Use of Computer Technology for Instruction in California Public Schools

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Abstract

This study examined the use of computer technology by students in public school. The uses of technology were divided between programmatic instruction and uses that built the students' computer literacy. Interviews and observations were conducted in 15 public schools representing a mix of elementary and secondary schools, serving different socioeconomic groups. It was found that computers across all schools were mostly used for programmatic instruction. More uses of building computer literacy were found in schools serving higher income students and in secondary schools. Such patterns are seen as likely to increase, rather than decrease the digital divide between low and high income students.

It is considered a truism that every educated person today should be literate in the use of computers. Almost everyone accepts that computers are an integral part of much of what we do in our daily lives, from shopping and planning travel arrangements to social networking and entertainment. Jobs for mathematics, the sciences, and even the arts usually require creative and skilled use of computer applications. Many claim that the recent presidential election campaign of Barack Obama was galvanized in part by the use of the internet. Educational policy groups argue that without advanced training in technology, the United States will fall behind other nations in global competitiveness (International Society for Technology in Education, 2007; U.S. Department of Education, nd.). This study looks at what our schools are doing to prepare students for this technological world.

As computers have become a common part of life outside of school, we also see a parallel increase in their presence in schools. In the early 1980s computers were just entering homes and schools. By 2005 over 95% of schools had internet access[1] According to the U.S. Department of Education, in 2003 83% of students were using computers in school, a jump from the 60% reported ten year earlier[2]. With such a huge shift over such a short time, one might ask what impact this has had on our educational system and on our students.

In considering what such a shift might mean for education, educational theorists interested in the topic have tended to predict one of two types of changes. One group has focused on the ability of the computer to empower students. The other group has focused on the power of the computer to effectively and efficiently deliver instruction.

Those of the first camp have claimed that computer technology would or should transform schools and education as we know it, bringing on new ways of teaching and learning

that were not possible in the past (Coppola, 2004; Dede, 2004; Papert, 1982). In particular, these theorists argued that computers made the traditional role of teachers as lecturers—the sage on the stage—obsolete. Computers give students access to almost any information anywhere in the world, replete with multimedia sources. Simulations allow students to engage in complex problem solving. Powerful programs put tools for creativity at students' fingertips. Constructivist, learner-centered teaching is based, in part, on being able to do real world authentic activities (Berger, 2003). Computer technology can bring the larger world into the classroom, and with Web 2.0 and Web 3.0 applications, students can share their ideas and creations with the larger world outside of the classroom in an interactive manner. With the use of such computers, teachers can and should now play more the role of guide, coach and facilitator. Some even argue that having computer technology in the classroom would inevitably lead to this revolutionary outcome (Cuban, 2001).

Another view has been that computers would or should transform schools, not by changing our basic paradigm of learning and instruction, but as a more effective and efficient way to deliver instruction, or at least as a strong supplemental aspect to the curriculum (Cruthirds & Hanna, 1997). The idea of using technology for programmatic instruction goes back at least to the 1960s. According this view, the promise of programmatic instruction is now possible with the powerful computers of today. Computers can now be programmed to assess the individual learner, and tailor the instructional pace and problem presented to that student. No longer will each teacher need to be the expert in instructional techniques, since it will be programmed into the computer. Once we have identified the steps, any skill can be taught most efficiently and effectively this way. While this approach could significantly alter the teachers role as deliverer of instruction or information, it does not substantially alter the role of the student.

As of yet, there is not much evidence of either of these becoming realities. There are lots of individual examples of teachers using computers in creative ways that do speak to the claim of a more constructivist paradigm (see for example Coppolla, 2004). On the other hand, these appear to be the exceptions that prove the rule (Cuban, 2001). While there is some evidence that many schools are using computers in ways that match the programmatic instructional idea—that is for teaching basic skills, there is of yet little evidence that it has improved learning beyond small scale examples (Cuban, 1993, 2006; Dynarski, 2007; Halverson & Smith, 2009).

Another issue that has concerned many in terms of technology use is the digital divide. Not surprisingly, those with more money and resources, and those of higher socio-economic-status, are more likely to have computers at home, and use them more powerfully (Snyder, Dillow, & Hoffman, 2007). Potentially public schools could be the place where those with fewer resources could get that access. However, often resources at schools mirror the resources of those in the community. Therefore schools, rather than leveling the playing field for disadvantaged students, may exacerbate those differences (Gorski, 2007; Kozol, 1991).

This study examined 15 public schools to examine what direction computer use has taken in terms of either building the students' computer literacy or as tools of delivering content. Further, we examined whether the schools in the this study demonstrated equity across socio-economic groups or whether they reflected the digital divide found outside of schools. Our research examined how these 15 schools in the greater Monterey Bay Area made use of computer technology for instructional purposes. We answered these questions through observing the use of technology in schools, and interviewing teachers in these schools. We have attempted to answer the following questions through our investigation:

- For what purposes do the students use the computer technology at the schools?
- In regards to the above question, what differences do we see among schools? Do socio-economic factors correlate with those differences? Is the age level of students a factor?

Framework for Classifying Computer Use

For the purposes of this research we divided computer use by students in two basic categories, aligning to some degree with the two basic directions outlined in the section above. Halverson and Smith (2009) used the phrases "technologies for *learners* and technologies for *learning* [italics in original]" (p.6). The first category is where students are using computers in ways that are likely to build their computer literacy skills. As a definition of computer literacy, we borrowed the framework developed by the International Society for Technology Standards (ISTE, 2007). In this framework for computer literacy, the ISTE developed six areas or types of uses that comprise full computer literacy: Creativity and Innovation; Communication and Collaboration; Research and Information Fluency; Critical Thinking, Problem Solving and Decision Making; Digital Citizenship; and Technology Operations and Concepts. These uses are more closely aligned with those that advocate for computers being used to transform education

into a more student centered approach.

The other category we referred to as Computer Aided Instruction (CAI). This mapped more closely with the programmatic instruction vision of computers in education. In these cases computers are used for skill building and directly teaching content. Examples of this type of use would be programs designed to reinforce or build reading skills, or practice math problems. We also included in this category programs that were used to track student progress or assess students. Accelerated Reader is such a program, where the computer is mostly used as a tool to assess the students' reading skill level, and track what they are reading.

Methods

In order to study this question of student computer use, we employed a qualitative design utilizing ethnographic methods. Interviews and observations took place in 15 schools over a tri-county area in the central coast region of California. Eight were elementary schools, four serving largely low-income students[3], and the other four serving more middle to high-income students. Three were middle schools, split between one serving low-income students and two serving middle to high-income students. Four were high school, two serving low-, and two serving mid- to high-income students. The schools were selected based on a convenience sample. These were the schools at which the research team worked. While not a random sample, these schools do offer a fairly representative sample of public schools in terms of grade levels served of the different socio-economic levels of the student bodies, allowing for a reasonable comparison.

Table 1: Schools Studied

	Elementary	Middle	High	Total
Low SES	4	1	2	7
Mid-High SES	4	2	2	8
Total	8	3	4	15

The research team consisted of students enrolled in a Masters of Education course on Qualitative Research Methods, with the course instructor acting as lead investigator and author of this paper. These students were also working teachers and educators. To gather this information each member of the research team conducted an observation and interview at one school site, usually the one at which they worked. Each member of the team engaged in an approximately 45 minute observation of technology being used by students for instruction

purposes at one of the school sites, looking specifically at which of the categories the use met, and if it met ISTE standards, which of those it met. Each member of the team interviewed a key person at the school site to ask questions about how they saw technology being used by the students in the school, and their perceptions of the effectiveness of this use, again specifically probing to see the ways computers were being used for each of these purposes.

Findings

This study did find that computers were used differently based on the socio-economic make up of the student body, and based on the grade level of students served. There did not appear to be any consistent factor related to quantity or quality of hardware available to students. However, schools serving predominantly middle- and high-income students were more likely to have well-trained computer technicians and teachers to help make the computers more useful. Schools that served low-income students mostly used computers for computer-aided instruction and as an assessment tool. Schools serving middle- and high-income students were more likely to spend some time using computers in ways that build computer literacy skills. However, in none of the cases did the schools meet the ISTE standard at more than a minimal level. It was also found that high school students were more likely to use computers in ways that built their computer literacy skills than elementary students.

Uses for computer-aided instruction (CAI) highly outnumbered uses that might build computer literacy. The most common use of computers overall was the Accelerated Reading program, with the large majority of schools studied using this program. Other skill building programs, such as Reader Rabbit in primary grades, and Excel Math were common in elementary schools. In the middle schools studied, some skill building programs still continued to be used. By high school such uses appeared to be uncommon. Commonly, computers were used for word processing and internet searches for research papers.

Schools Serving Low-SES v Schools Serving High SES Students

The data suggest that at least for the elementary students, schools serving low-income students use the computers mostly for CAI, due to pressures of the standardized testing. Most of these schools are Program Improvement schools under the No Child Left Behind Act. As such, boosting standardized test scores is the top priority. Such schools are then likely to use the

computers as a tool to boost these test scores, and therefore use programs that are promoted and designed specifically for that purpose. “They use it for intervention software,” typifies the uses we saw. Explanations for such uses were “ELD students … need help with reading and phonics, comprehension, some of that kind of stuff.” The behaviorist philosophy of such program use is explained by this quote, “What I find the main benefit, for at least the programs we use, is that there is immediate response, positive and negative, as in if you get the wrong answer… immediate response and a lot of positive reinforcement when they do well on the computer.” There were some instances of using computers for creative purposes in schools serving low-income students. One elementary teacher had received a grant that allowed her to buy digital cameras. Three teachers mentioned students being able to use drawing programs. Many of the schools mentioned students using the web for research, or doing so with the students.

Elementary schools serving middle- and high-income students, not being under those same pressures to raise test scores, may feel the freedom to use computers in more creative ways. Still, several of the schools did use their computers for Accelerated Reading. There were also several references to their use for reading and math skill programs. Some, not many, more creative uses were found in such schools. One school mentioned how as early as kindergarten the students are using the computers for projects. At another school the interviewee mentioned how they integrated computers into whatever they are studying. On the more creative side, one school mentioned the use of CAD programs, building virtual worlds and editing films.

The differences between the schools serving low and high income students were still there at the high school level, but these differences were less dramatic. Again research was a common use. Explicit teaching of the use of computers seemed slightly more likely in the schools serving low-income students (as was the case in 2 of the 3 schools serving lower-income students). In one of these schools it computer technology appeared consist mainly of taking the technology class geared toward teaching the Microsoft Office Suite programs. In that school it appeared that technology was used most creatively by the art students, research being the only other use mentioned. One of the high schools serving higher-income students only mentioned technology literacy type uses in regards to having a business technology class focused on Microsoft Office suite programs. The others mentioned a variety of creative uses, often initiated by the students themselves, such as music, simulations, photo imaging, and graphic design. In

one of these schools the teacher mentioned that often the students were ahead of her in terms of knowing how to use these programs.

We couldn't distinguish any differences in student to computer ratio, quality of computers or amount of use based on grade level or socioeconomic status from our limited data. However, schools serving lower-income students appeared to be less likely to have highly trained or certified teachers to run the computer labs, and more likely to have untrained classroom aides or other uncertified personnel in these positions. This quote from one technology person at a high schools serving low-income students illustrates this. "My job description is making sure that network and the equipment are running and the administrative reports are filled out and improving instruction using technology. Unfortunately, [the] improving instruction part is not done." On the other hand, at a k-8 school serving high-income students the interviewee described the technology support this way, "I think that's been a huge change in the curriculum, just having a passionate, highly skilled teacher in charge [of the computer lab]." Most schools felt they could use more and better technology support regardless of the age level or socio-economic group being served.

As has been found by other researchers, low-income students often have instruction that is geared to low-level basic skills, while middle- and high-income students are more likely to receive instruction that asks them to think creatively and critically (Finn, 1999). This was particularly apparent at the elementary level, and to a smaller degree at the middle/high school level. The types of computer use we found mirror those previous findings of overall content instruction. However, while it was clear that the schools serving middle- to high-income students did have more opportunities to use them for building computer literacy, both groups were often using them for skill building, assessment and programmatic instruction.

Elementary v Middle/High School Student Use

In regards to elementary versus high school student use, the findings suggest that more high school students were already likely to have basic computer literacy skills, allowing teachers to assign more creative projects without having to spend much time teaching how to use the technology itself, especially among middle- and high-income student bodies.

Virtually all of the elementary schools reported using the computers for some sort of CAI. As mentioned before, the reading assessment program Accelerated Reader was most often

cited. Next most often reported were reading programs designed for intervention or practicing skills, mostly for the early grades. One school mentioned using a program specifically designed for English language learners. Math skill programs were also frequently mentioned.

Both of the of the middle schools serving low-income students mentioned some use computers for CAI, though one of those sites mentioned that such use "had mixed success." Outside of Accelerated Reader, we did not hear much about such use at the high school level.

All of the elementary schools mentioned some use of the computers in ways that met at least one of the ISTE standards. In terms of the younger grades, five mentioned teaching keyboarding; six mentioned using Kidpix or other drawing programs. Four mentioned using computers for research, as in browser searches, mostly referring to upper grades. However, using it for research was usually in the context of availability of the individual student. It did not appear that the students were actually instructed in how to do so in any organized fashion. Several also mentioned using the computers for word processing. In one of the schools serving low-income students, the only creative use mentioned was by the teacher who had the grant to buy digital cameras.

In regards to the high schools, two schools (one serving low and one serving high SES students) mentioned having a specific technology class focusing on business type applications such as those in the Microsoft Office suite. Most of the schools mentioned having the students doing research, though in only two of the cases did the interviewees make it clear that students were getting guidance on how to do so. In one of the schools serving low-income students it did appear that students were using the computers in ways that built literacy, from music to writing to research to creating presentations, and allowed for creative uses. One of the other schools serving lower-income students mentioned the art students using a drawing and illustration programs. Two of the schools serving high-income students mentioned a wide variety of creative uses that the students put them to. However, in both cases is sounded as if often the students knew more than the teacher about these uses. The teacher created opportunities for the students to use those technology skills, rather than actually instructing the students in such uses.

Digital Citizenship

We found only two example of explicitly teaching digital citizenship. All but one school handled the issue through district or school filters and monitoring students. Some mentioned that

it was a problem, and that the more technologically capable students could often find ways around the filters. Rather than teaching digital citizenship, most schools attempted to police it. In some cases this actually may have led to teaching the reverse, as it seems to have encouraged some students to become adept hackers through the allure of the forbidden.

Discussion

The findings from this study must, of course, be taken as only tentative, given both the sample size and the limited basis of the data. Mostly the finding appear to confirm past studies on the issue of the digital divide. That is, low-income students are less likely to be using computers in powerful ways that build their computer literacy than high-income students. While all students were often using them for computer aided instruction and assessment, high-income students had somewhat more opportunities to use them in creative ways. There appear to be two main factors for this at the elementary level. One is the focus on test preparation which centers on rote skills in literacy and mathematics for schools that are program improvement schools under NCLB. All of the schools serving the low-income students were such schools. A second factor was that such schools were less likely to have high quality technology support or technology teachers. Without ongoing technical support, it can be hard to rely on the technology. Without highly trained personnel, the classroom teachers may not be up to the task of knowing how to use the computers in creative integrated ways, or the technology may often be inoperable.

At the elementary level, it was clear that teachers did want to give students opportunities to use computers in creative powerful ways. However time and technical resources limited their chances to do so. There were attempts to get students to know how to keyboard, and at least play with the computers to draw and write, and for upper graders do some basic web searches.

We saw a dropping off of computer aided instruction use for the high school students, and more of a focus on actually using them as tools for productivity, learning and creativity. Again there was slightly more opportunity for this, especially on the creative side for the higher-income students. How much was due to what is expected of students is hard to know. Some educational theories suggest that schools for high-income students are geared to prepare them to be creative and critical, while those serving low-income students train them to be productive workers (Finn, 1999). This research could be seen as somewhat supporting such a theory, though not strongly. The fact that many high-income students came to school knowing how to use

powerful programs for creative purposes probably made it easier for the teachers at these schools to integrate such uses into their assignments. They were also more likely to be able to assume that the students could work on these projects at home, and not have to rely on access to school computers.

Implications

This study suggests that if we want to create equity for students from all backgrounds we need to rethink what opportunities we provide for low-income students to use computers in ways that prepare them to be able to use them in as powerful ways as their more well-to-do peers.

Given that high SES students tend to have more opportunities and access to powerful technology at home, and that high SES students also have more opportunities to use computers in ways that build computer literacy, current school practices are likely to exacerbate rather than mediate the digital divide between low and high SES students.

To change such practices a serious reconsideration of what it would take to really bridge the gap needs to be undertaken. Such an examination is unlikely at most schools serving low-income students, given the pressures on district administrators, principals, teachers on down to students, to raise short-term standardized test scores. With such pressures almost everything else becomes at best secondary, if considered at all. Such pressures are only increasing under the current Federal policies.

It would also take an enormous input of resources. The real cost of having enough up-to-date computers, the software to use them well, the personnel to keep them running, and the professional development so that teachers would know how to use them effectively certainly does not exist in these times of economic crisis and education budgets cut to the bone. However, by most estimates, even in the best of times few schools could afford the real costs that such a commitment would take, especially over the long haul (Armstrong & Casement, 2000; Dede, 2004). It would take massive sate and possibly Federal reallocation and reprioritization of resources to make such a change feasible.

These are real difficulties that all of us who are committed to equity face. Those of us who do work with low-income students are therefore forced to think of creative ways to overcome these difficulties. While it is true that all students need to learn to read and do basic arithmetic, it is not true that for some students this should be done at the expense of learning

other things, including to be powerful users of technology. The brains of poor kids do not learn and function differently than those of rich children. Therefore, they do not need to be taught in fundamentally different ways. Without being prepared with equal technological skills, this lack will be just one more division and barrier when these students leave school, leaving them less prepared not just for the world of work, but the world of social empowerment, and access to information to improve their lives and make informed decisions.

Even without a change in resources, it is possible to use those limited resources differently. As the data showed, the difference in resources in the schools between types of schools was minimal. The real differences was in how they were used. These differences underscored an implicit or hidden curriculum (Giroux, 1988). The use of computers as programmatic instruction treats students as passive recipients of knowledge and instruction whose job is to input the correct answer. The uses that the ISTE standards promote ask students to be active participants in their own learning, using computers as a tool to create and convey knowledge. When these uses are promoted differently, for different types of students (which may coincide with the non-computer based instruction they are receiving), students come to view learning and the purpose of school in fundamentally different ways.

The argument for the need for this different instruction is, as mentioned earlier, the need to raise test scores. However, many schools have been effective using constructivist approaches to learning effectively with low- and high income students alike (see for example (Bensman, 2000; Berger, 2003). When students are asked to, and helped to use their minds, they not only do better on standardized tests of knowledge in the short term, but develop the abilities necessary to succeed in many arenas, in and out of school.

Endnotes

1. From the U.S. Department of Education's National Center for Educational Statistics http://nces.ed.gov/programs/digest/d07/ch_7.asp.
2. This is the most recent year for which they collected this data. http://nces.ed.gov/programs/digest/d08/tables/dt08_431.asp?referrer=list
3. Low-income was defined as over two-thirds of the students being eligible for free or reduced lunch

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