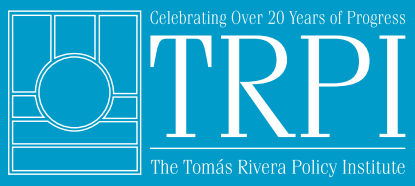
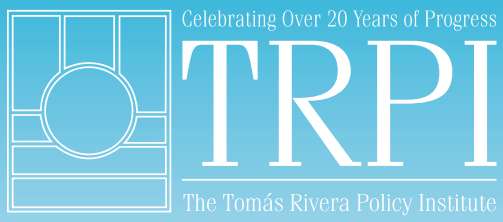
Computer Use, Parental Expectations & Latino Academic Achievement





The Tomás Rivera Policy Institute (TRPI) advances informed policy on key issues affecting Latino communities through objective and timely research contributing to the betterment of the nation.

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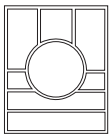


The Tomás Rivera
POLICY INSTITUTE

The Center for Latino Educational Excellence (CLEE) was established as a major initiative of the Tomás Rivera Policy Institute in the spring of 2002 to help improve educational attainment and achievement in Latino communities across the United States. Through its policy research, CLEE seeks to provide guidance for Latino leadership — across public, non-profit, and private sectors — on how to better the current systems of education that are, on many levels, failing Latino youth and adults.

EXECUTIVE SUMMARY

In the United States, traditionally underrepresented minority children have lower levels of academic achievement than their white counterparts. In the broadest perspective, this quantitative study seeks to help stakeholders and policymakers understand the factors responsible for Hispanic[1] or Latino student achievement relative to that of comparison groups. The key dependent variables in this study are student achievement in reading and writing, and in math and science. Specifically, the Tomás Rivera Policy Institute (TRPI) examines the impact on reading and writing, math and science achievement levels of computer use both at school and at home, and of teacher preparation for computer-based instruction. TRPI researchers analyzed the effects of these factors not only on comprehension of math and science, but also on reading and writing since research demonstrates that reading and writing ability facilitates understanding of math and science. Several studies have evaluated the relationship between computer use and academic achievement; however, these studies include a variety of limitations: being outdated; examining only math and not science achievement; lack of a control group; examining a limited sample; and a lack of focus on Latinos. Moreover, TRPI examines whether or not effects of race/ethnicity on achievement levels persist once confounding variables are controlled for.

Does computer use at school and at home and teacher preparation for computer-based instruction affect test scores?

Along with computer usage, this study also investigates the effects of other explanatory criteria such as parental expectations, race/ethnicity, language spoken at home, mother's education, and poverty level. A comparative analysis for both the Latino and non-Latino samples was conducted.

Additionally, the dataset is rich enough to allow the models TRPI analyzed to be controlled for selection bias by incorporating child and family characteristics including child's previous achievement (to control for ability). This study analyzes data from the Early Childhood Longitudinal Study (ECLS) which provides a nationally-representative sample of over 11,000 fifth graders. While this study focuses on the overall sample of children across all races/ethnicities, it also attempts to discuss any implications of the findings on Hispanics.

Significant findings of TRPI's analysis are as follows: (1) Once confounding variables are controlled for, the gaps in academic achievement between Hispanics/Latinos and their white counterparts disappear for reading and writing and math, and decrease for science achievement; (2) sufficiency of technical computer support provided to teachers has the most consistent positive effects on most scores; and (3) mother's education and parental expectations have consistently positive effects on scores.

OBJECTIVES OF THE STUDY

The key dependent variables in this study are student achievement in reading and writing, and in math and science. The research questions that this TRPI study strives to answer are as follows: What are the determinants that correspond to these scores? Do correlations of race/ethnicity persist once confounding variables are controlled for? Does computer use at school and at home and teacher preparation for computer-based instruction affect test scores?

[1] For this report we use the terms Hispanic and Latino interchangeably in reference to persons tracing their ancestry to the Spanish-speaking regions of Latin America and the Caribbean.

REVIEW OF THE LITERATURE

The important question for educators and policymakers is whether or not computer use enhances student learning. It is also important to recognize the important role teachers play in in-class instruction using computers, as well as teacher preparation and technical support.

In 2003, the National Center for Education Statistics (NCES) released a study on patterns of computer use and academic achievement. However, the NCES determined that due to the weaknesses of the National Assessment of Educational Progress (NAEP) dataset used as the basis for causal inference, even tentative conclusions about the relationship between achievement and computer use were not warranted. The NAEP data does not allow distinction in the direction of causality between computer use and achievement, nor does it allow analytic models to control for confounding variables, due to its insufficient background indicators. Moreover, the NAEP dataset was collected a decade or more ago (1996 and 1998). The 2003 NCES study does, however, provide an excellent review of literature, as discussed below.

Studies show evidence of a positive correlation between computer use and academic achievement (Becker, 1994; Christmann and Badgett, 1999; Hativa, 1994; Kozma, 1991; Kulik and Kulik, 1987; Liao, 1992; Niemiec and Walberg, 1987; Niemiec and Walberg, 1992; Ryan, 1991; Van Dusen and Worthen, 1994). In terms of subject-specific effects of computer use on achievement, results have generally supported significant positive effects of computer use on mathematics achievement (Clariana and Schultz, 1988; Mayes, 1992; Mevarich, 1994; Moore, 1988; Rhoads, 1986; Van Dusen and Worthen, 1994). In contrast, using more recent data, Wenglinsky (1998) found that computer usage appeared to be negatively related to mathematics achievement in grades 4 and 8, after adjusting for socio-economic status and applying data from the 1996 NAEP dataset. However, the Wenglinsky study is problematic because it failed to consider race/ethnicity, frequency of computer use in classrooms, poverty-related student characteristics, or teacher preparation for computer use.

Access to computers and the academic benefits that can be derived from computer use may not be the same for all students.

The 2003 NCES study also notes that access to computers and the academic benefits that can be derived from computer use may not be the same for all students. While federally-funded programs often purchase computers to benefit disadvantaged students (Scott, Cole and Engel, 1992), computer access still differs across socio-economic groups, as high-income and white students tend to have greater access than low-income and black students, and non-English speaking students tend to have the lowest level of computer access (Cuban, 1993; Neuman, 1991; Sutton, 1991). The "digital divide"—a term used to describe the gap between individuals with and without technology access—has certainly narrowed over the last decade; between 1994 and 1999 the proportion of schools with Internet access increased from 35 percent to 95 percent in the U.S. Similarly, the proportion of public school instructional classrooms with Internet access increased from 3 percent to 63 percent. However, schools in areas with high concentrations of poverty were much less likely to have Internet access; in 1999 less than half (39 percent) of instructional classrooms in schools in these areas were connected to the Internet. (May and Chubin, 2003) Therefore, low-income minority students, who are likely to attend these schools, are also more likely to have limited access to resources crucial for understanding science and mathematics, as well as access to science, technology, engineering, and mathematics (STEM) fields. The lack of computer and Internet resources in the 1990s may be one of the factors responsible for lower representation of low-income students majoring in STEM fields at colleges and universities in 2007. Revisiting the data paints a more hopeful picture: as of 2005, 100% of public schools

with minority enrollment of 50% or more had Internet access. Additionally, the ratio of public school students to instructional computers with Internet access was comparable for large-minority schools (4.1 students per computer) and low-minority schools (3.0 students per computer), according to the U.S. Department of Education, Fast Response Survey System, 2005.

Students in low-SES schools are more likely to use computers only for drill and practice exercises while their more affluent counterparts engage in more challenging activities.

Several studies conducted in the 1980s indicated that even when student-to-computer ratios are comparable for both high-socio-economic status (SES) schools and low-SES schools, students in low-SES schools are more likely to use computers only for drill and practice exercises while their more affluent counterparts engage in more challenging activities (Cole and Griffin, 1987; Kozma and Croninger, 1992; Watt, 1982). A number of quasi-experimental studies of the computer-achievement relationship for students of different abilities have also been conducted. The results from these analyses are mixed. Some studies show that even under the same treatment conditions, high-ability students receive greater benefits from learning via computer than their lower-ability classmates (Hativa, 1994; Hativa and Becker, 1994; Hativa and Shorer, 1989; Munger and Loyd, 1989; Osin, Nesher and Ram, 1994) while other studies indicate that high- and low-ability students attain similar gains (Becker, 1992; Clariana and Schultz, 1988). However, the results from longitudinal studies of computer-assisted instruction have prompted some researchers to conclude that computerized learning contributes to the increasing achievement gaps between high- and low-SES students and between high- and low-ability students (Hativa, 1994; Hativa and Becker, 1994; Hativa and Shorer, 1989). Finally, gender differences in achievement attained via computer-based instruction have been reported in some studies. Clariana and Schultz (1993) found that low-achieving eighth-grade females attained significantly smaller gains in mathematics, compared with high- and low-ability males and high-ability females, whereas in language arts, the low-ability females made the largest gains relative to the other three student groups. However, when ability is not taken into account, achievement gains for males tend to be significantly higher than the gains attained by their female classmates (Hativa and Shorer, 1989; Neuman, 1991).

A significant factor discussed in the computer use and academic achievement literature is the vital function teachers play in implementing computer use in-class instruction (Clariana and Schultz, 1993; Hativa, 1994; Hativa and Becker, 1994; Moore, 1988; Van Dusen and Worthen, 1994). Evidence from studies conducted in the 1980s and 1990s indicates that although teachers have had increasing access to computers for instruction, very few actually use them (NCES, 2003).

The 2003 NCES analysis of data from the 1980s and 1990s indicates that in general, computer use is poorly integrated into the classroom curriculum and is under-used (Maddux, Johnson, and Harlow, 1993; Becker, 1991; Ognibene and Stiele, 1990). Although it is apparent that teachers need to be trained in new technology, they also need to be trained to modify their teaching methods to take full advantage of the benefits offered by technology (Bright and Prohosch, 1995). Moreover, Sheingold and Hadly (1990) estimate that it takes at least five years for experienced teachers to become comfortable using computers in non-routine ways.

THE ANALYTIC STRATEGY

The outcomes of interest in this study are student achievement in reading, science, and math. The key independent variables are various indicators of computer use. This study also incorporates the confounding variables discussed in the literature review. These characteristics are included as explanatory variables in the models: the student's academic ability, gender, race/ethnicity, language spoken at home, parental expectations for the child, mother's education, whether or not mother is U.S.-born, poverty level, whether or not the child belongs to a two-parent family, and the number of hours spent watching television.

A multivariate analysis was used, with explanatory variables incorporated into the model to test the validity of the relationship between academic achievement and computer use. The student's previous academic achievement was used to control for endogeneity effects, to ensure that it was computer use affecting scores, and not the other way around.

The models were run for all students, and then separately for Hispanic students. Due to lack of statistical power as the sample drops for Hispanics, it is possible that our results do not show statistical significance for some correlations between academic achievement and independent variables.

Academic disparities between traditionally underrepresented minority children and their white counterparts significantly decrease or disappear once the key independent variables and other confounding indicators in the models are accounted for.

THE DATA

This study focuses on children in fifth grade. The dataset is nationally-representative, containing characteristics of 11,000 fifth-graders. The data was collected in 2004.

The key dependent variable is academic achievement, as measured by the Academic Rating Scale (ARS), developed for the Early Childhood Longitudinal Study-Kindergarten Class of 1998-1999 study (ECLS-K) to measure teachers' evaluations of students' academic achievement in three domains: language and literacy (reading and writing), science, and mathematical thinking. Teachers rated students' skills, knowledge, and behaviors on a scale from "Not Yet" (a low value of 1) to "Proficient" (a high value of 5). The scale corresponds to the 5-point rating that teachers used in rating children on key items.

The ARS was designed to measure both the process and products of children's learning in school, as evaluated by the teacher. It is a criterion-referenced indirect measure targeted to the specific grade level of the student and drawn upon daily observations made by teachers of the students in their classes. The difficulties per item and student evaluations are placed on a common scale. Accordingly, students have a lower probability of receiving a high rating on items above their scale score and a high probability of receiving a high rating on items whose difficulty is below their scale score. Therefore, the ARS scores children receive should not be interpreted as mean scores, but as the child's relative probability of success with regard to the assessment items.

While the data includes 11,000 children, the actual models are run on much less as data as some independent variables and explanatory variables are not available for all the children in the sample.

FINDINGS AND DISCUSSION

In general, the multivariate results for the overall sample hold true for the Hispanic sample as well. Results from the overall sample showed that "being Hispanic" has no significant effect on reading and math scores, but has a negative effect on science scores after other confounding factors in the model have been accounted for. The models using the overall sample that includes all ethnicities/races shows results that have more statistical rigor than those for the model using only the Hispanic sample. The Hispanic sample is smaller in size, and its within-sample characteristics have less variation, thereby affecting the statistical results (or lack thereof). This is a potential explanation for why the models using the overall sample showed more significant relationships compared with the models using only the Hispanic sample.

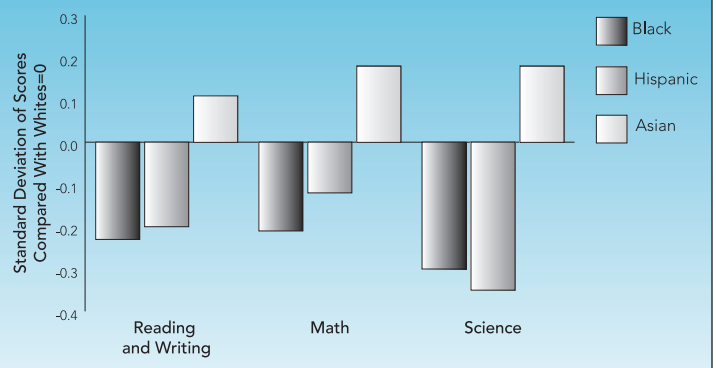
Academic Disparities Can Be Explained by Factors Other Than Race/Ethnicity

It is interesting to note that the *academic disparities between traditionally underrepresented minority children and their white counterparts significantly decrease or disappear once the key independent variables and other confounding indicators in the models are accounted for.* Analyzing the models with races/ethnicities as the only variables, the academic gaps between whites and blacks and between whites and Hispanics appeared huge, ranging from 12-35% (Figure 1). But once other factors were accounted for (such as computer use in the classroom, parental expectations, socio-economic characteristics, etc.), such disparities disappeared or at least decreased (as in the case of black students' scores in math and Hispanic students' scores in science) as shown in Figure 2. This indicates that in general, *the gaps in academic achievement can largely be explained by factors other than race/ethnicity.*

The remainder of the findings in this section refer to results after various confounding factors have been incorporated into the model. The major findings of this study center around computer use and mother's characteristics.

FIGURE 1

SCORES OF BLACKS AND HISPANICS LAG BEHIND WHITES BY A RANGE OF 12-35%

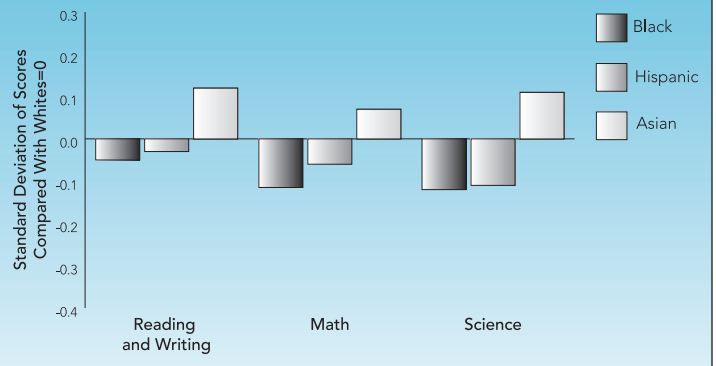


Notes: All results are statistically significant at 95% confidence level, except for Asian scores for science which are not significantly different from whites=0.

Source of Basic Data: National Center for Education Studies. Early Childhood Longitudinal Study: Kindergarten Cohort. K-Fifth grade longitudinal data. 2004.

FIGURE 2

ONCE CONFOUNDING FACTORS ARE ACCOUNTED FOR IN THE MODELS, THE ACADEMIC DISPARITIES DECREASE OR DISAPPEAR



Notes: Results that are statistically significant at 95% confidence level are: Asian scores for reading and writing, black scores for math, and Hispanic scores for science. All the rest are not significantly different from whites=0.

Source of Basic Data: National Center for Education Studies. Early Childhood Longitudinal Study: Kindergarten Cohort. K-Fifth grade longitudinal data. 2004.

Computer Use Has Some Effect on Academic Achievement

This study analyzed four different variables regarding the impact of computer use on academic achievement:

1. Adequacy of teacher preparation to use computer in class.
2. Sufficiency of technical support for the teacher for computer problems.
3. The frequency of a child's computer use in class.
4. The frequency of a child's computer use at home for homework.

The use of computers for in-class instruction appears to have a positive effect on math scores of Latino children, and science scores of all children.

Results indicate that adequate levels of teacher preparation for in-class use of computers is positively correlated with math scores. Moreover, on average, *the use of computers for in-class instruction appears to have a positive effect on math scores of Latino children, and science scores of all children.* But *it is the sufficiency of technical computer support provided to teachers that has the most consistent positive effect on reading and writing, math, and science scores.*

It should be noted that "computer use during classroom instruction" may be defined in a variety of ways. It could mean basic drill exercises or more complicated exercises that allow for additional analysis and rigor, either of which could have different effects on academic achievement. There is therefore a need to study further how teachers and students use computers for in-class instruction, and how best to prepare teachers to maximize the benefits from computer use in class.

Mother's Education and Parental Expectations Have Consistent Positive Effects on Scores

Of all the confounding variables included in the model, academic expectations of parents of Hispanic children has the most consistent positive correlation with test scores. Results show that there is a slight correlation between country of birth of the parent and parental expectations. There is no correlation between the age at which the non-U.S.-born mother moved to U.S. and parental expectations. It is interesting to note that Mexican-born mothers and U.S.-born mothers have the same level of expectations: they both expect their child to go to college. On average, Mexican-born mothers have the lowest level of education attainment (a little more than 12th grade) compared to U.S.-born mothers and other-born mothers ("some college" for both groups). This confirms previous TRPI findings that Mexican mothers have high aspirations for their children, since while the mothers, on average, only barely finish high school, they aspire for their children to finish college.

Mexican-born mothers and U.S.-born mothers have the same level of expectations: they both expect their child to go to college.

Results also show that non-U.S. born mothers (outside of Mexico) have the highest academic expectations for their child (a mean of almost 4.3, or on average, they expect their child to finish college or beyond).

As for disparities in academic achievement, the gender gap exists for reading and writing scores, with females exceeding the scores of males. There appears to be no gap for math and science scores.

Meanwhile, living below the poverty level appears to have some negative effect on reading and writing as well science. And being in a two-parent family structure has a positive effect on math scores.

TABLE 1

FINDINGS OF THE STUDY

Dependent Variable:	**Reading and Writing**		**Math**		**Science**	
Academic Rating Scores	**All ethnicities/ races**	**HISPANIC**	**All ethnicities/ races**	**HISPANIC**	**All ethnicities/ races**	**HISPANIC**
Computer Variables						
Teacher has adequate prep to use computer in class			+			
Teacher has sufficient support for computer problems	+		+	+		
Frequency child uses computer in math class				+		
Frequency child uses computer in science class					+	
Frequency child uses Internet for science						
Frequency child uses computer for homework					–	–
Explanatory Variables						
Female	+	+				
Age		+				
Black		–				
Hispanic					–	
Asian	+					
Other race			+			
Below poverty threshold	–				–	
Mother is non-US born	–					
Mother's education: less than HS	–					
Mother's education: some college						
Mother's education: BA or higher	+		+		+	
Home language is not English						
Two-parent family structure			+			
Academic expectations of parent for child	+	+	+		+	+
TV hours per week						

Notes: + means the variable has a positive effect on the dependent variable (academic achievement as measured by scores) with at least 95% level of confidence.
– means the variable has a negative effect on scores with at least 95% level of confidence.

Source of Basic Data: National Center for Education Studies. Early Childhood Longitudinal Study: Kindergarten Cohort. K-Fifth grade longitudinal data. 2004.

POLICY IMPLICATIONS OF FINDINGS

The good news is that achievement gaps between traditionally underrepresented minority students and their white counterparts are not necessarily rooted in race/ethnicity, but rather in the socio-economic characteristics and circumstances of the students. Because traditionally underrepresented minority children are likely to possess the characteristics that hurt academic achievement (Table 2), school and parental programs must address the needs of these students. Among Hispanics, in particular, 32% live below the poverty level. Almost 58% of Hispanic mothers in the United States are non-U.S. born, and nearly a third have less than a high school education.

TABLE 2

OF THE THREE GROUPS, HISPANICS HAVE THE WORST SOCIO-ECONOMIC CHARACTERISTICS

CHARACTERISTICS	White	Black	Hispanic
Below poverty threshold	7%	35%	32%
Mother is non-U.S.-born	5%	9%	58%
Mother's education: less than high school	3%	11%	28%

Source of Basic Data: National Center for Education Studies. Early Childhood Longitudinal Study: Kindergarten Cohort. K-Fifth grade longitudinal data. 2004.

The findings of this TRPI study are intended to inform education policies and parent-involvement programs to equalize opportunities and bridge achievement gaps across different race/ethnicities, income levels, and parental education backgrounds.

POLICY IMPLICATION #1
An increase in technical computer support for teachers in schools and classrooms may have a positive effect on test scores

Our findings show that an increase in technical computer support for teachers in schools and classrooms may have a positive effect on test scores. This should be explored further by school administrators in terms of the types of technical support that would most benefit classroom instruction. There is also a need to study how computer use is integrated, and can be better incorporated, into the curriculum. With the proliferation of computer games and home-based computers, there may very well be a digital divide between teachers and students, as well as between boys and girls. Both gaps merit further consideration.

POLICY IMPLICATION #2
Parents should be empowered with knowledge about the impact of their academic expectations on their child's academic achievement

Parents should be empowered with knowledge about the impact of their academic expectations on their child's academic achievement. Programs targeted at parents have been developed to guide them in how to make their aspirations for their children become reality. An example is *Kids to College*, a TRPI program funded by the Sallie May Fund, targeted toward children in 6th grade and their parents and teachers, with the objective of educating them about college and the various types of financial assistance available to them. Another example is the *Parent Institute for Quality Education* (PIQE), the goal of which is to assist California parents of Latino and other underserved student populations in preparing their children for university education. The *Mexican American Legal Defense and Educational Fund* (MALDEF) has developed a parent-school partnership designed to train parents, school personnel, and community-based organizations in furthering educational attainment of children. Another example is the *"Padres Promotores de la Educacion"* partnership in Santa Ana, California, which educates parents about the steps involved in helping their children to reach higher education.

APPENDIX A:
DATA USED IN THE MODELS

TABLE 3
DATA USED IN THE STUDY

Dependent Variables	Observations	Mean	Std. Dev.	Min.	Max.
Academic rating in reading and writing	9630	3.505366	.809089	1	5
Academic rating in math	4759	3.487262	.6780948	1	5
Academic rating in science	4564	3.360973	.8603446	1	5
Computer Variables					
Teacher has adequate prep to use computer in class	9497	3.77814	1.033533	1	5
Teacher has sufficient support for computer problems	9515	3.754178	1.115282	1	5
Frequency child uses computer in math class	4815	3.221184	.9007036	-4	-1
Frequency child uses computer in science class	4824	3.315091	.7209811	-4	-1
Frequency child uses Internet for science	4836	3.311208	.7136768	-4	-1
Frequency child uses computer for homework	8130	2.204674	.7346596	1	4
Explanatory Variables					
Female	10289	.5059773	.4999886	0	1
Age	10163	2.978746	.7980128		
White	10275	.5875426	.4923006	0	1
Black	10275	.099854	.2998198	0	1
Hispanic	10275	.1866667	.3896627	0	1
Asian	10275	.0721168	.2586938	0	1
Other race	10275	.05382	.225673	0	1
Below poverty threshold	9590	.1621481	.3686058	0	1
Mother is non-US born	9362	.2155522	.4112269	0	1
Mother's education: less than HS	9375	.0910933	.2877571	0	1
Mother's education: some college	9375	.3557333	.4787605	0	1
Mother's education: BA or higher	9375	.3092267	.4621994	0	1
Home language is not English	9852	.1526594	.3596771	0	1
Two-parent family structure	9590	.7863399	.4099109	0	1
Academic expectations of parent for child	9564	3.967796	.8317702	1	5
TV hours per week	9455	13.72247	8.093617	0	59

Source of Basic Data: National Center for Education Studies. Early Childhood Longitudinal Study: Kindergarten Cohort. K-Fifth grade longitudinal data. 2004.

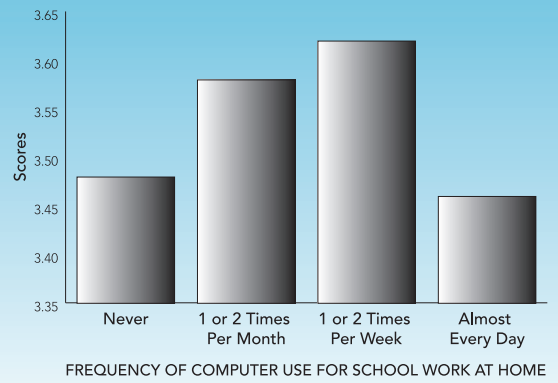
APPENDIX B:
DESCRIPTIVE ANALYSIS

Our results show positive correlations between teacher preparation, computer support for teacher, and computer use at school (math and science), as expected. There is a statistically-significant positive correlation between teacher preparation for computer use in class and sufficient support for teachers in computer use. There is also a positive correlation between teacher preparation and actual computer use in school for math and science subjects.

Our descriptive analysis showed mixed correlations between academic outcomes and computer use. There is no consistent correlation between computer use for educational purposes for reading and writing (Figure 3) or math (Figure 4). However, there does appear to be a positive correlation between computer use and science (Figure 5).

FIGURE 3

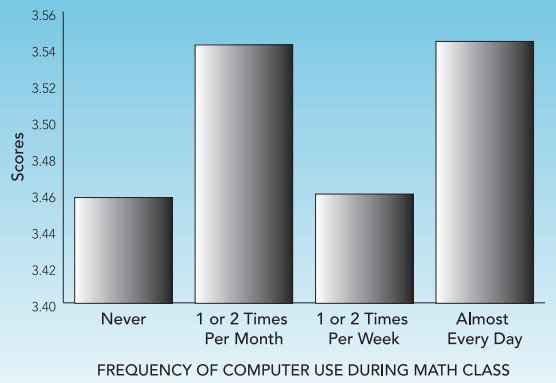
THERE IS NO CONCLUSIVE CORRELATION BETWEEN COMPUTER USE AND READING AND WRITING SCORES



Source of Basic Data: National Center for Education Studies. Early Childhood Longitudinal Study: Kindergarten Cohort. K-Fifth grade longitudinal data. 2004.

FIGURE 4

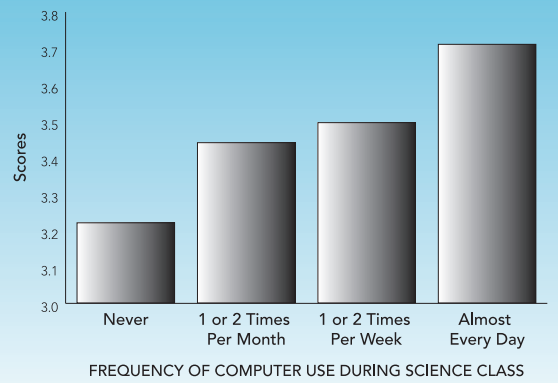
THERE IS NO CONCLUSIVE CORRELATION BETWEEN COMPUTER USE AND MATH SCORES



Source of Basic Data: National Center for Education Studies. Early Childhood Longitudinal Study: Kindergarten Cohort. K-Fifth grade longitudinal data. 2004.

FIGURE 5

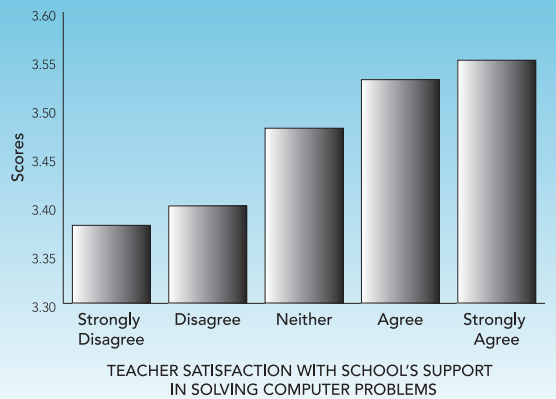
THERE IS A POSITIVE CORRELATION BETWEEN COMPUTER USE AND SCIENCE SCORES



Source of Basic Data: National Center for Education Studies. Early Childhood Longitudinal Study: Kindergarten Cohort. K-Fifth grade longitudinal data. 2004.

FIGURE 6

READING AND WRITING SCORES MOVE WITH TEACHER'S SATISFACTION WITH SCHOOL'S SUPPORT FOR COMPUTER USE



Source of Basic Data: National Center for Education Studies. Early Childhood Longitudinal Study: Kindergarten Cohort. K-Fifth grade longitudinal data. 2004.

Increasing technical computer support for teachers in schools and classrooms may have a positive effect on test scores.

Meanwhile, there appears to be a positive correlation between a child's reading and writing scores and the teacher's satisfaction with the technical support for computer use provided by the school (Figure 6). If this relationship holds once confounding factors are controlled for, then policy should ensure teachers are given adequate technical support by schools when using computers for class instruction. In our sample, teachers of 70% of the students agree or strongly agree that they are satisfied with the technical support they are getting. Teachers of 17% of the students in our sample stated they were unsatisfied with provided technical support.

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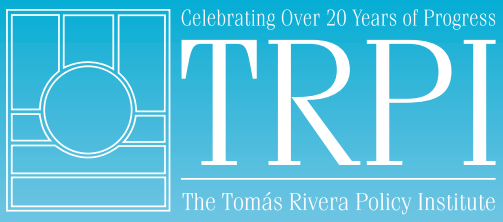

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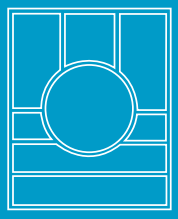

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