Computers & Education 82 (2015) 1–10

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Comparing marginal effects of Chilean students' economic, social and cultural status on digital versus reading and mathematics performance

Magdalena Claro [a, *], Tania Cabello [a], Ernesto San Martín [a, b, c, e], Miguel Nussbaum [a, d]

[a] Center for the Study of Educational Policy and Practice (CEPPE), Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna 4860, Campus San Joaquín, Macul, Santiago, Chile
[b] Faculty of Mathematics, Pontificia Universidad Catolica de Chile, Av. Vicuña Mackenna 4860, Macul, Santiago, Chile
[c] Faculty of Education, Pontificia Universidad Catolica de Chile, Av. Vicuña Mackenna 4860, Macul, Santiago, Chile
[d] School of Engineering, Computer Science Department, Pontificia Universidad Catolica de Chile, Santiago, Chile
[e] Center for Operations Research and Econometrics CORE, Belgium

ARTICLE INFO

Article history:
Received 6 May 2014
Received in revised form
15 October 2014
Accepted 17 October 2014
Available online 27 October 2014

Keywords:
Second digital divide
Digital literacy
ICT
Economic, social and cultural status
Digital skills test

ABSTRACT

This paper provides evidence that helps understand the digital divide in education. It does so by comparing the effect of economic, social and cultural status (ESCS) on the digital skills of Chilean students compared with mathematics and language. This comparison is made using national standardized tests. The marginal effect of a group of variables measuring student ESCS was compared both as a whole and separately using multivariate linear regression analysis. The results show that the marginal effect of ESCS as a whole on students' digital skills was equal to the effect on mathematics and greater than the effect on language. Furthermore, the results show that the parents' level of education was the most relevant factor of ESCS for explaining student performance on the digital test, more so than for mathematics and language. These findings challenge the belief that the Internet would reduce economic, social and cultural inequalities in new generations. Instead, they reveal that the gap among Chilean students tends to perpetuate or widen when comparing performance in mathematics and language with performance in the digital domain. At the same time, by comparing national test results, this paper offers empirical evidence for the existence of a second digital divide in the field of education, a concept which is widely discussed at a theoretical level but with little empirical support to date.

1. Introduction

For some, access to the Internet represents the promise of a more democratic and equitable society; for others it is a potential source of cultural and social inequality, giving rise to the so-called digital divide (Castells, 2001; DiMaggio, Hargittai, Celeste, & Shafer, 2004; Selwyn & Facer, 2007; Van Dijk, 2006; Warschauer, 2012). In this context, the adoption of Information and Communication Technologies (ICT) by educational systems has been partly inspired by a social rationale that sees schools as leveling access to the opportunities provided by ICT and digital literacy. As several authors have reported, the concept of the digital divide was initially defined in dichotomous terms as the distance between those that have access to ICT and those that do not (Di Maggio et al., 2004; Hargittai, 2008; Selwyn, 2004; Van Dijk, 2006). To reduce this gap, schools have been equipped with computers and the Internet. In some countries, such as Uruguay, Peru and Haiti, One-to-One programs have been implemented to provide children from low-income families with access to a personal computer (Näslund-Hadley, Kipp, Cruz, Ibarrarán, & Steiner-Khamsi, 2009; Severin & Capota, 2011). However, evidence today shows that as quantitative access increases and levels-out, qualitative disparities appear in the way in which technology is used. These disparities are not only financial, but also cognitive, social, and cultural, leading to the concept of a 'second digital divide' (OECD, 2010). This concept represents a more refined approach that shows that the benefits of using ICT depend not only on access, but also on the conditions of the individual and their ability to

* Corresponding author. Tel.: +56 2 354 1330.
E-mail addresses: magdalena.claro@gmail.com, mclarot@uc.cl (M. Claro), tjcabell@uc.cl (T. Cabello), esanmart@mat.puc.cl (E. San Martín), mn@ing.puc.cl (M. Nussbaum).

http://dx.doi.org/10.1016/j.compedu.2014.10.018
0360-1315/

take advantage of the opportunities provided (Hargittai, 2008; OECD, 2010; Selwyn, 2004; Selwyn & Facer, 2007; Van Dijk, 2006). In this sense, the concept of digital divide goes from being one-dimensional to multidimensional. It also accounts for factors that are extrinsic and extrinsic to technology, such as individual skills or digital literacy (Ferro, Helbig, & Gil-Garcia, 2011).

An important question in the field of education is how the second digital divide relates to other differences in student learning. Research on the differences in student learning outcomes has strongly focused on the role played by the student's economic, social and cultural status. The impetus for this research was partly provided by two important projects: the Coleman Report in the USA (Coleman et al., 1966) and the Plowden Report in Great Britain (Peaker, 1971). In broad terms, these reports concluded that the family context was more important than school-level factors in determining student achievement. Initially, the family context was restricted to economic and social status (measured by income, and the parents' education and occupation). However, this definition has become more complex over time. This is because research has found evidence to suggest that factors such as educational resources at home, as well as the family's social and cultural capital also influence student's educational outcomes (Buchmann, 2002; Sirin, 2005; Sullivan, 2007). Studies of performance in various subjects, particularly in mathematics and language, consistently show the relevance of these factors in explaining differences between students (Bradley Corwyn, 2002; Dahl & Lochner, 2005; OECD, 2013a, 2013b; Perry & McConney, 2013; Schulz, 2005; Sirin, 2005; Starkey & Klein, 2008).

Research into the role of economic, social and cultural status in explaining the digital divide among students has mostly been centered on how it affects student use of ICT (Hargittai, 2010; Peter & Valkenburg, 2006; Van Deursen & Van Dijk, 2014). So far, little research has been focused on student performance in a digital context, partly due to the difficulty of defining and measuring ICT or digital skills (Litt, 2013). Initially the concept of digital literacy referred to computer literacy, i.e. the ability to operate computers and their different programs (Norman, 1984). Subsequently, a broader concept appeared, transcending technical ICT skills and including skills linked to the capacity to solve information and communication problems in a digital environment. For example, searching, assessing, summarizing, analyzing, representing, or creating information; as well as sharing and collaborating with others (Claro et al., 2012; Ferrari, 2013; Fraillon, 2012; Fraillon, Schulz, & Ainley, 2013). The most reliable way to measure these skills is to use standardized tests in closed computational environments. However, due to the high cost involved in their design, measurements tend to rely on self-reporting by those being assessed (Van Dijk, 2006). Nevertheless, there are some studies that measure individual Internet skills (Hargittai, 2002; Van Deursen & Van Diepen, 2013; Van Deursen & Van Dijk, 2009) and digital reading skills (OECD, 2012). Furthermore, some countries such as Australia (ACARA, 2012) and Chile (Enlaces, 2011) have developed performance tests that are taken nationally and cover a range of objectives. Likewise, under the auspices of the IEA (International Association for the Evaluation of the Educational Assessment) the International Computer and Information Literacy Study (ICILS), an international evaluation, has been carried out with the participation of 21 countries (Fraillon et al., 2013). In general, the results of digital skills tests tend to show that, as within other fields of performance, family background measured using economic, social and cultural variables is a strong predictor of digital skills (Claro et al., 2012; Gui & Argentin, 2011; Hargittai, 2010; Hatlevic, Ottestad, & Throndsent, 2014; Litt, 2013; Van Deursen & Van Dijk, 2010).

In summary, academic research and discussion shows that the digital divide is more complex than simply the *haves* vs. the *have nots*. In the field of education, research is increasingly focused on the differences between students in terms of their digital skills. Furthermore, there is plenty of research on the importance of economic, social and cultural status to student performance in mathematics and language. Additionally, there is increasing evidence of this also being the case for digital skills. Nevertheless, there have been few studies as to whether the performance gap explained by student ESCS differs for print and digital tests in language or mathematics. One such study is PISA 2009. This study featured a print and digital reading test, and compared the effects of student attitudes and family background on both assessments. The results showed a very similar relationship between socio-economic background and student performance on both the print and digital tests (OECD, 2011:140). These types of studies are important for understanding whether there is anything new or different about the gap in student performance in the digital domain when compared with more traditional academic domains, such as print tests in language and mathematics. Consequently, the purpose of this study is to compare the effect of economic, social and cultural status in three performance domains —mathematics, language, and digital skills— in order to answer two questions:

1. Is the marginal effect of ESCS on students' digital skills equal to, greater than or less than the marginal effects on students' performance in language and mathematics?
2. Which factors of ESCS best explain student performance in the digital domain?

To do this, we will compare the effect of ESCS on student performance by a single group of Chilean students on a national standardized test in digital skills (sample test) against their performance on national standardized tests in mathematics and language (census tests).

2. Methodology

To answer the research questions, we will analyze the marginal effect of ESCS on the results of a group of Chilean students on three standardized tests. These tests are the Mathematics SIMCE, the Language SIMCE and the ICT or digital skills SIMCE. As will be described in more detail in Section 2.2, the ICT SIMCE measures students' digital skills. ESCS was measured using five variables that are typically used in international studies on education: parents' highest level of education, parents' highest occupational status, household income, educational resources at home, and cultural possessions at home (OECD, 2012).

The sample used in this study is presented in Section 2.1. The variables that comprise student ESCS, as well as the dependent variables, i.e. the national SIMCE tests, are described below in Section 2.2 and 2.3, respectively (Table 1).

2.1. Sample

Chile is an OECD member Country since 2010. Disposable household income in Chile is about 60% of the OECD average. The Country also has the highest level of income inequality and the 4th highest level of relative poverty in the OECD area (OECD, 2014a). Chile spent 6.9% of its GDP on educational institutions in 2011, above the OECD average of 6.1%, but has the highest share of private expenditure on all levels of