Home computing, school engagement and academic achievement of low-income adolescents

Findings from Year One of a Three Year Study of the CFY intervention

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This study examines the relationship between specific home computing practices and low-income adolescents' school engagement and achievement. We surveyed 174 middle school students who participated in the Computers for Youth (CFY) program. More than 90% were Black or Hispanic, and a majority performed below grade level on reading and math standardized tests prior to receiving CFY's intervention. We found that the students actively and regularly used their home computers and the Internet for learning and that their computer use was associated with increased success in school. Students' engagement and home computer use, particularly their home Internet use and computer use for self-regulated learning, explained 14% of the variance in their 2006 math test scores over and above 2005 scores.

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Introduction

This research explores whether specific types of home computing are associated with improved academic achievement and test scores for low-income youth. Our study counter-poses recent, highly-publicized research that found that educational software used *in the classroom* led to no change in students' test scores (IES, 2007).

We hypothesized that certain home computing practices would be associated with greater academic engagement and academic achievement because in the home, computer use is not only less restricted than computer use at schools, but it also has a unique socio-motivational component.

We focus on the period of early adolescence because these years are known to present crucial stumbling blocks for children's long-term academic success. During these years, children begin to withdraw from academics and demand more autonomy from their families. Parents (particularly low-income parents) also start to feel less capable of helping their children with increasingly complex homework assignments. These changes are reflected in trends in academic performance. Research reports that academic performance declines more sharply between elementary and middle school than at other times (Herszenhorn, 2006).

Our research provides new thinking around the constructs used to characterize and measure students' academic computing at home. This knowledge should improve future studies in this area and aid practitioners in strengthening their interventions.

Theoretical Framework

The home learning environment and children's learning

The term *home learning environment* refers to material, informational, social, and psychological resources that are provided to children at home which, in turn, help them succeed in school (Bradley, Corwyn, McAdoo, and Coll, 2001). Books, television programming, software, web content, and home tutoring are typically included in the conceptualization of material and informational resources. Social and psychological resources include parents' values regarding education, their academic expectations for their children, and their encouragement of learning.

A rich and supportive home learning environment helps children succeed in school. (Bradley et al., 2001; Jordan, Snow, and Porche, 2000; Hoover-Dempsey and Sandler, 1997). Children whose families are actively involved in their learning have more positive attitudes towards school, do better in school, and are more engaged in learning (Eccles and Harold, 1996; Connell, Halpert-Felsher, Clifford, Crichlow, and Usinger, 1995). In fact, parenting practices can account for as much as 25% of the achievement differences between higher- and lower-performing students (Rosenzweig, 2001).

The home learning environment of low-income families differs considerably from more affluent families. On average, the homes of poor children have fewer cognitively stimulating materials, (Bradley and Corwyn, 2002), and low-income parents converse much less with their children than do middle-income parents (Bradley et al., 2001).

For children living in poverty, Guo and Harris (2000) found that the quantity of cognitively stimulating materials in the home strongly predicted the intellectual development. Moreover, Rosenzweig (2001) showed that positive parenting strategies have a greater impact on the academic achievement of students of low SES than on students of middle- and high- SES.

Self-directed computing and students' success in school

Much research has documented the positive impact of home computing on children's engagement with school and homework

(Marshall, 2002; Pew Internet and American Life Project, 2001; Honey and Henriquez, 1997). For example, Reaux et al. (1998) reported that among the most dramatic effects of Virginia's PCs for Families project were increases in students' self-esteem, motivation, interest, and improved study habits. Similarly, CFY's existing research has shown that home computing activities boost students' academic engagement, consistently increasing their self-reported levels of confidence, interest and effort (Tsikalas and Huerta, 2006; Tsikalas, 2005).

Research has also indicated that home computing can impact academic achievement. Jackson, von Eye, and Biocca (2003) found that, among low-income African-American adolescents, greater Internet use at home was significantly associated with better performance on standardized reading tests. Wenglinsky (2005) found a positive association between the amount of time 12th graders used computers outside of school for generic academic tasks and their NAEP history assessment scores.

Student engagement and academic achievement

Research studies have demonstrated a strong relationship between academic achievement and academic engagement. For example, Campbell, Voelkl, and Donahue (1997) demonstrated the striking impact of engagement on reading achievement using *National Assessment of Educational Progress* (NAEP) 1996 student data of three age groups. They found that the national sample of 13-year-old students with higher engagement performed better on reading achievement tests than 17-year-old students with lower engagement. Similarly, engaged students from low-income families scored higher on reading tests than less-engaged students from high-income families (Guthrie and Wigfield, 2000). This latter result indicates that increasing engagement may be one way to close the achievement gap between low- and high-income students.

Methods

The study reported in this paper is based on data collected in Year 1 of a three year study on the Computers for Youth (CFY) program.

Participants. A sample of 174 sixth- and seventh-grade students was drawn from approximately 2,000 students in CFY's program. Students attended five public middle schools in New York City (NYC). Sixty-four percent were sixth graders and 36% were seventh graders. Of the students, 89% were eligible for free- or reduced-priced lunches, 70% were Latino and 29% were African-American; and 43% were female. Prior to CFY's intervention, a majority of students scored below grade level on standardized tests of math and reading.

Intervention. All students in the study received a CFY computer-based home learning center consisting of:

- A high-quality, refurbished desktop computer.
- Engaging educational software in math, science, social studies and reading/writing.
- StarOffice (similar to Microsoft Office).
- Internet access provided at a reduced rate (8 hours free and then $9.95/mo).

All students were also required to attend a family learning workshop with at least one adult from their family. At this workshop, they were taught how to set up the computer and use its software to support learning.

Measures. Based on CFY's model of impact, five primary factors were included in these analyses:

- ***System use:*** Twelve items measuring the frequency and nature of home computer and Internet use.
- ***Students' use of home computers for self-regulated learning*:** Five items measuring how students use home computers to seek help and study more effectively (Reliability $\alpha = 0.71$).

- ***Family computing:*** Eight items measuring the extent to which students' families draw together around computing activities (Reliability $\alpha = 0.83$).
- ***Students' perceived computer impact:*** Six items measuring how students perceive the impact of home computer use (Reliability $\alpha = 0.84$).
- ***Student Engagement:*** Eight items measuring student effort and independent learning (Reliability $\alpha = 0.76$).

Data collection. Parental consent was obtained for all participants, and a survey was administered, three to six months after they received the CFY intervention. About one-third of students were also informally interviewed about their survey responses.

Individual-level data on demographics and standardized test scores were acquired from the NYC Department of Education for the year prior to (2005), and following (2006), the CFY intervention. Because NYC changed its tests considerably between these two years, we were not able to use change scores. Instead, we included 2005 scores as covariates in relevant statistical analyses.

Results

System use. Nearly 90% of students indicated that their home computer was working at the time of the survey (n=151). Of these students, 78% said they used the computer at least a few days a week, and 59% said the same about home Internet use. Thirty percent never used the Internet at home. There were no significant differences in computer use based on gender or prior-performance levels in reading and math.

Students' use of home computers for self-regulated learning (SRL). Students indicated that they used their home computers for SRL. Fifty-four percent indicated that they used their home computer "often" or "very often" to get homework help, and 36% said the same for practicing or improving their math skills. Prior reading levels were positively and significantly associated with use of computers for SRL, $F(3)= 2.946$, $p=.036$. Students' remarks about computer-related SRL practices include:

- I love looking for vocabulary so I write a short story in the computer and I underline some words and see if the computer has another word for it.
- I use the math programs on the computer to study for my tests.
- I go to my textbook on-line to learn things better.

Family computing. For students with working computers, the average family computing score was 11.06 out of a possible 24.00. Seventy-seven percent of students indicated that their parents praised them for what they did or created on the computer. Examples of family computing activities are:

- Working on projects with parents.
- Learning English together with parents using the Internet.
- Being asked by parents to teach younger siblings with CFY's software.
- Being asked to do specific Internet research for the family.
- Going on-line with parents to view school's website and recent assignments.

There were no differences in family computing by demographics or prior performance levels.

Students' perceived computer impact. Students felt that home computing had a positive impact on their learning and performance in school. Among students with working home computers, 70% indicated that having a home computer helped them improve in language arts and 68% said the same for mathematics. In both cases, about 30% reported that it helped them "a lot" in these ways. Seventy-four percent reported that having a home computer helped them feel more confident, and almost one quarter said that it helped them feel "a lot" more confident. About two-thirds of the students felt that having a home computer made

them feel more interested in their classes and helped them work harder in school.

Student engagement. Students rated themselves as being engaged in school. Sixty-one percent indicated they "very often" tried their hardest when completing homework, 40%, said they "very often" finished their math homework when it was boring, and 20% reported they "very often" chose to study on their own after school.

Significant predictors of math test scores. This study found a positive and significant relationship between home computing factors, students' engagement and students' 2006 math test scores. For students with working home computers, the positive and significant predictors of math scores were (1) prior year's math test score, (2) frequency of home Internet use, (3) their engagement with school, and (4) use of computers for self-regulated learning. Together, all factors explained 48% of the variance in math scores. Over and above their prior year's math test scores, and additional 14% of variance in math scores was explained by students' engagement, system use and home computing practices (see Table 1).

Significant predictors of student engagement. The same variables were entered into a hierarchical regression equation with student engagement as the dependent variable. For students with working home computers, family computing was the most sizeable and significant predictor of student engagement, β=0.419, p=.000. Additionally, the number of different software programs used at least a few times a week significantly predicted engagement. Prior mathematics achievement did not predict engagement. Together, the two computing factors explained 35% of the variance in student engagement.

Educational importance

This study demonstrates that low-income middle school students in the CFY program actively and regularly use their computers and the Internet for learning at home and that their computer use is associated with increased achievement. Students' engagement and home computer use, particularly their computer use for SRL and home Internet use, explain 14% of the variance in their 2006 math test scores over and above 2005 scores.

These findings raise important questions about where technology can have its greatest impact on learning—in the classroom or the home—and have implications for schools planning their purchase and deployment of instructional technology. They also have implications for developing policy to promote the academic success of low-income children. Our research suggests that improving the quality of middle school students' home learning environment is a powerful way to increase their academic engagement and achievement. As such it should be considered in school reform initiatives.

Table 1. Hierarchical Regressions predicting Students' 2006 Math Test Scores

		Math score 2006			
		β Coefficient (standardized)	Sig.	R-square	Partial R-square
Regression 1.	Math score 2005	.610***	.000	.372	--
Regression 2.	Math score 2005	.615***	.000	**.388**	.025 (3%)
	Student Engagement	.187***	.006		
Regression 3.	Math score 2005	.620***	.000	**.403**	.024 (2%)
	Student Engagement	.144	.072		
	Computer use for SRL	.185	.077		
	Family Computing	-.083	.443		
Regression 4.	Math score 2005	.583***	.000	**.484**	.136 (14%)
	Student Engagement	.167*	.034		
	Computer use for SRL	.215*	.033		
	Family Computing	-.210*	.049		
	Frequency of home computer use	.085	.299		
	Frequency of home Internet use	.213**	.009		
	Number of different software programs used frequently	.046	.636		

Note: Variables in Italic font are added variables in the sequence of hierarchical regressions.

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