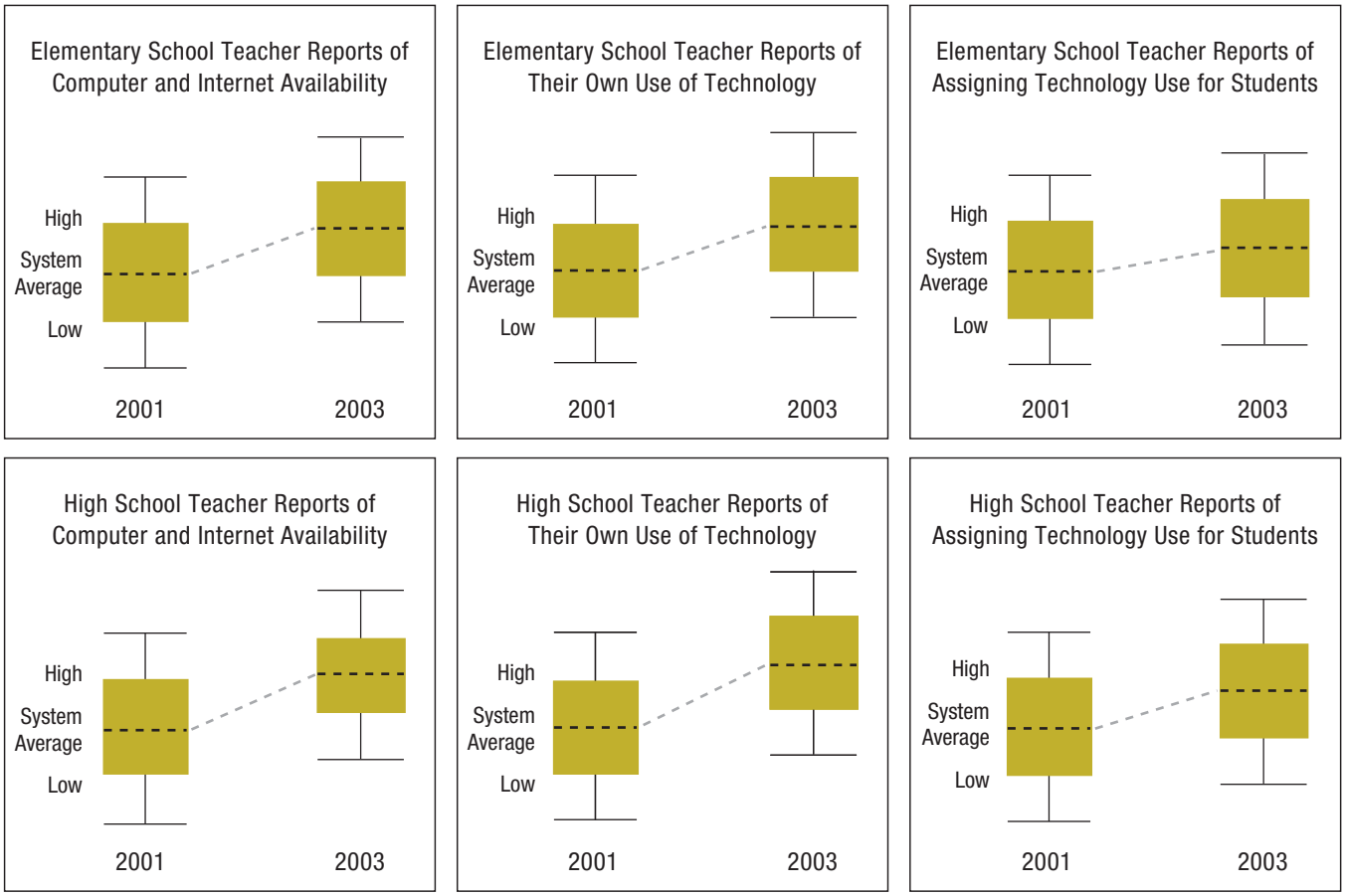
The most common computing activities that teachers assign their students are word processing and research on the Internet (see Figure 14A). About two-thirds of elementary school teachers and four-fifths of high school teachers expect their students to do at least occasional word processing, which is a modest increase since 2001. Most high school teachers have been assigning research on the Internet since 2001, but among elementary school teachers there was a substantial increase in the assignment of Internet research from 2001 to 2005. Still, less than half of teachers expect their students to do word processing or Internet research more than once or twice a semester. Other types of computer usage, such as creating presentations or graphing data, are even more infrequent.

We might expect that not all teachers would report assigning all types of tasks. For example, graphing data should be a common task in math assignments while word processing is more common in English classes. Yet, as shown in Figure 14B, more than half of the high school math and science teachers never assign their students to analyze or graph data with computers. It is uncommon for teachers of any subject to ask their students to do computing tasks more than once or twice a semester. This suggests that only a few teachers are regularly assigning tasks that require computer usage. Teachers' reports of what they are assigning their students to do closely mirror students' reports of what they are doing in their classes.

Figure 15 shows the general trends in computer availability, professional use, and assignment of technology among teachers from 2001 to 2003 using comparable metrics (standard deviations across schools). Notice that the slopes of the gray lines—representing change from 2001 to 2003—are steeper among high school

FIGURE 15

The Increase in Teacher Availability and Professional Use of Computers Surpassed the Assignment of Technology



teachers than among elementary school teachers. This is consistent with the manner in which laptops were distributed, which affected more high school teachers than elementary school teachers. These figures also show that computer integration into assignments for students rose more modestly than teacher access or their professional use of computers among both elementary and high school teachers—the slopes are much less steep for these measures.

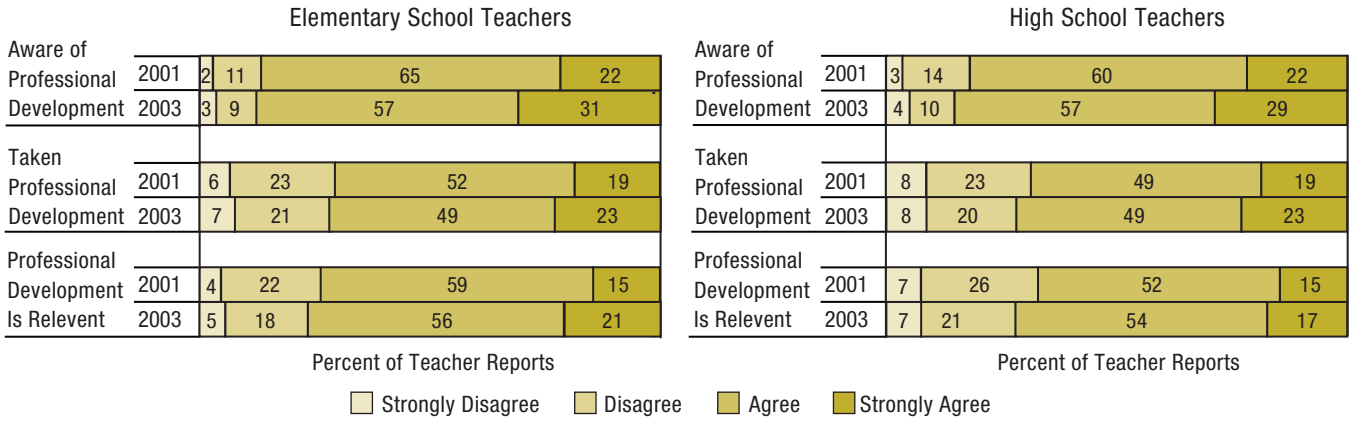
The 2001–02 technology initiatives seem to have been successful at providing access to technology to teachers for their own professional work, but incorporating technology into the classroom requires more than teachers' access to computers. Relevant professional development is one element that helps teachers incorporate technology. Improvements in access to technology should have encouraged more teachers to participate in professional development around technology, since they had greater capacity to use technology than before. But by 2003, only slightly more teachers were aware of and participating in professional development around the use of technology in classroom instruction than two years earlier (see Figure 16). Although there were large improvements in access to technology, particularly at the high school level, teachers' reports about participation in professional development about technology, and its relevance, did not improve to a great extent over these two years.

Another vital element for incorporating technology into class assignments is the degree to which students have access to computing technology; if students have limited access, it is difficult for teachers to expect them to use computers. As shown in the previous chapter, students' access to technology did not increase along with improvements in teachers' access to technology; this may also partially explain why computer integration into student assignments did not improve as much as teachers' use of computers for their own professional work.

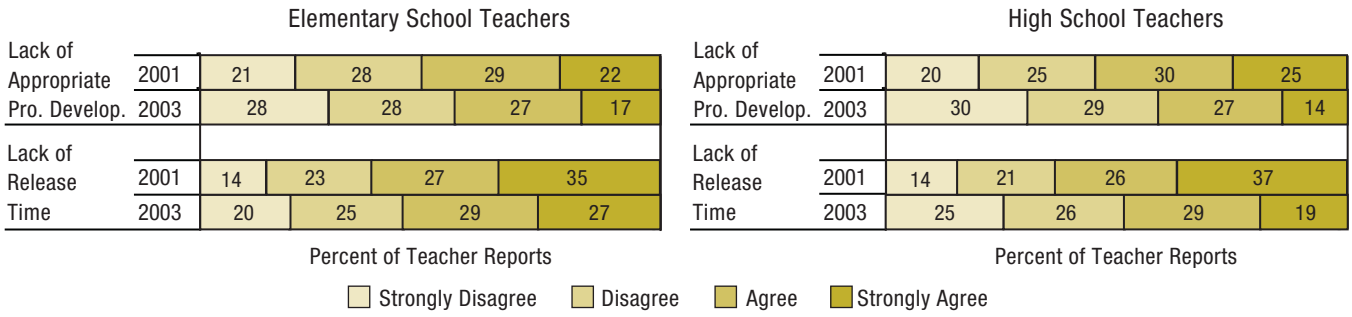
FIGURE 16

Professional Development Opportunities Slightly Increased

Please indicate to what extent you agree with the following statements:



Please indicate to what extent, if any, each of the following is a barrier to our use of school computers or the Internet for instruction.



Chapter 3 Endnotes

1 The analyses in this section include survey responses from all CPS teachers, pre-kindergarten through twelfth grade. This allows us to look at the general trends of all CPS teachers, as well keep our analyses consistent with the 2002 report.

2 In 2001, 89 percent of elementary school teachers and 95 percent of high school teachers had access to a computer somewhere in their school. In 2003, 93 percent of elementary school teachers and 97 percent of high school teachers had access to a computer somewhere in their school.

DELL

Chapter 4

Interpretive Summary

Most schools are no longer struggling with substantial hardware and wiring issues. Technology initiatives that began in the 2001–02 school year seem to have been successful at moving schools forward in their capacity for computing technology. Many areas that showed notable deficits in the 2002 report, such as exacerbation of the digital divide in high schools and little use of computers for basic administrative tasks, have improved considerably. Principals and teachers reported considerably more access to, and use of, technology from 2001 to 2003. However, improvements slowed from 2003 to 2005, and improvements were not seen to the same extent among students as among teachers and principals.

CPS schools made large strides in computer access and use among principals from 2001 to 2005. In just a few years, computers have become pervasive in the professional work of principals. Principals now use technology frequently to communicate with teachers, other principals, and the central office. Principals frequently do administrative record keeping on computers, and they are increasingly using computers to analyze students' performance data.

Principals reported fewer barriers to teachers' use of school computers or the Internet for instruction after 2001, particularly around networking and infrastructure issues. This is particularly good news because principals' perceptions of barriers in schools predict the degree to which teachers and students use technology. However, issues around hardware, infrastructure, and networking increased in high schools from 2003 to 2005. At the elementary school level, principals continued to report some improvements after 2003, but the improvements were much more modest than those seen

after 2001. At both the elementary and high school levels, principals reported increasing problems with the computers in their schools being in good working order after 2003—an indication that the hardware brought into the schools in 2001 was aging.

While concerns about infrastructure declined considerably, as of 2005 some schools still struggle with basic issues of computer access and many principals recognize other barriers to using technology in their schools. The number of computers available in schools continues to be a concern for about half the CPS principals—perhaps because more teachers are trying to use computers in their classes, thereby raising the demand. In addition, principals continue to report that there is insufficient release time or professional development for teachers around computing technology. There also seem to be continuing, and even growing, concerns that the central administration is not sufficiently supportive of technology integration in the schools.

Overall, students are using computers more at school than they were in 2001. However, there are two areas of some concern. For most students, computer use for schoolwork is still occasional. Technology is not regularly incorporated into their assignments. The next step for building students' computer skills is to integrate technology into students' everyday work, as it has been integrated into the everyday work of principals and teachers. The majority of students do not even regularly do basic computing tasks, such as word processing or Internet research. Many students are not gaining any experience using computers for graphing, data analysis, or creating presentations. This might partially indicate a need for professional development around technology for teachers, particularly as half of all principals believe the need for professional development is a barrier to technology use in their school. In addition, lack of access to computers at their school continues to be an issue for many students. While the 2001–03 initiatives greatly improved computer and Internet access for teachers and principals, students' access to computers at their school just kept pace with demand. Regular use of computers requires regular access. Teachers are unlikely to expect students to use computers if they are uncertain that students have sufficient access to technology.

In 2002, we were particularly concerned about students' use of computers at school because a large percentage of CPS students did not have access to a computer at home. Many more students now have computers at home than in 2001. However, this does not mean that it is no longer important that students have reliable access to computers at school. About half of students are seldom using computers at home for schoolwork, and about one-fifth of students never use computers at home for schoolwork. This indicates that many students may lack appropriate software, reliable and consistent access, or appropriate assignments. Schools that overwhelmingly serve low-income students, in particular, cannot rely on students' access to computers at home. While some people may view computer skills as supplementary to the core of instruction, these skills are important for issues of employability, preparation for college, and, increasingly, everyday life in the twenty-first century. It is a concern if CPS students fall behind students in other districts in their familiarity with computers and software programs.

CPS schools are helping to compensate for differences in students' access to computers at home to a greater extent than they were in 2001. Now students at schools primarily serving racial/ethnic minorities are using computers at school as much as or more than students at integrated schools. However, their use of computers is still infrequent, particularly given the pervasiveness of computers today. We hope that CPS initiatives launched since 2005 are helping to improve students' access to computers and the frequency of computer use among CPS students.[1] Moving forward, the 2005 data suggest three main areas of concern for technology integration: the degree to which students have ready access to networked computers, the degree to which teachers receive relevant professional development around regular integration of technology in their coursework, and the degree to which teachers incorporate a variety of technology assignments into students' everyday work.

Summary Endnotes

1 The high school transformation project, for example, has a substantial technology component. We expect that schools that are participating in the program would show increases in their students' computer skills.

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Appendix A:
Further Details on the Survey and Methods Used in the Analyses

Survey Participants

Information on teachers', students', and principals' use and perspectives of computing technology are drawn from surveys by the Consortium on Chicago School Research at the University of Chicago. Every two years, the CCSR surveys CPS students, teachers, and principals. From these CCSR surveys, we create measures of features of the schools, including the degree to which students, teachers, and principals have access to technology, use technology, and perceive barriers to technology in their schools.

Students

In 2001, we collected surveys from 59,662 elementary school students and 28,068 high school students in 364 elementary schools, 67 high schools, and 16 combination schools (combination schools serve some combination of elementary and high school grades).[1] In 2003, we collected surveys from 58,007 elementary school students and 27,573 high school students in 379 elementary schools, 57 high schools, and 16 combination schools. In 2005, we collected surveys from 66,185 elementary school students and 35,608 high school students in 412 elementary schools, 80 high schools, and 14 combination schools. In order to make the survey populations comparable across years for the item level analyses, we only examined students at schools that participated in 2001, 2003, and 2005 surveys.[2] After removing schools that did not participate in all three years so that the survey samples were comparable across years, 125,758 elementary school student surveys from 244 elementary schools and 68,701 high school student surveys from 45 schools were used in our analyses.

Teachers

In 2001, we collected surveys from 8,572 elementary school teachers and 2,642 high school teachers in 364 elementary schools, 67 high schools, and 16 combination schools. In 2003, we collected surveys from 8,963 elementary school teachers and 3,205 high school teachers in 379 elementary schools, 57 high schools, and 16 combination schools. In 2005, we collected surveys from 11,079 elementary school teachers and 4,142 high school teachers in 412 elementary schools, 80 high schools, and 14 combination schools. In order to make the survey populations comparable across years for the item level analyses, we only examined teachers at schools that participated in 2001, 2003, and 2005 surveys.[3] After removing schools that did not participate in all three years so that the survey samples were comparable across years, 16,604 elementary school teacher surveys from 187 schools and 7,028 high school teacher surveys from 40 schools were used in our analyses.

Principals

In 2001, we collected surveys from 282 elementary school principals, 39 high school principals, and 11 combination school principals. In 2003, we collected surveys from 267 elementary school principals, 39 high school principals, and 13 combination school principals. In 2005, we collected surveys from 325 elementary school principals, 51 high school principals, and 7 combination school principals. In order to make the survey populations comparable across years for the item level analyses, we only examined principals at schools that participated in 2001, 2003, and 2005 surveys. After removing principals who did not participate in all years so that the survey samples were comparable across years, 141 elementary school principal surveys, and 13 high school principal surveys, and 5 combination school principal surveys were used in our analyses. Combination school principals were recoded as high school principals.

Measures Used in Analyses

All measures were constructed using Rasch scaling methods. Some of the questions regarding technology in the 2001 survey were removed or altered in later survey years. As a result, some measures were not recreated or were revised in later years. Rasch construction allows us to make measures that are comparable across survey years and to determine whether the removal of specific items affects the meaning of the measure.

The individual reliabilities for the student and teacher measures that we present here are calculated from 2001 survey data. The school reliabilities for the student and teacher measures are from the 2001 elementary measure analyses. We did not find large differences in the school reliabilities across years or between elementary school and high school student and teacher measures. The individual reliabilities for the principal measures are from analysis of the 2005 survey data.

Students

Access to Computers

Measures the extent to which students report computer hardware is available to them. A high score indicates greater availability (individual reliability = 0.44; school reliability = 0.88).

How much do you agree with the following statements *[Strongly Disagree, Disagree, Agree, Strongly Agree]?*

- At school I can usually find an available computer to use for homework.
- My school has enough computers for students to use.

Students' Use of Technology

Measures the extent to which students report using a computer at school for various activities including practice drills, word processing, research on the Internet, and creating presentations. A high score indicates more frequent and diverse use of technology in school (individual reliability = 0.67; school reliability = 0.90).

This school year, how often do you use a computer AT SCHOOL for the following things *[Never, Once or Twice a Semester, Once or Twice a Month, Once or Twice a Week, Almost Every Day]?*

- Practice drills (for example, math problems, vocabulary, spelling)
- Analyze or graph data (in Excel, for example)
- Word processing or typing (in Word, for example)
- Create presentations (in PowerPoint, for example)
- Create web pages
- Computer programming
- Do research using the Internet
- Correspond with others via email or the Internet

NOTE: In the 2005 survey, the question wording changed to: "This school year, how often were you required to use a computer to do the following things?" The item bank also changed to: Type written assignments, use a program like Excel to analyze or graph data, use a program like PowerPoint to create a class presentation, and use Internet/online resources to locate information for class assignments. These changes prevented us from recreating this measure in 2005.

Students' Home Use of Technology

Measures students' availability and use of home computers (individual reliability = 0.65; school reliability = 0.53).

- Which of the following does your family have in your home?[4]
  A computer *[Yes, No]*
- Which of the following does your family have in your home?[5]
  Internet access *[Yes, No]*
- This school year, how often have you used a computer in the following places?
  At home *[Never, Once or Twice a Semester, Once or Twice a Month, Once or Twice a Week, Almost Every Day]*

NOTE: In the 2005 survey, we dropped the questions: "Do you have a computer at home?" and "Do you have Internet access at home?" Also, the third question in this measure was changed to: "This school year, how have you used a computer to complete CLASS ASSIGNMENTS in the following places?" These changes prevented us from recreating this measure in 2005.

Teachers

Availability of Technology

Measures the extent to which teachers are able to use technology hardware including computers, the Internet and email in their schools and classrooms. Higher scores indicate more extensive availability of technology for teachers (individual reliability = 0.36; school reliability = 0.88).

Are the following available to you; and, if yes, how often do you use them *[Never, Once or Twice a Semester, Once or Twice a Month, Once or Twice a Week, Daily or Almost Daily]?*

- Computer in your classroom
- Computer elsewhere in the school
- Internet in the classroom
- Internet elsewhere in the school
- Email in your classroom
- Email elsewhere in the school

NOTE: These questions were not asked of teachers on the 2005 survey. Therefore, we could not recreate this measure for 2005.

Teachers' Use of Technology

Measures the how frequently teachers use technology in their own work. Activities include creating instructional material, accessing model lesson plans, and creating multimedia presentations. A high score indicates more frequent and diverse use of technology (individual reliability = 0.80; school reliability = 0.53).

For each activity below, please indicate how often you use computers or the Internet to complete the activity *[Never, Once or Twice a Semester, Once or Twice a Month, Once or Twice a Week, Daily or Almost Daily]:*

- Create instructional materials (i.e., handouts, tests)
- Gather information for planning lessons
- Access model lesson plans
- Access research and best practices for teaching
- Access CPS Intranet
- Create multimedia presentations for the classroom

NOTE: These questions were not asked of teachers on the 2005 survey. Therefore, we could not recreate this measure for 2005.

Teachers' Assignment of Technology

Measures teachers' assessment of how frequently they include various uses of technology in their assignments. Activities include practice drills, word processing, creating presentations and research on the Internet. A high score indicates more frequent and diverse assignment of technology. (Individual reliability = 0.70; school reliability = 0.49)

For each activity below, please indicate how often you use computers or the Internet to complete the activity *[Never, Once or Twice a Semester, Once or Twice a Month, Once or Twice a Week, Daily or Almost Daily]:*

- Practice drills
- Analyze or graph data
- Do word processing or typing
- Create presentations
- Create web pages
- Computer programming
- Do research using the Internet
- Correspond with others via email or Internet
- Do demonstrations/simulations

NOTE: In 2005, the question wording on the elementary school teacher survey changed to: "Please indicate how often you ask the students in your TARGET CLASS to use computers in the following ways." The item bank was also changed to: Do word processing or typing, create presentations, and do research using the Internet. In 2005, the response categories changed to "Never," "Once a Quarter," "Once or Twice a Month," "About Once a Week," "Several Times a Week," and "Almost Every Day." The "Once a Quarter" and "Once a Month" were collapsed into one category (Once or Twice a Semester). Furthermore, the structure of the elementary survey changed such that only teachers who taught reading were asked to respond to this question. The question wording on the high school teacher survey changed to: "In an average class, about how often do you ask students to use computers in the following ways?" The item bank also changed to: do word processing or typing, create presentations, do research using the Internet, and analyze or graph data. We recreated this measure for 2005.

Professional Development for Technology

Measures the extent to which a teacher is aware of and participating in professional development regarding use of technology in the classroom. A high score indicates that a teacher has been able to find and take advantage of professional development opportunities in technology use (individual reliability = 0.79; school reliability = .62).

Please indicate to what extent you agree with the following statements *[Strongly Disagree, Disagree, Agree, Strongly Agree]:*

- I am aware of professional development that could enhance my ability to use computing technology in classroom instruction.
- I have taken professional development that enhances my ability to use computing technology in classroom instruction.
- The professional development available to me is relevant to how I believe computers should be used in the classroom.
- I have tried to take advantage of computing technology training, but was not able to do so because of circumstances outside of my control (access, cost, etc.).

Please indicate the extent, if any, each of the following is a barrier to your use of school computers or the Internet for instruction *[Not A Barrier, Small Barrier, Moderate Barrier, Great Barrier]:*

- Lack of release time to learn/practice/plan ways to use computers or the Internet.
- Lack of appropriate professional development on how to integrate computing technology into curriculum.

NOTE: These questions were dropped from the 2005 survey for elementary school teachers. For high school teachers, the item: "I am aware of professional development that could enhance my ability to use computing technology in classroom instruction" was dropped. For high school teachers, we recreated this measure for 2005.

Principals

Principals' Use of Technology

Measures the extent to which principals use technology for their own work. Activities include emailing teachers in the school, emailing people in the regional or central offices, emailing parents of students in school, emailing other principals, doing administrative record keeping, and analyzing school performance data. A high score indicates more frequent and diverse use of technology. (Individual reliability = 0.72)

For each activity, please indicate how often you use computers or the Internet either at home or at school to complete the activity *[Never, Once or Twice a Semester, Once or Twice a Month, Once or Twice a Week, Daily or Almost Daily]:*

- Email teachers in your school
- Email people in the regional or central office
- Email parents of the students at your school
- Email other principals
- Do administrative record keeping
- Analyze school performance data

Principals' Perceived Barriers to Teachers' Use of Technology for Instruction

Measures the extent to which principals perceive barriers to teachers' use of school computers or the Internet for instruction. Possible barriers include: computing technology not in good working order, not enough computers, infrastructure issues, Internet or networking issues, lack of release time for teachers to learn/practice/plan ways to use computers or the Internet, and lack of appropriate professional development on how to integrate computing technology into the curriculum (individual reliability = 0.71).

To what extent do you agree or disagree with the following statements *[Strongly Disagree, Disagree, Agree, Strongly Agree]?*

- The computing technology in my school is in good working order

Please indicate to what extent, if any, each of the following is a barrier to teachers' use of school computers or the Internet for instruction *[Not a Barrier, Small Barrier, Moderate Barrier, Great Barrier]:*

- Not enough computers
- Infrastructure issues (wiring, asbestos, etc.)
- Internet or networking issues (not enough Internet connections, incompatible networks, etc.)
- Lack of release time for teachers to learn/practice/plan ways to use computers or the Internet
- Lack of appropriate professional development on how to integrate computing technology into the curriculum

Appendix A Endnotes

1 School numbers represent the number of schools that participated either in the student or teacher survey or in both surveys.
2 Schools with fewer than ten students responding were considered not to have participated.
3 Schools with fewer than ten teachers responding were considered not to have participated.
4 In 2003, the question was changed to: "Do you have a computer at home?"
5 In 2003, the question was changed to: "Do you have Internet access at home?"

Appendix B:
Details of the System Trend Analyses

The trend analyses were designed to determine whether there were changes in measures of technology use and access from 2001 to 2003 or from 2001 to 2005. Analysis of each measure was run separately for elementary and high school students/teachers/principals, using three-level hierarchical linear models. The first level was a measurement model, which determined the most accurate estimation of each person's score on the technology measure, given their standard error on the measure. The standard error was determined through a Rasch analysis based on their response pattern to the items in the question. The second and third levels, which contained no predictors, simply served to properly estimate school averages.

Level-1 Model (Measurement Model)

$$Y = \pi_{1jk}*(WGT01) + \pi_{2jk}*(WGT03) + \pi_{3jk}*(WGT05) + \boldsymbol{e}_{ijk}$$

Level-2 Model (Student, Teacher, or Principal Model)

$$\pi_{1jk} = \beta_{10k} + \boldsymbol{r}_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + \boldsymbol{r}_{2jk}$$

$$\pi_{3jk} = \beta_{30k} + \boldsymbol{r}_{3jk}$$

Level-3 Model (School Model)

$$\beta_{10k} = \gamma_{100} + \boldsymbol{u}_{10k}$$

$$\beta_{20k} = \gamma_{200} + \boldsymbol{u}_{20k}$$

$$\beta_{30k} = \gamma_{300} + \boldsymbol{u}_{30k}$$

To discern whether there was a significant change in each measure from 2001 to 2003 or 2001 to 2005, a contrast was performed between the fixed effects representing the system average in each year, γ_{100} and γ_{200} or γ_{100} and γ_{300}, through a general linear hypothesis test with a chi-squared statistic. These analyses provided information for the system trend displays presented in Figures 2, 4, 14A, and 14B.

Details of the Equity Trend Analyses

The equity trend analyses were designed to determine whether particular types of schools, such as those serving mostly minority or low-income students, were different from other schools in the degree to which their students used technology in 2001 and 2003. Analysis of each measure was run separately for elementary and high school students using three-level hierarchical linear models. In each analysis, the first level was a measurement model. The second level was unconditional, while the third level compared schools with different demographic characteristics by entering dummy variables representing the type of students served by the school (their racial composition or percent low-income students). Models were run separately for each set of school characteristics (racial composition or percent low-income students) so as not to be confounded by collinearity.

Level-1 Model (Measurement Model)

$$Y = \pi_{1jk} * (WGT01) + \pi_{2jk} * (WGT03) + e_{ijk}$$

Level-2 Model (Student Model)

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

Level-3 Model (School Model)

Example is for percent low-income, school-level racial/ethnic characteristics were modeled in the same way.

$$\beta_{10k} = \gamma_{100} + \gamma_{101} (\text{high poverty}_k) + u_{10k}$$

$$\beta_{20k} = \gamma_{200} + \gamma_{201} (\text{high poverty}_k) + u_{20k}$$

These analyses provided information for the school-level equity displays presented in Figure 9 and 10. Each coefficient representing school type (e.g., predominantly Latino, integrated) provided information on the difference of each group from the comparison in each year.

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Vanessa Coca is a Research Analyst at the Consortium on Chicago School Research. She received her B.A. in public policy from the University of Chicago and her Master of Public Policy, with a concentration in education policy, from the Irving B. Harris School of Public Policy at the University of Chicago. Currently, she is involved in research on the transition to college of CPS students. She is an author of *Keeping New Teachers: A First Look at the Influences of Induction in the Chicago Public Schools* (2007); *Sample Individual School Reports: Results about Postsecondary Preparation* (2006); and *From High School to the Future: A First Look at Chicago Public School Graduates' College Enrollment, College Preparation, and Graduation from Four-Year Colleges* (2006).

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The Consortium on Chicago School Research (CCSR) at the University of Chicago conducts research of high technical quality that can inform and assess policy and practice in the Chicago Public Schools. We seek to expand communication among researchers, policy makers, and practitioners as we support the search for solutions to the problems of school reform. CCSR encourages the use of research in policy action and improvement of practice, but does not argue for particular policies or programs. Rather, we help to build capacity for school reform by identifying what matters for student success and school improvement, creating critical indicators to chart progress, and conducting theory-driven evaluation to identify how programs and policies are working.

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