Full length article

Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure

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A B S T R A C T

Paradoxically, in Spain, schools have relatively ample information and communication technology (ICT) infrastructure but low levels of classroom ICT use. In this study, we analyse the role of school ICT infrastructure and teacher characteristics to explain ICT use in education. We use data from the Spanish sample in the 2013 Teaching and Learning International Study (TALIS), which consists of 3339 teachers from 192 secondary education centres. The analysis was conducted using multilevel logistic regression models. The principal results indicate that the availability of educational software, teacher ICT training, collaboration among teachers, perceived self-efficacy, and teaching concepts influence classroom ICT use. School hardware and internet-connection infrastructure are less significant. Based on the findings, recommendations are presented to orient Spanish educational policy to encourage the use of ICT in classrooms.

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1. Introduction

Educational systems worldwide aim to develop the digital competency of students. Thus, the curriculum developed in educational centres has included the acquisition of skills in using technology to discover, evaluate, store, produce, present, and exchange information. In addition to being an object of study, information and communications technology (ICT) has been gaining ground as a learning tool. Many educational systems have sought to increase the availability of computers and internet connections in classrooms. This equipment is an efficient tool for study, a valuable source of information, and an interesting support for teaching (Tondeur, van Braak, & Valcke, 2007). Software programs designed for editing texts, creating graphs, organizing data, and completing calculations are useful tools for students. An internet connection makes it possible to access information and resources available on platforms designed for educational purposes. Additionally, opportunities are emerging to complement in-person teaching with virtual teaching thanks to the availability of software that simplifies the presentation of content, the performance of various activities,

and providing students with feedback and that accommodates interaction between students and teachers.

Generally, ICT use by teachers can be divided into two levels (Van Braak, Tondeur, & Valcke, 2004). The first level involves relatively ineffective use, such as basic support for teachers, which most often involves use in class preparation. The second level is effective use, which involves the use of ICT as an educational resource in the teacher's daily work with students. In this connection, Eng (2005) observes that introducing ICT into educational centres occurs in three phases. The first (emerging) phase involves amassing infrastructure. In the second (application) phase, teachers apply technology in the same teaching-learning processes that they have always used. In the third (infusion phase), teachers start to use technology in different ways in innovative pedagogies.

The provision of equipment and infrastructure has been the starting point of ICT policies that have been developed in national contexts. In recent years, some countries have developed specific programmes for the provision of ICT infrastructures to schools, as in the case of Spain (the 2.0 School Program), Hungary (The Digital School Plan), Italy (The Intelligent School Program), and Turkey (the FATIH Project). This provision was also extended to the homes of students from low-income families, as in the United Kingdom and Singapore (the Home Access Program). According to the report drafted by Vacchieri (2013), initiatives in this regard have been the general trend of ICT policies in countries both inside and outside

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Europe, but they have adopted different strategies. Although Hungary, the Czech Republic, Portugal, Germany, Estonia and Italy provide grants to schools or even classes that meet certain requirements, other countries such as Spain, the United Kingdom, the USA and Singapore have attempted to cover all schools. In a third case, countries such as France, Italy, Malta, Poland, Portugal and Israel, the Ministry of Education, in collaboration with private companies, grants incentives so that students or families acquire netbooks and, in some cases, broadband connectivity.

Regarding ICT integration into the curriculum, most countries have a curriculum framework that specifies general guidelines for ICT. These guidelines are established in different regions, localities, states, communities and, in some cases, even schools (Ireland). Only in countries such as Cyprus and Turkey is the curriculum entirely defined by the Ministry of Education. When focusing on the ICT competency that students must achieve, the actions of countries such as the United Kingdom, Italy, Norway, Belgium, Austria, Hungary and the Czech Republic should be emphasized. In these countries, the targets of this type of competency are widely specified. In other European countries, these targets are set in much more general terms.

In focusing on the Spanish context where this study was conducted, the policies that were developed for the implementation of ICT in education were, in their initial period (in the 1980s), promoted by the central government through the Athena Program, which was later known as the National Program for Information and Communications Technology. This program involved incorporating subjects related to computer science into the curriculum, providing schools with computers for administrative purposes (e.g., enrolment, grading, record keeping), and the first attempts at training teachers in ICT use. During the 1990s and until 2009, each autonomous community developed its own initiatives (e.g., constructing computer rooms in schools, training teachers, producing digital educational materials). All that the initiative had in common was that they were funded by the central government (Meneses, Fàbregues, Jacovkis, & Rodríguez-Gómez, 2014).

It was not until 2009–2012 that thanks to the 2.0 School Program a true nationwide policy was established under which the various autonomous communities promoted similar goals and activities. These activities focused on providing classrooms the largest possible amount of equipment under the auspices of the model known as One-to-One, also referred to as One Laptop Per Child. Subsequently, decentralization occurred in parallel with budget cuts, which resulted in individual and diverging activities in different autonomous communities (Area et al., 2014). We refer to the use of digital platforms with educational content, tablets, wireless technology, digital blackboards, bring your own device (BYOD) models, blogs, and wikis and the creation of virtual classrooms.

There has been considerable evolution in the computing equipment provided for teaching and learning activities in Spanish secondary schools. In just over a decade, the average number of students per computer has decreased from 12 (2002–2003 school year) to three (2013–2014 school year) (INE, 2014). According to European Commission (2013), Spain occupied third place in a European ranking for this indicator, and the nation stands out for having nearly all schools online via a relatively fast broadband network. Additionally, 82% of schools have a website and virtual learning space, a statistic that clearly surpasses the median of 61% observed for EU countries.

Despite the high levels of equipment and broadband access, Spain is below the median for European countries with respect to ICT use in classrooms. Specifically, it is one of the five countries with the lowest percentage of such use. Only 52% of grade eight Spanish students declared using a school computer for learning purposes during lessons at least weekly (European Commission, 2013, p. 61). The results obtained for Spanish secondary-school teachers who participated in the 2013 Teaching and Learning International Study (TALIS) are similar. A total of 19.6% of these teachers stated that they never or nearly never use ICT in classroom teaching, and 43.4% stated that they do so only occasionally.

In short, we have established a low usage rate for computer resources in Spanish secondary schools. However, the availability of ICT infrastructure is high, and the Education Administration has developed policies directed at incorporating ICT into teaching. This paradoxical situation makes the Spanish case particularly interesting. In an effort to increase understanding of this issue, this study presents an analysis of variables associated with ICT use in secondary-education classrooms in Spain using country data from TALIS 2013.

1.1. Factors associated with ICT use

Computer-equipment availability (Akbulut, Kesim, & Odabasi, 2007; Lee, 2002; Tallent-Runnels et al., 2006), student-to-teacher ratio (Erdogdu & Erdogdu, 2015), school leadership (Suárez, Almerich, Orellana, & Belloch, 2012) and presence of ICT in the curriculum (Akbulut, 2009) are the school-related variables that have been studied because of their potential implications for the introduction of ICT into classrooms. Study results indicate that the effect of these variables is small, particularly compared with other factors, such as openness to change and appropriate school policies (Tondeur, Valcke, & van Braak, 2008). Similarly, Pelgrum and Voogt (2009) cite the need for leadership in educational centres that encourages in teachers a desire to use new ICT-based teaching methods, the acquisition of higher levels of ICT competency, and the development of a collaborative culture that promotes the introduction of ICT into the teaching and learning process. In this regard, Akbulut (2009) also indicates that Learning Community Policies are factors that are associated with ICT use.

Regarding teachers, the characteristics that are associated with ICT use include experience, the grade that is taught, age, gender (Suárez et al., 2012; Tondeur et al., 2008; Wong & Li, 2008) and academic department (Akbulut, 2009). Use appears to be greater among male teachers who are relatively young (Scherer, Siddiq, & Teo, 2015) and who teach the highest grades, although the effect of these variables is small and only statistically significant in the cases of age (Scherer et al., 2015) and gender (Suárez et al., 2012; Van Braak, 2001). Other noteworthy traits include teachers' commitment and skill (Ertmer, Ottenbreit-Leftwich, & York, 2007; Fraizer & Bailey, 2004; Koehler & Mishra, 2009), their attitude towards ICT (Anderson & Maninger, 2007; Bas, Kubiatko, & Murat, 2016), their attention to special education and health concerning ICT (Akbulut, 2009), their self-efficacy in ICT use (Kreijns, Van Acker, Vermeulen, & Van Buuren, 2013; Rohatgi, Scherer, & Hatlevik, 2016), their beliefs regarding the use of technologies (Bas et al., 2016), their type of use of technology (Bai, Moo, Zhang, Boswell, & Rozelle, 2016), their methodological ideas that are aligned with constructivism (Koehler & Mishra, 2005; Petko, 2012; Prestridge, 2012), and their coordinated efforts with one another at the centre to incorporate and use ICT (Bingimlas, 2009; Tondeur et al., 2008; Wong & Li, 2008). Abbitt and Klett (2007) affirm that the level of interest in computer technology represents 41% of the variance in teacher feelings of self-efficacy in incorporating technology. In addition, Van Braak (2001) warns that while positive attitudes towards technology may affect the incorporation of ICT into the classroom, their effect is mediated by the capacity for technological innovativeness, which he considers the predictor with the greatest explanatory power. Akbulut et al. (2007) state that content and pedagogy are considered the most important