The association between having access to computers and Internet and educational achievement for primary students in Brazil

Jacques Wainer [a,*], Paula Vieira [a], Tatiana Melguizo [b]

[a] University of Campinas, Computing Institute, Av. Albert Einstein 1251, Campinas, SP 13083-852, Brazil
[b] University of Southern California, Rossier School of Education, 3470 Trousdale Parkway, Waite Phillips Hall, Room 702 G, Los Angeles, CA 90089-4083, USA

ARTICLE INFO

ABSTRACT

This study tests the association between having home access to a computer and to the Internet and the educational achievement of primary students on a standardized test in Brazil for the years 2007–2011. The results show a significant (both practical and statistical) benefit of owning a computer for 5th and 9th graders. The effect sizes range from 0.2 to 0.4 and are similar across different socioeconomic status. On the other hand, the correlation between having access to the Internet with higher test scores is generally smaller and highly dependent on the socioeconomic status of the student's family, varying from 0.2 to −0.2. This study also points out to a weaker evidence that there is an increase of the positive effects of owning a computer and access to Internet over time, which may explain some of the divergent results in the literature.

1. Introduction

There is still substantial uncertainty regarding the usefulness of having a computer and access to the Internet at home on the educational outcomes of young students (Biagi & Loi, 2013; Fuchs & Wößmann, 2004; Luu & Freeman, 2011; Machin, McNally, & Silva, 2007; Papanastasiou, Zembylas, & Vrasidas, 2003; Wainer et al., 2008; Wittwer & Senkbeil, 2008; Spiezia, 2010). Some studies show that an increase use of computers or just computer ownership are correlated to increase scores in some standard tests (Luu & Freeman, 2011; Machin et al., 2007; Papanastasiou et al., 2003; Spiezia, 2010) while other results show no correlation or even a negative correlation between computers and scores in these tests (Biagi & Loi, 2013; Fuchs & Wößmann, 2004; Wainer et al., 2008; Wittwer & Senkbeil, 2008). This study aims to contribute to the literature by taking advantage of a unique dataset for the largest country in South America that enables us to explore the association between having access to a computer and the Internet and the educational achievement on a compulsory test.

1.1. Related research

In this research we are interested in computer use/ownership and Internet access from home for primary education students (in Brazil, grades 1–9, for students up to 14 years old), as opposed to high school students (secondary education in Brazil are grades 10–12), or college students.

1.1.1. Observational studies

Most of the literature on this field takes advantage of national level standardized achievement tests that also collect information on a number of student and family characteristics such as gender, socioeconomic information, and, most importantly, some questions regarding computer use or ownership, and tests whether there is a positive correlation between having or using computers and the students' test scores.

* Corresponding author.
E-mail addresses: wainer@ic.unicamp.br (J. Wainer), paulaulaula@gmail.com (P. Vieira), tatiana.melguizo@gmail.com (T. Melguizo).

If the model that relates test score and computer use or ownership also includes the student gender, socioeconomic status (SES), parent education level, and so on, one says that the research *controlled for* those variables. Biagi and Loi (2013) classify these external variables into institutional level factors (for example teacher training regarding computer use in class, and technological infrastructure at school), school level factors (teacher/principal attitude towards computers, school computer infrastructure and support), student level factors (gender, age, interaction with peers, etc.), and family level factors (socioeconomic status, parents' education level, attitudes toward learning). This research controls only for family level factors.

Table 1 summarizes some of the observational studies published on computer ownership/use and outcome for elementary education students. "Test" refers to the standardized test that was used in the study; "Year" refers to the year the test was applied, not the year of publication of the study, "Result" is "+" for positive results (computer use/ownership is associated with higher grades in the tests), "−" for negative association, and "0" for no significant association between computers and the test results.

1.1.2. Intervention studies

Observational studies can only show a *correlation* between computer ownership or use and student outcome. Other studies use designs that can provide stronger evidence of *causation*. Malamud and Pop-Eleches (2011) use an interrupted time series design: the study uses data from a 2008 Romanian program on vouchers to low income families with children to buy computers. There was a significant *reduction* of the Math, Romanian, and English test scores for the students that received the voucher; the effect size was from −0.2 to −0.5, that is, the group that received computers had test scores from 0.2 to 0.5 times the standard deviation *lower* that similar students that did not receive the voucher. The study also found some positive effects on cognitive skills and computer skills.

A random intervention design was used by Cristia, Ibarrarán, Cueto, Santiago, and Severín (2012) in the 2009 evaluation of the "One laptop per child" program in rural Peru. Random schools were given laptops for all their students. There was evidence of increase computer use and some evidence of improved cognitive skills, but no evidence of improved student achievement in Math or Language for the students that received the laptops.

1.2. Context

In Brazil, schooling is mandatory for children from ages 6 to 14. In 2006 an extra grade was added to primary education. Thus the 5th grade corresponds to the (old) 4th grade, and the current 9th grade corresponds to the 8th grade in some of the Brazilian education papers published a few years ago (Sprietsma, 2012; Wainer et al., 2008). In general, 5th graders are around 10 years-old, and 9th graders, 14 years-old.

2. Methods and data

2.1. Materials

2.1.1. Prova Brasil

"Prova Brasil" is a standardized test applied every two years to all 5th and 9th grade students from urban public schools. Prova Brasil tests for competencies in Portuguese and Mathematics, and also collects information regarding the students and their parents. The state and city Education departments decide which public schools within their district will participate in the test. Thus, although in Brazil non-university level public schools are considered, on average, worse than private schools, it is reasonable to expect that the best public schools will be selected for the exam.

Table 1
Summary of the literature on observational studies of computer impact on elementary school achievement.

Reference	Country	Year	Test	Result	Details
Vigdor and Ladd (2010)	US (North Carolina)	2000–2005		+/−	Positive and small correlation for when groups with and without computers are compared but negative and small correlation when each student is followed within the period.
Papanastasiou et al. (2003)	US	2000	PISA Science	+	Positive correlation between computer use and Science grades. Controlled for socioeconomic status.
Fuchs and Wößmann (2004)	Various	2000	PISA	−	Controlled for student, family and school characteristics.
Wainer et al. (2008)	Brazil	2001	SAEB	0/−	No correlation for computer ownership, negative correlation for Internet access for the lower socioeconomic classes.
Sprietsma (2012)	Brazil	1999–2003	SAEB	−	Negative correlation for computer availability at schools for 5th grade students.
Machin et al. (2007)	UK	2001		+	Analyzes the impact of changes in ICT funding for schools in regions of the UK.
Naevdal (2007)	Norway	2002		+	Positive correlation between time spent in computers and the test scores in English for most groups. Controlled for gender, subject interest, reading disabilities and different computer activity categories.
Wittwer and Senkbeil (2008)	Germany	2003	PISA Math	0	No correlation between computer use and the results in the Mathematics exam.
Spiezia (2010)	Various	2006	PISA Science	+	Positive correlation of computer use and Science grades, controlling for socioeconomic status, gender, school characteristics, etc. Stronger correlation for home use than school use.
Luu and Freeman (2011)	Canada/ Australia	2006	PISA Science	+	Positive correlation of computer use and Science test scores, controlling for gender, immigrant status, socioeconomic status, and school characteristics.
Biagi and Loi (2013)	Various	2009	PISA	−	Generally negative correlation for different computer uses and test grades (for most countries). Only gaming as a form of computer use is positively correlated with better test grades.