

ICT TEACHER TRAINING: EXPLORING THE FINDINGS OF THE ICT IN EDUCATION SURVEY IN BRAZILIAN SCHOOLS

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Abstract

Although the past years have seen an increased attention towards the use of information and communication technologies in education, teachers struggle to adapt their pedagogical practices to the newly established scenario. Based on the results of the ICT in Education Survey 2012, this paper aims to examine factors involved in supporting ICT adoption by Brazilian schoolteachers. Formal ICT training was not found to influence teachers' uptake of ICT in the classroom. The results suggest that the lack of public policies aiming at continuing, network-based training represents a major barrier to the integration of ICT in pedagogical activities in Brazilian schools.

Introduction

In a fast-paced and continuously changing world, new technological developments have stimulated and required significant changes in all segments of society. In this context, the past years have seen an increased attention towards the use of information and communication technologies (ICT) in education, especially with regard to ICT-based pedagogical innovation. In fact, as technological resources become more embedded into educational settings, teachers struggle to adapt their pedagogical practices to the newly established scenario (CGI, 2013a).

Previous research (CGI, 2011; CGI, 2012; CGI, 2013a) has indicated that, despite the transformational potential of educational technologies, teachers report not having satisfactory skills so as to effectively implement ICT in complex teaching-learning situations. Even though this issue has received considerable critical attention within the academic literature, there is a lack of empirical data regarding Latin American countries. Overall, researchers have found no consensus on the topic and it remains to be established how ICT and ICT training affects the integration of technologies into educational processes.

This paper seeks to provide further evidence by exploring quantitative data on the use and appropriation of ICT in educational settings in Brazil, assessing ICT infrastructure, ICT use in teaching activities and the integration of new technologies into pedagogical practices. More specifically, it aims to examine critical information on Brazilian teachers' perceptions of their ICT skills, as well as the factors that might support or undermine ICT use by teachers in Brazil. For this purpose, a data set from the ICT in Education Survey 2012 on the use of ICT

in Brazilian Schools, conducted by the Center for Studies on Information and Communication Technologies (CETIC.br), will be explored.

In order to assess the factors leading to successful or unsuccessful integration of ICT in schools, the following research questions will be addressed: (1) Does formal ICT training¹ influence teachers' use of technologies in schools? (2) Which factors support effective ICT uptake by schoolteachers?

Literature Review

Over the past decade, major challenges presented by new technological developments in educational settings – e.g., necessary changes in the teacher role, in the teacher professional training and in the curriculum design – have been widely reported (Almeida, 2008; Alonso, 2008; Bastos, 2010; Fullan, 1991; Lévy, 1999). To a large extent, these studies explored new directions and expectations brought about by the adoption of ICT in teaching and learning experiences by both teachers and students.

With regards to empirical data, early evidence has shown that there are multiple factors aside from technical knowledge affecting technology integration in classrooms. Cox, Preston and Cox (1999) collected evidence to investigate the factors which influence teachers' uptake of ICT in the classroom. The authors suggested that most teacher training courses in the UK have mainly focused on technical aspects of ICT, whereas there has been given little attention to the use of facilitating or networking technologies for pedagogical activities. In accordance with these findings, Enochsson and Rizza (2009) conducted a research review on empirical studies in 11 OECD-countries during the years 2002 and 2009 and concluded that student teachers from different countries do not integrate ICT into their teaching activities. In an attempt to draw a clear picture of the impact of other factors on ICT integration in pedagogical practices, Murphy and Greenwood (1998) found a significant correlation between computer access in the workplace and teachers' perceptions of ICT. Along these lines, both Enochsson and Rizza (2009) and Moseley and Higgins (1999) claimed that attitudes towards ICT are found to be a significant factor affecting ICT use in the classroom.

Although a considerable amount of empirical data has been collected on teachers' uptake of ICT in both regional and global contexts, Latin American countries have been rather poorly documented. D'Esposito and Perina (2012) studied continuous teacher training courses in the Brazilian State of São Paulo. The examined courses have been shown to offer a productive environment for interaction and exchange of knowledge and information between student teachers. Based on a study conducted in public schools in the Brazilian State of Santa Catarina, Hack and Negri (2010) identified the lack of equipment and specific ICT training as major barriers to the effective integration of ICT in the classroom. A broader perspective has been adopted by Alonso (2008) who considers technological resources as not sufficient to achieve a significant and positive transformation in pedagogical patterns. In accordance with Cox et al. (1999) and

Jung (2005), Alonso (2008) argued that the use of ICT in teacher training initiatives enables the integration of schoolteachers into a wider international teaching community. In fact, as Alonso noted (2008), belonging to an Internet network of supporting teachers is believed to positively affect the use of ICT in pedagogical practices in schools.

Altogether, the studies presented so far provide evidence that in spite of growing attention to teacher training, teachers still encounter obstacles to incorporating ICT into complex teaching and learning situations. However, there has been little agreement on which factors might lead to a successful or unsuccessful integration of ICT in schools. In this context, this paper seeks to remedy this lack of research by empirically exploring possible relationships between these indicators.

Research Methodology

In order to explore teachers' adoption of ICT in educational settings, this paper assesses quantitative data collected in 856 public and private schools, selected from the 2011 School Census from the Brazilian Ministry of Education. The analysis in the pages that follow is based on the results of the ICT in Education Survey 2012, conducted annually by the Center for Studies on Information and Communication Technologies (CETIC.br) since 2010².

The survey investigates the use and appropriation of ICT in Brazilian schools, addressing topics such as ICT infrastructure, ICT use in general activities, as well as the main obstacles preventing actors in the educational system from integrating new technologies into pedagogical practices. Data were collected between September and December 2012 through structured questionnaires specifically administered to four different groups, as follows: teachers, students, directors of studies and principals. Questions addressed topics such as demographic and professional profile, ICT skills and training, ICT use in both administrative and pedagogical activities, as well as perception of limitations to the integration of ICT in education.

With regards to the teachers group, a total of 1,592 teachers were selected for the study. It is worth emphasizing that the target population of the survey comprises public (state and municipal) and private schools in urban areas providing standard instruction for either one of the following levels: Elementary Education I (5th year), Elementary Education II (9th year) and Secondary Education (2nd year).³ However, owing to geographical access difficulties and cost limitations in conducting face-to-face interviews in remote areas, schools in rural areas were excluded from the survey sample. Additionally, federal public schools were not considered for the sample selection due to their unique pedagogical practices. This methodological restriction imposes limitations in terms of statistical representativeness that should be carefully considered when assessing the findings of this paper.

Findings

The findings reported by the ICT in Education 2012 Survey⁴ provide significant insights into the possible impacts of ICT and ICT training on the integration of new technologies in pedagogical activities. Results relevant to this paper are presented in two subsections. The first subsection presents critical information on teachers' ICT use and access to these technologies. The second assesses data on both teachers' perceptions of their ICT skills and ICT teacher training. Factors possibly leading to successful or unsuccessful integration of ICT in schools are discussed in the subsection Factors of Influence on ICT Uptake by Teachers.

Teachers' Access to Computer and the Internet

In order to better understand the adoption of ICT in Brazilian educational settings, it is essential to explore teachers' access to computer and the Internet across the country. The survey findings indicate that most public schoolteachers in urban areas already own computers and have access to the Internet in their households. Considering previous years' findings (CGI.br, 2011; CGI.br, 2012), there has been a gradual increase in the proportion of teachers who own some type of computer device: from 90% in 2010 to 96% in 2012. This figure is considerably high when compared to the national average of households in urban areas with computer access (51%).⁵

Not only was there an increase in computer ownership, but also the type of devices owned by public schoolteachers has shifted significantly. Between 2010 and 2012, there has been a sharp rise in individual ownership of portable computers (25 percentage points), whereas the percentage of desktop computer ownership declined 13 percentage points (CGI.br, 2011; CGI.br, 2012). The findings concerning the rise in personal ownership of portable computers point to a trend towards increasing mobility of devices in schools. Here, it is worth mentioning that nearly half of all public schoolteachers owning this type of device take it to school with them. However, certain attributes were found to affect the use of personal devices at the workplace: the use of personal laptops in school was, for instance, less prevalent among older teachers. When crossing different analysis dimensions, 'Taking portable computers to school' has been shown to be associated with ICT use in educational activities with students. The activities pursued by those teachers who own personal laptops and take them to school were as follows: searching for information with students (57%), conducting projects or assignments on a specific topic (53%), as well as the production of materials by students (47%). However, the association between taking personal devices to school and ICT use in educational activities with students has not been observed in private schools. This scenario possibly reflects a rather more developed infrastructure of ICTs in those institutions.

With regards to the mode of acquisition of personal ICT devices, the findings indicate that 73% of those teachers owning a laptop purchased the device using their own resources, while 93% of those owning a desktop did likewise. In this

context, it is worth noting that it is mainly due to their own efforts that Brazilian public schoolteachers have access to these devices: government subsidies were much less frequently mentioned (16%) as a funding source for purchasing portable computers. These statistics point to a lack of public policies aimed at fostering computer access among teachers. In fact, when comparing the Brazilian case to other South American countries, it is possible to observe some examples of effective policies in this context. According to the Departamento de Monitoreo y Evaluación del Plan Ceibal (2011), for instance, nearly half of all teachers in Uruguay (56%) have purchased portable computers through subsidies provided by the Ceibal Plan, a program developed in 2006 with the purpose of offering free individual laptops to both students and teachers in public schools.

Similarly to computer access, survey results also indicate that most public schoolteachers (92%) in urban areas already have access to the Internet in their households. Internet access via other devices aside from desktop and portable computers has experienced a steep rise over the recent years: while 6% of the teachers accessed the Internet via mobile phones in 2010, this figure climbed to 22% in 2012 (CGI.br, 2011; CGI.br, 2012). With the rise in personal ownership of portable computers, these statistics reinforce the hypothesis of increasing mobility of devices in Brazilian schools. In addition to Internet access, survey results point out a substantial use of Internet among teachers in Brazilian public schools.⁶ Nearly all respondents (99%) stated that they had accessed the Internet in the three months prior to the survey. As far as frequency of use is concerned, public schoolteachers seem to be frequent Web users, as a considerable proportion of them (84%) access the Internet on a daily basis.

ICT Teacher Training

Despite almost universal Internet access at the household level, data analysis has shown that most public schoolteachers still face difficulties when carrying out complex computer and Internet activities, such as developing presentations (49%) and using multimedia software (46%). Regarding activities that require rather basic skills, most public schoolteachers do not have difficulty in searching for information on the Web (93%), writing with text editors (83%) or moving or copying files in a folder (71%). A similar pattern was observed for activities in the Internet: most teachers report not having difficulty with communication activities, as in sending e-mails (87%), instant messages (75%) or using social networks (72%). However, activities concerning the production of content posed a greater challenge to the interviewees. Whereas 25% encountered some difficulty in posting videos on the Internet and 27% in developing or updating pages, remarkably high 43% and 40%, respectively, had never pursued these activities.

With regards to ICT teacher training, the survey has identified an interesting scenario: nearly half (52%) of the public schoolteachers learned to use ICT through specific training, while 48% learned it on their own. The proportion of self-taught teachers has grown in the last years: whereas 40% of them were self-

taught in 2010, this figure increased gradually to 45% by 2011 and continued to increase, but more steeply, to 52% in 2012 (CGI.br, 2011; CGI.br, 2012). In terms of initial training, findings indicate that less than a half of public schoolteachers (44%) had formal training on ICT during tertiary education. Similarly to the mode of acquisition of personal computers, public schoolteachers taking specific training on ICT, to a great extent (73%), paid for the course with their own resources. In the previous editions of the survey, 2011 and 2012, the proportion of teachers who had their courses subsidized by the government/department of education or by the school remained fairly static at approximately 22% and 13%, respectively (CGI.br, 2011; CGI.br, 2012).

Among the types of support received for personal and professional development of ICT skills, a significant 80% cited informal networking or contact with other teaching professionals, and 63% of the respondents mentioned the director of studies of the school as a source of development support. Also, a considerable 29% of public schoolteachers stated having learned to use ICT with other people, such as children, relatives, friends, etc. When considering the patterns of ICT skills development, especially in terms of supporting networks, it becomes evident that formal teacher training is posed a great challenge to enhance teachers' uptake of new technologies. As empirical data reveal that much knowledge is acquired through informal networking, this aspect should be carefully considered in the development of policy measures aiming at integrating ICT in educational settings.

Factors of Influence on ICT Uptake by Teachers

In order to further examine contributing factors for the successful integration of ICT in schools as well as to address the previously posed research questions, *likelihood ratio chi-square statistic*⁷ was performed for the following analysis dimensions. The aim was to assess the relationship between the variables formal ICT training and ICT uptake by schoolteachers:

- (1) Mode of ICT Training/Learning: Self-taught; With another teacher or educator from the school; With students/with a student; With other people (children, relatives, friends, etc.); Taking a specific course; and Formal training on ICT during tertiary education;
- (2) Location of pedagogical use of ICT with students: In the classroom; and In the IT lab/computer room.

Table 1 presents the *likelihood ratio chi-square* tests results, (design-adjusted), testing the hypothesis that two categorical variables are independent. The test results suggest that there is an association between the mode of ICT training/learning - expressed by the variables 'Self-taught' and 'With other people (children, relatives, friends, etc.)' - and teachers' adoption of ICT in the classroom.⁸

Table 1

Likelihood Ratio Chi-Square Test of Association Between Mode of Training/ Training/Learning and Location of ICT Use (in the classroom)

Location of ICT Use: In the classroom	Chi-Square Test	P value
Self-taught	Wald Test: F(1;810) = 4,987	0.026
With another teacher or educator from the school	Wald Test: F(1;810) = 1,16	0.282
With students / with a student	Wald Test: F(1;810) = 0,271	0.603
With other people (children, relatives, friends, etc.)	Wald Test: F(1;810) = 8,209	0.004
Taking a specific course	Wald Test: F(1;810) = 1,139	0.286
Formal training on ICT during tertiary education	Wald Test: F(2;1576) = 1,035	0.354

As presented in Table 2, the variable ‘With another teacher or educator from the school’ has been shown to affect the use of ICT in the IT lab or computer room.⁹

Table 2

Likelihood Ratio Chi-Square Test of Association Between Mode of ICT Training/Learning and Location of ICT Use (in the IT Lab/Computer Room)

Location of ICT Use: In the IT lab/computer room	Chi-Square Test	P value
Self-taught	Wald Test: F(1;810) = 0,038	0.845
With another teacher or educator from the school	Wald Test: F(1;810) = 42,724	0.000
With students / with a student	Wald Test: F(1;810) = 2,475	0.116
With other people (children, relatives, friends, etc.)	Wald Test: F(1;810) = 1,245	0.265
Taking a specific course	Wald Test: F(1;810) = 1,697	0.193
Formal training on ICT during tertiary education	Wald Test: F(2;1534) = 1,89	0.154

Surprisingly, formal ICT training, as in the variable ‘Formal training on ICT during tertiary education’, was not found to influence teachers’ adoption of ICT

tools both in the classroom and in the IT lab/computer room. Overall, the results corroborate the basic ideas of Alonso (2008), as discussed in the Literature Review section of this paper, suggesting that aside from technical skills, there are multiple other factors affecting technology integration in educational environments. Thus, this paper provides further support for the hypothesis that the uptake of ICT as pedagogical tools in schools requires a continuous, network-based and collaborative training environment – rather than merely focusing on formal or technical aspects of ICT – so as to enable an exchange of knowledge and practical experiences among supporting teachers.

The analysis of the data also raises concerns about the reach of formal ICT training initiatives. As exposed by the ICT in Education Survey 2012, the most frequently employed teaching activities regard the instrumental use of ICT, i.e., basic use of technological tools that do not fully take advantage of their potential for teaching and learning activities. This scenario possibly reflects the shortcomings of formal ICT teacher training in Brazil: twenty years after the arrival of the commercial Internet in the country, educational actors have not yet managed to make use of the whole potential offered by the global network, especially in what regards the production of educational resources and contents and the exchange of experience-based knowledge in networks of practice.

Final Considerations

The review of the previous literature has revealed that despite increasing debates over ICT training, schoolteachers still face difficulties in effectively implementing ICT-based tools into complex pedagogical activities. Different authors have thoroughly discussed several factors aside from technical skills affecting technology integration in classrooms. Data analysis has shown that most public schoolteachers in Brazil do not have difficulty in carrying out elementary computer and Internet activities. Yet, despite this promising picture, a considerable percentage has not taken any formal training courses on ICT use or did not have access to training courses provided by governmental bodies. It is interesting to note that even where formal ICT training is undertaken, it was not found to influence teachers' uptake of ICT in schools. This suggests that there is a need for continuous ICT training creates an environment for the exchange of knowledge and practical experiences among a supporting network of teachers.

Overall, in providing some insights on the use of ICT-based tools in educational settings in Brazil, this research seeks to extend our understanding of the use of technologies in educational settings and provide additional evidence on the relationship between formal ICT training and pedagogical use of ICT by schoolteachers. Taken together, these findings might have practical implications for both actors of the educational system and policymakers in the development of public policies aiming at continuing, integrated, network-based ICT teacher training. Further research on this topic needs to be undertaken before the association between ICT training and teachers' pedagogical use of ICT is more clearly understood.

Notes

1. For the purposes of this paper, *formal training* is defined as training activities planned in advance and following a predefined curriculum and a structured format. Examples include both specific courses on ICT and ICT training during tertiary education.
2. In 2012, CETIC.br, a department of the Brazilian Network Information Center (NIC.br) – the executive branch of the Brazilian Internet Steering Committee (CGI.br) –, has carried out the third edition of the Survey on the Use of Information and Communication Technologies in Brazilian Schools – the ICT in Education Survey. The survey was based on methodological frameworks for data collection developed by the World Bank and the International Association for the Evaluation of Educational Achievement. For the purpose of this survey, the questionnaire was adapted to meet the specificities of the Brazilian educational system (CGI.br, 2013a).
3. Portuguese and mathematics teachers were interviewed in the selected classes. Basic subject teachers were interviewed in 5th year classes. In the case of schools selected for interviews in two different classes in the same grade, one teacher per subject and class was selected, thus totaling two teachers each class. For schools selected for interviews in one class and one grade two teachers per subject in each class were interviewed, summing up four teachers altogether. For schools selected for interviews in two different grades, the pursued procedure for each selected grade was as described above.
4. Full results are also to be found on: <http://www.cetic.br/publicacoes/2012/tic-educacao-2012.pdf>
5. Data retrieved from the Survey on the Use of Information and Communication Technologies in Brazil – the ICT in Households 2012 Survey. Conducted by CETIC.br, the survey's main goal was to measure the use of ICTs by the Brazilian population aged 10 years old and over (CGI.br, 2013b).
6. According to the ITU - International Telecommunication Union, the definition of computer or Internet users refers to those individuals who had used the equipment or service within the three months prior to the survey (ITU, 2014).
7. The likelihood ratio test statistic is commonly used to test the hypothesis of independence of variables in two-way tables (Heeringa, West, & Berglund, 2010).
8. *Likelihood ratio chi-square test* fails to reject a null hypothesis of independence between 'In the classroom' and the following variables: 'Self-taught' and 'With other people (children, relatives, friends, etc.)' (at significance of 0.05).
9. *Wald test* fails to reject a null hypothesis of independence between 'In the IT lab / computer room' and the variable 'With another teacher or educator from the school', thus indicating an association between these variables.

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