Methodological Framework for Measurement of Access and Use of Information and Communication Technologies (ICT) in Education

Regional Center for Studies on the Development
of the Information Society (Cetic.br)

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CONCEPT NOTE

1. INTRODUCTION[1]

The 2030 Agenda for Sustainable Development of the United Nations (UN)[2] proposes transformational actions and measures for the prosperity of people and the planet so as to overcome the enormous challenge of promoting, in a balanced manner, the three dimensions of sustainable global development: economic growth, inclusion and environmental sustainability. In this regard, literature suggests that access to and adoption of information and communication technologies (ICT) have tremendous potential to integrate and accelerate sustainable development. Therefore, measuring and monitoring the expansion of access to ICT and its use within each of the 17 Sustainable Development Goals is essential for the process of designing and monitoring public policies that are able to drive transformations for humanity.

Education plays a central role in the agenda put forth by the UN, since it is both a fundamental right and the foundation for countries to progress. It is an indispensable means for individuals to develop their abilities and maximize their possibilities to learn, produce and create. One of the agenda's goals (SDG 4) refers to quality education, which should *ensure inclusive and equitable quality education and promote lifelong learning opportunities for all* – challenges that, undoubtedly, could be overcome by the adoption of ICT for the provision of access to information and as an educational tool.

Moreover, information and communication technologies serve as catalysts for achieving other goals, such as: SDG 1 – *End poverty in all its forms everywhere*; SDG 5 – *Achieve gender equality and empower all women and girls*; SDG 9 – *Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation*; and SDG 17 – *Strengthen the means of implementation and revitalize the global partnership for sustainable development*. The provision of quality education and the development of new ICT competencies and skills for the 21st century should be regarded as effective strategies for reaching these and other targets of the long-term agenda for sustainable development.

In addition to the Sustainable Development Goals, the UN promotes another international agenda, the World Summit on the Information Society (WSIS)[3]; which seeks to reduce the digital divide and increase access to the Internet. The 11 action lines of the WSIS cover themes related to education and culture, in addition to embracing other themes such as ICT infrastructure, access to information and knowledge, ICT capacity building, ICT applications, cultural and linguistic diversity, ethical dimensions of the information society, and media and freedom of speech, among other topics linked exclusively to ICT access and use.

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[1] This document is based on the article entitled "ICT Education Survey: from inclusion to a digital culture", written by Leila Rentroia Iannone, Maria Elizabeth Bianconcini Almeida and José Armando Valente, at the request of the Regional Center for Studies on the Development of the Information Society (Cetic.br).

[2] The 2030 UN Agenda for Sustainable Development is a set of programs, actions and guidelines to steer the work of the United Nations and its member states toward sustainable development. The 2030 Agenda sets forth 17 Sustainable Development Goals (SDGs) and 169 corresponding targets. More information at: <https://sustainabledevelopment.un.org/post2015/transformingourworld>.

[3] More information at: <http://www.itu.int/net/wsis/>.

The internationally agreed-upon goals, action plans and targets in the Sustainable Development Goals of the 2030 Agenda and the goals of the World Summit on the Information Society are important benchmarks for establishing a transformational vision to guide the conception of a methodology and set of indicators for measuring ICT access and use in education.

Furthermore, the production of comparable indicators must also take into consideration the spurring changes in ICT adoption, particularly regarding the multiple Internet-based applications and mobile devices. In the case of school-age children, the dissemination of digital devices (tablets, smartphones and video game consoles) has been even more intense, creating numerous opportunities to draw them into an increasingly connected world. Researchers and policymakers recognize that the use of these devices, as well as access to broadband networks, has important social and cognitive implications in the lives of children in the school context, since they transform the ways in which children socialize and interact with their peers, families and schools (CGI.br, 2015). These facts, coupled with the advent of new and renewed demands in the educational field, led the Regional Center for Studies on the Development of the Information Society (Cetic.br)[4] – in collaboration with the UNESCO Institute for Statistics (UIS), the Working Group on Measuring ICT from the Statistical Conference of the Americas (SCA-ECLAC), representatives from the ministries of education from a number of Latin American countries, and academic researchers, to recommend the creation of a methodological framework to measure ICT (computer, tablet, smartphone and network) access and use in education, which includes proposed survey objectives, a set of dimensions for measurement, a group of indicators, and a methodological approach to sample survey design, methods, techniques and instruments for data collection.

In summary, this effort is aimed at creating a framework that defines appropriate dimensions and indicators for providing answers related to the regional context in Latin America and the global setting, based on the systematic production of statistics that are not only internationally comparable but that also take into consideration each country's demands in terms of public policies.

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[4] The Regional Center for Studies on the Development of the Information Society (Cetic.br) was created in 2005 as a department of the Brazilian Network Information Center (NIC.br), linked to the Brazilian Internet Steering Committee (CGI.br). In 2012, a cooperation agreement was signed, making it a Category II Center under the auspices of UNESCO. The Center is linked to the Information and Communication sector and it contributes to the institution's strategic objectives by strengthening its efforts to monitor the building of information and knowledge societies. Its regional work covers Latin America and Portuguese-speaking countries in Africa. The Center's lines of action comprise activities designed to contribute to a more informed debate on the importance of ICT measurement for public policy making and exchange of experiences among key actors engaged in investigating the intersection between society and technology topics and their implications for building knowledge societies. The Center works on four lines of action: i) Capacity Building in Survey Methodologies; ii) Knowledge Center: iii) Laboratory of Ideas; and iv) Culture and Ethics on the Internet. More information at: <http://www.cetic.br>.

2. STARTING POINT: "ICT IN EDUCATION" SURVEY PROJECT – CETIC.br

Since 2005, the Regional Center for Studies on Information and Communication Technologies for the Development of the Information Society (Cetic.br), under the auspices of UNESCO, has been conducting specialized surveys on ICT aimed at the regular production of statistics on access to and use of information and communication technologies in different segments of society, providing important input for the process of formulating sector-based public policies. One of the surveys Cetic.br has been conducting since 2010 is the survey "ICT in Education", which investigates the use and appropriation of computers and the Internet in public and private schools (elementary and secondary) in urban areas of Brazil.

The survey was initially designed in 2008/2009 with the institutional support of the Ministry of Education of Brazil, UNESCO Brazil and the technical and methodological support of a group of academic researchers specialized in the intersection of education and digital technologies. As the methodological framework for the creation of indicators and data collection instruments, the survey drew on the work conducted by the *International Association for the Evaluation of Educational Achievement* (IEA), released in two publications: *Sites 2006 Technical Report: Second Information Technology in Education Study* and *Sites 2006: User Guide for the International Database.* Also used as a reference was the *Guide to Measuring Information and Communication Technologies (ICT) in Education* from the UNESCO Institute for Statistics. Based on the available international references, the methodology and questionnaire were created to meet the specific needs of the Brazilian school environment, as well as the needs of different sectors of society, such as government, academia, civil society organizations and the private sector.

The first wave of the survey began in 2010, when Cetic.br established a Group of Experts (GE) as a regular consulting forum for the ICT in Education survey. The group of experts is composed of renowned specialists in the field of education and technology, academic researchers, and representatives from government agencies, international organizations, and civil society organizations (see Table 1).

Table 1. Composition of the group of experts for the Brazil ICT in Education Survey

Government and International Organizations	Academia	Civil Society Organizations and Consultants
• Ministry of Education of Brazil • United Nations Educational, Scientific and Cultural Organization – UNESCO • National Council of Secretaries of Education – Consed • National Union of Municipal Education Leaders – Undime • Brazilian Institute of Geography and Statistics – IBGE • Institute for Applied Economic Research – Ipea	• Pontifical Catholic University of Paraná – PUC-PR • Pontifical Catholic University of São Paulo – PUC-SP • Pontifical Catholic University of Rio de Janeiro – PUC-Rio • Federal University of Ceará – UFC • Federal University of Minas Gerais – UFMG • Federal University of Rio Grande do Sul – UFRGS • State University of Campinas – Unicamp • University of São Paulo – USP	• Educadigital Institute • Ação Educativa • Paulo Montenegro Institute • Victor Civita Foundation • REA Brasil and New America Foundation • Safernet • Independent consultants in education and media

UNESCO cetic.br

United Nations Educational, Scientific and Cultural Organization   Regional Centre of Studies for the Development of the Information Society under the auspices of UNESCO

The GE contributes to the ICT in Education survey project in meetings that validate the indicators and methodology and define guidelines for the data analysis. The collaboration of the GE is essential to identifying new fields of investigation, perfecting methodological procedures and ensuring the production of high-quality and reliable data.

The universe examined by the ICT in Education survey, as well as the units of analysis and dimensions currently investigated (2010-2015) are presented in Table 2. The results of the ICT in Education survey in Brazil have become increasingly important for understanding the current scenario and trends related to the pedagogical use of new technologies and the Internet in Brazilian schools, especially in terms of the role of teachers as key agents for the dissemination, appropriation, and use of ICT in educational institutions.

Table 2. ICT in Education: Survey Universe, Units of Analysis and Research Dimensions

Survey Universe	Units of Analysis	Research Dimensions
• Public schools (municipal and state) • Private schools	• Principals • Schools	• Demographic and professional profiles • Computer and Internet use profiles • Management, planning and interaction activities • ICT infrastructure • Barriers to use
	• Directors of studies	• Demographic and professional profiles • Computer and Internet use profiles • Coordination and planning activities • Barriers to use
	• Teachers (Portuguese and mathematics)	• Demographic and professional profiles • Computer and Internet use profiles • Computer and Internet skills • Specific training • ICT activities with students • Barriers to use
	• Students (Elementary Education I and II; Secondary Education)	• Demographic profiles • Computer and Internet use profiles • Computer and Internet skills • Specific training • School activities

In the field of measuring ICT in education, the survey model developed by Cetic.br has been adopted and conducted for six years and has resulted in an important repository of knowledge on the subject. The ICT in Education survey publications are aimed at disseminating survey results and also feature articles written by experts, methodological reports, data analyses and tables of indicators with their respective results.

Reference center for the production of ICT statistics

Throughout its history as a data producer, Cetic.br has become an internationally renowned center of excellence in the production of ICT statistics and currently has an important voice in national and international discussions on the standardization of indicators and methodological definitions for the production of ICT statistics. In 2012, the Brazilian government signed a pioneering agreement through which Cetic.br became a regional center operating under the auspices of UNESCO. It is UNESCO's first center of studies on the information society.

Among the five sectoral areas covered by UNESCO, the Center is linked to the Information and Communication sector and it contributes to the institution's strategic objectives by strengthening its efforts to monitor the building of information and knowledge societies. Its regional work covers Latin America and Portuguese speaking countries in Africa.

The Center's lines of action comprise activities designed to contribute to a more informed debate on the importance of ICT measurement for public policy making and exchange of experiences among key actors engaged in investigating the intersection between society and technology topics and their implications for building knowledge societies. The work of Cetic.br is based on four lines of action:

- Knowledge Center: Dissemination of information and knowledge, including survey methodologies, indicators, analyses and thematic publications.

- Capacity Building in Survey Methodologies: Capacity-building in survey methodologies for using statistics in the development and evaluation of public policies and academic research.

- Laboratory of Ideas: Debates, lectures and discussion panels with experts to explore emerging topics related to the social impacts of ICT.

- Culture and Ethics on the Internet: Investigation of the intersection of topics related to culture, ethics and the Internet and studies on the ethical dimensions of using the Internet and its social implications.

In the context of internationally comparable indicators on ICT, Cetic.br actively participates in permanent forums maintained by international organizations that define methodologies and indicators for ICT measurement, particularly in the areas of health, education, households, enterprises, digital economy and media literacy. Of note are forums of the International Telecommunication Union (ITU), United Nations Conference on Trade and Development (Unctad), Organisation for Economic Co-operation and Development (OECD), United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Economic Commission for Latin America and the Caribbean (ECLAC)/Statistical Conference of the Americas (SCA).

The new demands to understanding the role that ICT plays in the educational field, in addition to the prospect having this survey methodology serve as a reference for international initiatives to measure ICT in schools, led Cetic.br to revise the current framework used in the ICT in Education survey. In light of the effort required to reformulate the ICT in Education survey, a temporary Working Group was created to guide Cetic.br in the preparation of a proposal for the revision of the survey model that had been consolidated over the past six years. Three group members were responsible for systematizing the discussions between experts and producing a first version of the base document (Concept Note): Prof. Leila Rentroia Iannone PhD (Scientific Coordinator of the ICT in Education project and Working Group coordinator), Prof. Maria Elizabeth Bianconcini de Almeida PhD (Pontifical Catholic University of São Paulo) and Prof. José Armando Valente PhD (Unicamp). For the composition of the Working Group, Cetic.br considered multiple perspectives on the interface between ICT and education, as well as the particularities of the regional context of Latin American countries.

The objective of this concept note is to justify and recommend paths for the process of reformulating the current ICT in Education survey and support the development of a structured conceptual framework that can be adopted and disseminated by UIS/UNESCO to measure ICT use and appropriation in education and also to allow its adoption by other countries based on these definitions and a shared methodological framework.

3. MAIN POINTS RAISED BY THE WORKING GROUP AND ADDITIONAL CONTRIBUTIONS FROM THE GROUP OF EXPERTS

The Working Group met in March 2016 to discuss the methodology and indicators used in the ICT in Education survey in its previous six editions (2010-2015) and the relevance of reformulating the survey on other levels, considering:

- Progress, obstacles and challenges facing basic education in Brazil and Latin America in recent years, given the spiraling growth of digital culture in society;
- Posing the issue of digital culture being at the core of the new ICT in Education survey;
- The findings and results of the previous surveys regarding the current meaning of integration of ICT in basic education, within a context of change and innovation.

The experts' ideas for suggested changes were organized into eight categories that contribute to the construction of a framework for the new survey architecture. The categories are presented below:

- Equitable access to ICT infrastructure (no one left behind);
- Spaces for learning both in and out of schools and tools available for ICT use;
- ICT and curriculum;
- Digital culture competencies and skills of students;
- Digital culture competencies and skills of teachers;
- Teacher training;
- Actions of school managers;
- Actions of public administrators (policy makers).

4. ASSUMPTIONS FOR REFORMULATING THE SURVEY MODEL

The core focus of the ICT in Education survey is to provide input for public policies that promote the integration of ICT in the educational context, specifically schools, by investigating motivations and barriers related to the implementation of existing policies, supporting the measurement of their results and contributing to the design of new strategies. The survey reformulation process and the production of this base document were guided by the following assumptions:

- The objectives, plans and international goals involving the interface between ICT and education, particularly the Sustainable Development Goals (SDG) and the goals of the World Summit on the Information Society (WSIS), served as a starting point for the reformulation of the survey design.
- Although the field of interest of the ICT in Education survey is the theme of education in its full amplitude, it monitors ICT access and use in Brazilian schools (public and private elementary and secondary education). The focus, therefore, is formal education and the primary unit of study is the school environment. It is important to bear in mind that other efforts to measure ICT access and use through other surveys such as households or safe ICT use by children and adolescents, which can approach education from a cross-cutting perspective, enable cross-referencing of data that would not be possible in the ICT in Education survey.

- The ICT in Education survey has generated an important time series over the past six years on ICT access and use in Brazilian schools (2010-2015), which is an important and uncommon asset in the field of Brazilian social research on this issue. From this point of view, the reformulation process must identify the indicators that should be preserved as to maintain the time series of of the study's key indicators.

- The ICT in Education survey uses a quantitative sampling methodology (survey) that enables results that are representative of its study universe. In this regard, the definition of dimensions and indicators needs to consider the strengths and limitations of this method as well as understand its differences from other common approaches in the area (such as structured evaluations, policy evaluation techniques, qualitative methods and/or mixed [qualitative/ quantitative] methods).

- The idea of change is inherent in all activities performed through digital media and technologies. Thus, any analysis of the degree of appropriation of ICT by a particular social group applies within a specific context, and can be quickly surpassed by its subjects as they reach the next level, while other groups may be moving into the most basic level of technology appropriation. Changes, therefore, do not occur simultaneously, or with the same intensity and to the same degree in different scenarios, which promotes different processes of inclusion, appropriation and transformation of ICT by these subjects. It is important to capture these different processes with this study.

5. BASIS FOR CONSTRUCTION OF A CONCEPTUAL FRAMEWORK FOR THE PRODUCTION OF INDICATORS: THE DIGITAL CULTURE PARADIGM

In the late 1990s, with the possibilities opened up by ICT use, an international agenda was put forth to address digital inclusion. The major issue was how to promote democratization of access to technologies, so as to include everyone in the information society. As computerization measures were implemented – such as telecenters, information centers, computer labs, subsidized computer purchases, incentive policies for free software use, expansion of the Internet – access to information technologies were made accessible to more segments of society, using them as a means of communication, social interaction, consumption, etc. Even though digital culture is practically universal in our society, many schools still do not use ICT or have not developed more innovative and open practices, as they do not have access to such technologies or the institution's conditions do not allow them, especially in terms of infrastructure and teacher training.

In the first decade of the 2000s, the discussion on digital inclusion began to take into consideration the inequities surrounding effective ICT use and appropriation. At present, the spread of mobile technologies with wireless Internet connection has ushered in new possibilities of continuous use of the features, applications and services offered by these technologies, giving rise to a debate about the Internet of Things (IoT). The social use of mobile technologies, represented by different devices – which characterize ubiquity – is causing more intense and visible changes in the meanings that people associate to relationships, life, technology and knowledge, intensifying the development of the so-called "digital culture".

Even though digital technologies have gained tremendous ground among all social classes, challenges still remain regarding access to technologies and networks, such as the availability of broadband in households. From a general perspective, digital inclusion is yet to be achieved for a significant portion of the population of countries in the Global South, despite the advances achieved over the last two decades, driven by public policies on computer and Internet use, economical computer models, and installation of public Internet access points. This issue encompasses a range of challenges that go beyond access to technology and is part of a complex process of democratization of social, cultural, economic and educational uses of ICT. The spread of mobile devices that can be connected to the Internet (laptops, tablets, iPads, smartphones, etc.) expands the potential for access, creation and circulation of information, interaction, social participation, and integration into formal, nonformal and informal education, providing new possibilities for reducing and perhaps overcoming the digital divide (Castells, 2003).

All citizens have the right to access and appropriate the symbolic instruments and technological artifacts that make up the digital culture as "authors and producers of ideas, knowledge, proposals and interventions that provoke actual transformations in their life context" (Bonilla; Pretto, 2011, p.10). One of the first to address the connection between technology and culture in the contemporary context was Pierre Lévy in his book *Cyberculture* (1997). He discusses the cultural impact – on the arts, entertainment, education and cities – of media and information and communication technologies. He also examines the propositions and problems arising from cyberspace development, understood as the "network," the new means of communication that arises from the global interconnection of computers. Lévy defines "cyberculture" as "the set of techniques (material and intellectual), practical habits, attitudes, ways of thinking and values that develop mutually with cyberspace" (Lévy, 1999, p. 17).

It is increasingly clear that ICT, especially the Internet, the World Wide Web and mobile technologies, allows people to do things they could not do, or never imagined they could do, before. ICT is transforming the world and people, their ways of thinking and understanding their own identity. Current ways of interacting and participating in social networks calls into question concepts of social relationships, the identity of individuals and the understanding of what constitutes a community or group of friends. In addition, the multiplicity of texts and languages (multimodality, encompassing visual, sound, space and body languages, etc.) requires an understanding of the multiliteracies that expand the attribution of meanings to different modes of representation and attribution of meaning (Kress, 2000).

However, contrary to what is generally thought, it is not just technology that determines or contributes to the creation and evolution of digital culture. Charlie Gere, in his book *Digital Culture* (2008), conducts a long and thorough study of the emergence of digital culture and shows that technology is just one of the sources that has contributed to the development of this culture. Other sources include technical and scientific discourses on information systems, avant-garde art practices, counterculture movements, critical theory and philosophy, and even subcultural formations such as punk. The author notes that these different elements are as much a product of the paradigm of abstraction, codification, self-regulation, virtualization and programming as computers. Therefore, that which is identified as digital culture should be recognized in the light of recent technological developments and other knowledge that has been built. Gere (2008) argues that this culture is not new and cannot be determined merely by technological advances.

It is more accurate to suggest that digital technology is a product of digital culture, rather than vice versa. As Gilles Deleuze points out, 'the machine is always social before it is technical. There is always a social machine which selects or assigns the technical elements used.' (Deleuze; Parnet, 1977, pp. 126-127). Digital refers not only to the effects and possibilities of a particular technology. It defines and encompasses the ways of thinking and doing that are embodied within that technology, and which make its development possible. (Gere, 2008, p. 17).

Efforts to characterize or conceptualize digital culture are complex, since it deals with the junction of polysemic terms (Buzato, 2010). The term "culture" can be used for "national culture," "pop culture," "organizational culture," "digital culture," etc. As Buzato points out: "Each one of these meanings refers to one or more knowledge production fields – Anthropology, History, Literary Criticism, Sociology, Cultural Studies, etc. – and each of these fields, in turn saturates the word with its particular axiologies." (2010, p. 71). The same occurs with the term "digital," as previously mentioned. Technological development in the last 30 years has been exponential, making it almost impossible to keep pace with what has been produced. Furthermore, the appropriation and use of these technologies is another area of extreme innovation and, for the most part, surprising creativity.

Buzato (2010) emphasizes some significant assumptions. First, digital culture should be seen as a living thing that moves and is constantly updated. Therefore, "To think of digital culture as a 'shared repertoire' (of signs and meanings, practices, values, customs or anything else), demarcated by some criterion is just and only just an analytical maneuver." (p. 71). Second, the study of culture should assume that there is no "one" culture. It is precisely the encounter with other cultures that helps "one" specific culture to be understood and enables the renewal and transcendence of each culture. In addition, one culture does not eliminate another. They generally complement each other and intertwine, requiring people to take on an attitude of openness and flexibility to live with the diverse and multiple.

The solution for studying digital culture is to make use of techniques used by researchers on culture, in the sense of addressing cultural boundaries, i.e., "any description or mapping of a culture done 'from the outside' must be supplemented by other descriptions made 'from within'." (p. 72). Finally, concurring with Gere's proposal (2008), Buzato suggests that digital literacy should be seen as mediation and not as reflection. "As mediation, digital culture is only a collaborator with what we call the network society (or information society). Already contained within it are conflicts, domination and subordination. It involves all the dynamics that are processed in social practice." (Buzato, 2010, p. 85).

Few authors define what digital culture is. In the Brazilian context, this debate was proposed by the former minister of culture of Brazil, Gilberto Gil (2004), and by authors such as Bianca Santana and Sergio Amadeu (2007) and Anna Helena Altenfelder et al. (2011), from the Center for Studies and Research in Education, Culture and Community Action. These definitions emphasize the issues of the Internet, access to information, the act of sharing (Pretto; Assisi, 2008), human relationships and productions, and the fact that digital culture is related to the customs and values of Brazilian society. Spanish sociologist Manuel Castells (2011) breaks digital culture down into six topics:

1. Ability to communicate with or mix any product based on a common digital language;

2. Ability to communicate from local to global in real time and vice versa, to dilute the interaction process;

3. Existence of multiple modes of communication;

4. Interconnection of all digitized networks of databases, or realization of Ted Nelson's dream of a hypertext with a storage system and data recovery, called Xanadu and introduced, in 1965 – it was the first global project based on the idea of hypertext through non-sequential writing;

5. Ability to reconfigure all configurations, giving new meaning to the different layers of communication processes;

6. Gradual formation of the collective mind by networking, through a set of brains without limit; on this point, referring to the connections between a brain network and the collective mind.

The importance of this definition is that it is not centered on a particular technological apparatus and does not try to explain the lack of skills in a particular community or during a certain historical period. Digital culture also includes the ability to deal with the continuous flow of information disseminated via digital media. The full exercise of this ability implies developing other skills, such as: searching for, selecting, analyzing, and assessing the validity of information, in addition to and producing and sharing knowledge in coordination with the accessed information. The challenge, however, is being able to operationalize these ideas within a specific segment, such as education. In light of this, some other elements and attributes that are part of the concept of digital culture in schools are outlined below.

5.1 DIGITAL CULTURE IN SCHOOLS AND SCHOOLS IN THE DIGITAL CULTURE

Indications of immersion in digital culture can be seen in what occurs in a considerable number of segments of society and how their actions and interactions have been altered by the presence of technology. However, one of the segments that still leaves much to be desired in this regard is schools. On this subject, Buckingham (2010) refers to the gap that exists between the world of children outside schools and the emphases being targeted in educational systems. By all indications, actors related to schools – managers, teachers and students – outside institution walls enjoy many benefits of digital culture, whereas educational institutions, or more specifically classrooms, have still not partaken of these advances. Buckingham also believes that schools are a place for negotiations and discussions between pedagogical concepts and cultural values. However, he notes that there is a contrast between the high levels of activity and enthusiasm that characterize children's consumer cultures and the passivity that increasingly suffuses their schooling.

For much of the time, working with ICT in schools has meant implementing high-cost projects and programs focused more on providing technology and infrastructure than on people, their ideas, values and beliefs. That is, more emphasis has been placed on technological objects than on teacher training and engaging in teaching practices so that the technologies would bolster curriculum development and learning. While these initiatives were not being effectively integrated into educational activities and failed to promote changes in school culture – being limited to isolated actions within certain disciplines –, the emergence of digital culture in society has led to another approach, with wider dissemination and impact, that has been generating changes of a tremendous magnitude. These changes affect education and permeate the pedagogical sphere through the introduction of innovative concepts, translated into the social practices of the people working within education (Almeida, 2016).

This trend, stemming from intensive use of media and digital technologies, has been gaining strength in different social segments due to the spread of portable devices (tablets, laptops, smartphones, etc.) associated with mobile connections. This can be seen in social practices that assign new meanings to physical mobility and mobility of information and knowledge (Lemos, 2009), to the relationships between those practices and the production of new information in authentic learning situations, and in the assignment of meaning to events and relationships (Almeida; Valente, 2011). Practices inherent in digital culture bring about changes in schools and intersect with curriculum development (Almeida, 2014).

Researchers and educators in the United States and European countries have proposed these so-called digital competencies and skills of the 21st century as ways for students to prepare to live in and enjoy society inserted in a digital culture. These competencies are divided into three main areas: i) cognitive, involving learning strategies and processes, creativity, critical thinking; ii) intrapersonal, related to the ability to deal with emotions and shape behavior to achieve goals; and iii) interpersonal, involving the ability to express and interpret ideas and discuss and respond to the stimuli of other people.

In a document that defines ICT competency standards for teachers in the 21st century, UNESCO (2008) lists the technological competencies to be developed by students: skills for using available ICT, research development, analysis and critical selection of information, problem solving, creativity in the use of productivity tools, production of information and knowledge, collaboration, communication, responsibility, participation and contributions to the betterment of society.

These competency standards for teachers are based on three levels of ICT appropriation: "Technology literacy, knowledge deepening and knowledge creation" that are developed through "six components of the educational system – policy and view, curriculum and evaluation program, pedagogy, ICT, organization and administration, and teacher training." (p. 5).

The role of teachers in digital culture is aimed at the highest level of appropriation defined by UNESCO (2008). Thus, the creation of digital culture in schools and their participation in that culture are related to a set of competencies that develop gradually, according to the characteristics of each school milieu. Within every school unit there are teachers with different competency levels, which

has a bearing on the ways they incorporate ICT into their teaching. Thus, it is expected that surveys in this field will find that while some schools embrace digital culture, others stand further away.

5.2 CURRICULA AND ICT INTEGRATION: DILEMMAS BETWEEN EDUCATIONAL PRACTICES AND DIGITAL CULTURE

The concept of curricula is always linked to pedagogical intent and entails a commitment to promoting knowledge, whether in a transmissive way or through individual and collective construction of student knowledge, or even curriculum development from multiple perspectives. The core of a curriculum is knowledge (Pacheco, 2016), considered as a historical, social, temporal and cultural production, encompassing both its formal organization and the teaching and learning processes.

From this perspective, it is the responsibility of schools to provide students with an education that goes beyond mere instruction focused on acquiring information and is geared toward the understanding of knowledge and development of cognitive, social, cultural and civic potential. In light of the transformations of social practices that have been strongly influenced by digital culture, education comes across dilemmas that lead to a false idea of the conflict between two visions of curricula. One cannot ignore the history of education, but rather needs to assign new meanings to education, given the integration of ICT into everyday life and social practices (Bercker et al., 2005), creating areas of convergence between digital culture, social practices, public policies and educational goals.

A planned curriculum, as expressed in curriculum proposals within the political pedagogical projects of schools and teachers' lesson plans, includes the integration of systematized knowledge considered "socially valid" (Smith, 1995, p. 8) for everyday knowledge and experiences, which are made explicit in socioeducational relationships and with the cultural instruments of contemporary society, including media and digital technologies (Almeida; Valente, 2011).

A digital culture curriculum (curriculum defined as a set of intentional and non-intentional activities developed in the teacher-student relationship) integrates required curriculum knowledge with the knowledge that emerges from the educational act itself, knowledge and experiences of teachers and students, languages, symbols, values, cultures, and respective instruments, mobilized in dialogical pedagogical practices, which are developed through the mediatization of ICT (Almeida, Valente, 2011). In this process, all participants have opportunities to interact, create productions (nodes) and carve out different epistemological paths (links) of learning. From this complex integration of elements, scenarios and circumstances, web curricula emerge, understood as a set of intentional and unintentional actions composing educational itineraries or learning pathways (Almeida, 2014).

Faced with the dilemma of transmissive school cultures, which are still prevalent in many situations, and the more collaborative digital culture present in society, public policy makers and educators are called upon to take on more active roles in actions that can induce the qualitative leap required by education, placing schools within the cultural historical era. This implies favorable infrastructure conditions, availability of technology, and Internet connections in schools, so that teachers, students and other professionals can exploit the potential of technologies to move a considerable number of schools in the direction the digital culture is moving. This would entail reorganizing themselves according to the modes of production of rationality inherent in the information and knowledge society, set in opposition to the rationality and ordering of traditional education (Gimeno Sacristán, 2010). At

the same time, it is necessary to take action to supply the needs of schools that show themselves to be more integrated into this movement.

It is a question of using the potential of ICT to link schools to the connected society, integrated with different physical and virtual spaces that work with knowledge. This would create hybrid learning contexts that favor the development of dialogical, contextualized and constructive education, in a critical and creative relationship with digital media and technologies (Almeida; Valente, 2014), aimed at human development, reflection, intentionality, ethics and creativity.

Schools that participate in and interact with digital culture play a key role in shaping students who are make decision independently, defend their ideas, work in groups, take an active and critical approach to situations, difficulties and challenges, and participate in social transformation.

In schools like this, the potential of ICT is incorporated into their practices by using mobility, connection and multimodality to enable authorship on the part of students who: seek information from different sources; establish new relationships between information, systematized knowledge and knowledge that arises from the connections in networks or are generated through life experiences; reconstruct knowledge represented by multiple languages and non-linear structures; and interact and work in collaboration with peers and experts located in different places (Almeida, Valente, 2011). Also worth noting are new practices that spread among students and gradually penetrate school spaces, such as:

- Use of digital games and development of new games by students;
- Participation in social networks and communities created on the Internet built around themes of interest;
- Use, creation and sharing of open educational resources available on the Web;
- Production of videos, animation and digital narratives about student experiences;
- Use and creation of applications on special themes from school curricula, such as simulations or virtual experiments;
- Student participation in virtual science laboratories;
- Collective participation in the creation of virtual cities and discussion of their problems;
- Creation of digital glossaries for specific topics.

There are other practices, applications and interfaces that arise, with strong potential to promote active, interactive, authorial and collaborative learning. School integration into digital culture is made possible by the appropriation of media and digital technologies by managers, teachers, students and their families, and other school professionals for:

- Establishing multicultural dialogue;
- Identifying and posing problems related to everyday knowledge of students, encouraging them to turn this knowledge into objects of study and research, which are developed in combination with the content of school curricula and other content sought from different sources and networks;
- Accepting diversity and freedom of speech;

- Being open to inclusion, solidarity and collaborative work;

- Questioning the reliability of information (critical thinking);

- Taking a stance regarding everyday events;

- Creating conditions for democratic experiences that contribute to exercise citizenship in physical and virtual environments seeking to make social changes and achieve the common good.

5.3 FACTORS THAT PROMOTE DIGITAL CULTURE IN SCHOOLS

There are multiple factors that can help build digital culture in the school environment, premised upon continuous Internet access in schools and community spaces that is public and free for all actors in schools, as well as parents and members of surrounding communities. It is essential to think in terms of continuous availability, quality and adequate capacity of technology infrastructure of schools, which should include effective policies to support and maintain ICT infrastructure (networks, equipment, software, applications, etc.) in good working condition.

Another factor conducive to the creation of digital culture in schools is identifying already-available spaces for the creation of networks among education professionals, where they can interact and take advantage of available materials, such as lesson plans and technological resources, while also sharing experiences and exchanging materials with colleagues. Websites provided by the Ministry of Education or created by schools themselves or their communities are examples of this.

The use of online learning platforms to complement or facilitate new pedagogical approaches, such as active learning or flipped classrooms (Valente, 2014), is a factor that favors the development of digital culture. As generators of knowledge and promoters of authorship by students and teachers, schools could then start to serve as venues for dialogue, discussion and the search for solutions to real problems.

The creation of content by teachers and students can be done using various software, interfaces and media technologies to produce materials and serve as knowledge development sources that also promote digital culture in schools. Students can be authors, creating stories in digital narratives or even in virtual books on specific themes. In such projects, teachers have the opportunity to contribute to the learning and knowledge-building process of the students by identifying employed concepts that are worth revising, refining, amplifying or correcting.

Since schools are still strongly based on verbal and printed literacy, expanding the concept of literacy to incorporate new digital media is also a factor that facilitates the development of digital culture. Due to the convergence of media, it is important for students to know how to use other media resources to represent and express their knowledge, such as images, sound, videos, etc. However, this does not necessarily mean the inclusion of digital literacy courses in curricula, but the cross-cutting integration of these media into the curricular activities of the various disciplines, promoting the development of digital narratives on different topics that can be addressed in an interdisciplinary way, using different media. For example, Roxane Rojo (2010) explains that media and ICT enable literacy or multiliteracy practices, such as:

> ... the addition of the prefix "multi" to the term literacy is not something restricted to the multiplicity of reading and writing practices that mark the world today: contemporary literacy practices involve multiplicity of languages, semiosis and media involved in the creation of meaning for contemporary multimodal texts, as well as plurality and cultural diversity brought by contemporary authors/readers to this creation of meaning. (ROJO, 2010, p. 1).

Rojo (2012) refers to certain characteristics of multiliteracies that have a direct influence on school practices by emphasizing that they are interactive and collaborative; infringe on the relationships of power and property; are hybrids; and come from a mixture of languages, media, technologies and contexts.

The relationship between local and global can be encouraged, for example, through GPS or dynamic navigation maps available on the Internet; or the relationship between the formal school context and contexts outside schools, non-formal (museums, galleries, culture points financed and supported by the Ministry of Culture, etc.) and informal (public squares, community events, bookstores, etc.) (Almeida; Valente, 2014; Valente; Almeida, 2014). These are also factors that favor the development and consolidation of digital culture.

The promotion of digital accessibility through assistive technologies (screen readers, audiovisual teaching materials with audio descriptions, sign language translators, QR code, etc.) stimulates the creation of digital culture in schools, not only by considering individuals disabilities, but also, as Boll and Kreuzt (2010) argue, by action resulting from the singularities of the subjects.

Investigating school insertion within digital culture means considering schools as a fundamental units of action and training for teachers and students, parents and guardians, and school communities. Since the first place where digital culture emerges is within society and the family, in addition to schools, which are responsible for pedagogical programs and teaching practices where the essence of curricula materialize, it is essential to consider the link between schools and the family life of students, represented by their parents and guardians.

6. DEFINING THE METHODOLOGICAL FRAMEWORK FOR THE NEW SURVEY MODEL

The current methodological framework for the ICT in Education survey (2010-2015) serves as the basis for the proposal of a new framework. Some dimensions of the current model are still relevant in the context of this proposal, whereas others need to be updated due to rapid and complex changes in the situations of schools: introduction of innovation; effects of public policies to promote democratization of access, appropriation and widespread use of new technologies; adoption of new applications; and social networks in the daily life of schools.

Taking into consideration the analysis of these changes, the contribution of experts, the guiding principles that triggered this study, the Sustainable Development Goals, the goals of the World Summit on the Information Society, the document "ICT skills standards for teachers – implementation guidelines" (UNESCO, 2008), it was decided to base the new survey model on the issue of digital culture.[5]

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[5] In the case of Brazil, the following were also taken into consideration: the current legislation regarding the initial education requirements for teachers (Resolution number 2, July 1, 2015 of the Brazilian National Education Council; and documents on the development of educational goals, such as the National Education Plan – Law 13005, June 25, 2014 (Brazil, 2014).

Figure 1 presents the proposed conceptual model for structuring the ICT in Education survey, whose main line of investigation is the relationship between institutionalized school culture, the emerging culture of each school's individual practices, and digital culture. In other words, the survey investigates how schools in digital culture and the insertion of digital culture in schools; i.e., as schools appropriate ICT and the cultural products arising from it and, at the same time, act as generators of knowledge and information through their actors (students, teachers, directors of studies and principals), ICT will be disseminated among the groups and niches that make up the digital culture.

Classrooms are viewed as microcosms where public policies, curricula, ideas and social relations are converted into actions and where the main interactions between actors occur, especially in regard to teacher-student and student-student relationships. However, digital culture is also present in other areas of the school environment, such as libraries, computer labs, staff rooms, principals' offices and shared social spaces of the students, which must also be investigated in the survey.

Schools are also set within communities, which also influence them and in which they act as propagators of knowledge and information. Communities, represented by the parents and guardians of students, are also a sphere that should be included within the survey's scope of investigation. It is the same in the political sphere which, through the formulation of curriculum guidelines and policies for access to and use of technology, changes school positions in relation to digital culture.
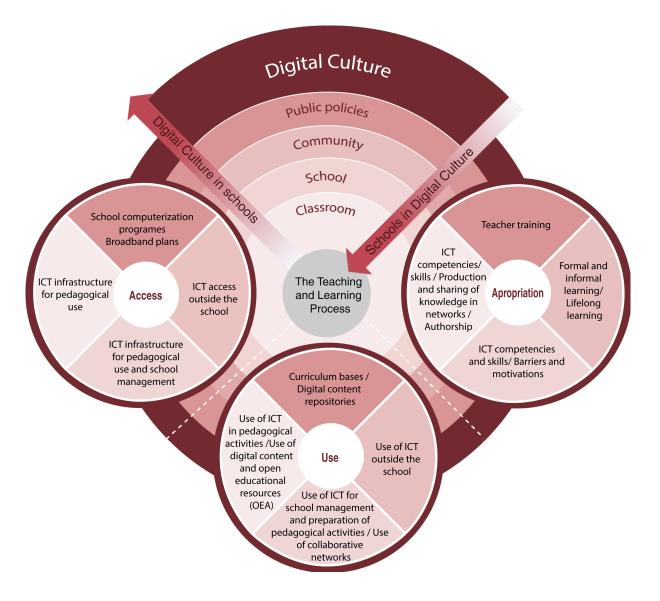
Bearing in mind these spheres and actors, the methodological framework of the survey seeks to understand three dimensions of analysis in relation to digital culture: access, use and appropriation. In each sphere, as well as the interaction between actors, these dimensions give rise to specific indicators. Access is understood as the availability of means to carry out projects in classrooms (teaching resources) and schools (teaching and school management resources), as well as the use of educational content outside the school environment, such as access by mobile devices. Public policies operate in the access dimension through programs to provide infrastructure for the use of devices and the Internet.

The use dimension includes the way actors draw the knowledge and information they need from ICT to carry out projects and enhance the teaching and learning process. The appropriation dimension encompasses the indicators related to the production, mixing and sharing of information, knowledge and cultural activities with the development of competencies.

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Figure 1. Conceptual model for defining the measurement dimensions and indicators

The new framework for the ICT in Education survey should guide the application of a quantitative sampling methodology, which enables results that are representative of its study universe. Taking into account the dimensions and indicators, the potential and limitations of approaches using sample surveys, and understanding their differences in relation to other common approaches in the field, the conceptual framework also allows for adopting other methodological approaches, such as qualitative case studies.
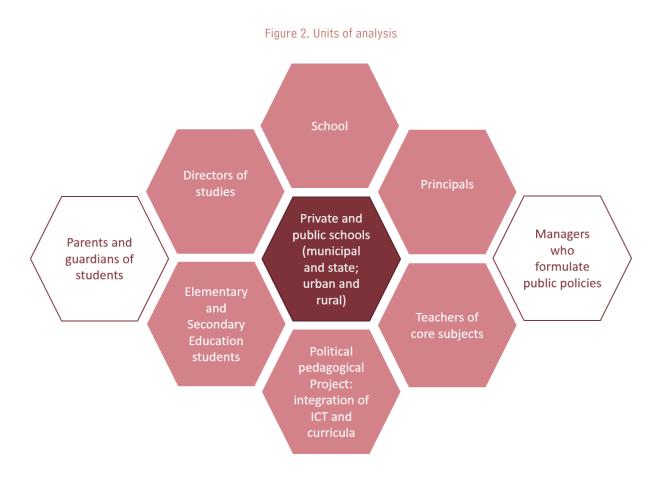
Based on this perspective, a new design for the survey is being proposed, as outlined below.

Survey universe

The survey should include urban and rural public and private schools.

Units of analysis

Figure 2. Units of analysis

- Schools;
- Political pedagogical project: integration of ICT and curriculum;
- School managers: principals and directors of studies;
- Teachers of core subjects: national language, mathematics, geography, history and science;
- Elementary and Secondary Education students (adjust to ISCED levels);
- Parents and guardians of the students (optional);
- Managers who formulate public policies (optional).

The proposed universe, units of analysis and dimensions for defining the suggested methodological framework are presented in Table 3.

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Table 3. Proposed Methodological Framework: Survey Universe, Units of Analysis and Research Dimensions

Survey Universe	Units of Analysis	Research Dimensions
• Public schools (municipal and state/ urban and rural) • Private schools (urban and rural)	• Schools	• Infrastructure of schools • ICT infrastructure • Integration between ICT and the political pedagogical project • Partnerships with communities and surrounding areas • Participation in social networks • Partnerships with other institutions (governmental and non-governmental) and other public and non-public equipment
	• Political pedagogical project: integration of ICT and curricula	• Integration of ICT in curricula, lesson plans and work projects • Identification of curricular components for pedagogical use of ICT in initial teacher training • Identification of use of media and ICT in pedagogical practices (communication, creation of content, planning, use with the community, administrative matters, personal and pedagogical matters, pedagogical practices – development of projects, problem-solving, exercise and practice, simulations, gaming, authorship by students) • Barriers to use
	• School managers: Principals	• Demographic and professional profiles • Computer and Internet use profiles • Management, planning and interaction activities • Barriers to use • Location, interpretation, creation and sharing of multimodal information • Interconnection with global and local networks • Mixing of languages, media, technologies and contexts and configurations of the different layers of communication and education processes • Use of ICT for integration between the pedagogical, administrative and technological dimensions and shared management • Leadership in the integration of technologies with school political pedagogical projects • Leadership in collaborative work in schools and with other agents outside schools • Promotion and incentives to carry out successful experiments
	• School managers: Directors of Studies	• Coordination and planning activities • Training of teachers in schools for pedagogical appropriation of ICT • Guidance for teachers for and about integration of ICT in lesson planning and work projects and for integration of curricula and technology

▶ conclusion

Survey Universe	Units of Analysis	Research Dimensions
• Public schools (municipal and state/ urban and rural) • Private schools (urban and rural)	• Teachers of core subjects: national language, mathematics, geography, history and sciences	• Demographic and professional profiles • Computer and Internet use profiles • Location, interpretation, creation and sharing of multimodal information • Interest in pedagogical appropriation of ICT and use in classrooms • Initiative for self-training • Competency to integrate digital media and technologies in specific pedagogical practices • Specific training for pedagogical appropriation of ICT
	• Elementary and Secondary Education students (adjust to the ISCED levels)	• Location, interpretation, creation and sharing of multimodal information • Use of media and ICT in classrooms (communication, creation of content, personal matters, development of projects, problem-solving, exercise and practice, simulations, gaming, authorship by students) • Focuses of interest of students in using media and ICT in everyday life • Focuses of interest of students in using media and ICT in classrooms • ICT use by students with special needs
• External actors (parents)	• Parents and guardians of students (optional)	• Impressions and how they view school actions in the pedagogical use of ICT • Extent of the pedagogical activities inside and outside school property • Knowledge about school pedagogical projects • Consistency between what schools say and practices regarding ICT use • Satisfaction in relation to infrastructure conditions • Perception of progress in ICT use • Understanding how children interpret and comment on ICT use in school assignments
• External actors (managers)	• Managers who formulate public policies (optional)	• Knowledge about the dimensions of the policies and problems for implementing digital culture in schools • Analysis of future scenarios and pursuit of public policies

7. NECESSARY DEVELOPMENTS FOR THE CREATION OF THE METHODOLOGICAL FRAMEWORK: NEXT STEPS

Policymakers face new challenges in the field of education when aiming to ensure universal access to digital technologies as pedagogical tools in the school environment. The situation experienced by schools imposes the need to measure the potential impact of ICT in education in order to face the challenges of ICT implementation, use and appropriation in schools, as well as maximize the opportunities for change in educational processes through the use of ICT. Therefore, creating a methodological framework that enables ICT measurement in education and the production of reliable, high-quality and internationally comparable data is an essential initiative for formulating public policies in education.

Sample surveys are the most commonly used, systematic method of collecting information in the social sciences to understand social behavior and gather relevant information, mainly through the use of questionnaires. Surveys can also be seen as a set of various interconnected steps, including: survey planning (development of concepts, methodology, indicators and data collection instruments); data processing; production of estimates and projections; data analysis; and dissemination of results to interested parties.

The production of internationally comparable data on ICT access and use has been discussed at the national and international levels, but there is still a shortage of systematic, reliable and comparable statistics with a focus on education. In this regard, the proposal of a methodological framework is an important contribution to ministries of education and the international community involved in the discussion about ICT in education.

The next steps for the construction of the methodological framework containing guidelines aligned with best practices for the production of statistics includes the following components:

1. Definition of the survey objectives.
2. Definition of the information sources.
3. Definition of the appropriate methodology for data collection.
4. Sampling plan.
5. Target population.
6. Units of analysis and domains of interest for dissemination.
7. Procedures for processing and weighting of data.
8. Definition of the data collection instruments (specific questionnaires for each public).
9. Cognitive test and pretest procedures.
10. Interviewer training procedure.
11. Documentation: database, data dictionary.

The historical series of indicators gathered for the ICT in Education survey since 2010 can serve as the groundwork for defining indicators in the new framework. Table 4 shows the indicators used in the survey's last edition:

Table 4. Indicators collected in the 2015 edition of the ICT in Education survey according to the new methodological framework

Spaces for teaching and learning	Indicators		
	Access	Use	Appropriation
Classrooms	• Permission to use mobile phones in classrooms • Presence of desktop computers in classrooms • Availability of Internet access in classrooms	• Internet use in classrooms • Use of portable computers and tablets in classrooms • Use of computers by teachers in activities with students in classrooms • Use of digital resources to prepare classes and activities with students: types of resources, frequency of access, platforms used, reasons for use, forms of use, publication, and verification.	• Guidance given by teachers to students through the Internet • Perception of students of ICT use in teaching and learning activities • Activities carried out by teachers with students using computers and the Internet • Perceptions of directors of studies of ICT use in classrooms • Perceptions of teachers, directors of studies, and principals of the changes brought about in schools due to the use of ICT in pedagogical activities.
	Access	Use	Appropriation
Schools	• Adopting didactic materials accompanied by digital materials • Use of student's and teacher's own portable computers in school • Frequency with which students and teachers take their own portable computers to school • Location of Internet access • Permission for students to use the school's Wi-Fi network • Permission for students to use mobile phones outside of classrooms • Types of connection used by students to access the Internet • Structure of human resources related to ICT (IT lab monitors, teachers and/or IT technicians) and the role of each professional	• Internet use by students in school activities • Location of Internet use in school by students in school activities • Social networks used by students to carry out school assignments • Location of computer and Internet use by teachers in activities with students • Frequency of computer lab use by teachers in activities with students • Use of teacher' own computers or school computers to carry out activities with students • Use of mobile phones to access Internet with students • Use of school computers and the Internet to carry out administrative school tasks	• Perceptions of teachers, directors of studies, and principals of the challenges to ICT use in school • Perceptions of teachers of ICT use in schools • Perceptions of teachers, directors of studies, and principals of priority actions for the integration of computers and the Internet into teaching practices • Perceptions of directors of studies of initiatives carried out as a result of the introduction of ICT in schools, especially in the work of teachers, developing teacher-student relationships, and with parents and legal guardians • Teacher training activities on ICT and education carried out in schools: number of participating teachers

Spaces for teaching and learning	Indicators		
	Access	Use	Appropriation
Schools	• Professionals responsible for the school computer and Wi-Fi maintenance services • Presence of computers in schools: types of computers, number of functioning computers, installed operational systems, location of installation, and computers available for pedagogical use • Presence of computer labs: number of functioning computers installed with Internet access • Computer maintenance and software updates • Presence of Internet access in schools: type of connection and speed • Presence of Wi-Fi Internet access in schools • Restrictions on Wi-Fi use by students • Websites, resources and platforms maintained by schools (blogs, institutional websites, virtual learning Environments, etc.) and the content available on these channels	• Schools that use an online management system • Location in schools of portable computers, tablets, and Internet use • Computer lab use by the school community	• Perceptions of directors of studies and principals of the presence of guidance on ICT use in the politico-pedagogical projects of schools • Schools that offer lectures, debates and courses about responsible Internet use • Usage restrictions on devices by schools (blocking adult content, games, and social networking sites) to promote safe Internet use
	Access	Use	Appropriation
Communities	• Internet access: time of last access, location and frequency of access • Type of computer present in the household (desktop computers, portable computers and/or tablets) • Devices used to access the Internet • Internet access via mobile phones	• General activities carried out with computers and the Internet (desktop computers, portable computers and/or tablets) • Type of computer used to carry out general activities • Location of Internet use by students (at home, at school, someone else's house, public access centers, cafés, churches) to carry out school activities • Use of social networks	• Strategies used by teachers and students to learn about and update themselves on ICT use • Teacher initiatives to access training courses about ICT use in teaching and learning activities • Teachers whose tertiary education included a specific subject on how to use computers and the Internet in teaching and learning activities with students

▶ conclusion

Spaces for teaching and learning	Indicators		
	Access	Use	Appropriation
Public Policy	• Services provided by government institutions related to the maintenance of school computers and Internet networks • Adherence to institutional programs related to the implementation of technological infrastructure in schools	• Principal's knowledge of the Civil Rights Framework for the Internet (Marco Civil da Internet) • Influence of government institutions on teachers' motivation to use digital resources • Teacher use of platforms, repositories, and portals developed by government institutions	• Ongoing education programs on ICT use in teaching and learning activities provided by government institutions • Perceptions of teachers of ongoing education courses about ICT use in teaching and learning activities offered by government institutions • Influence of training programs on the adherence and motivation of teachers in the use ICT in teaching and learning activities

7.1 OTHER METHODOLOGICAL APPROACHES

Considering the difficulties of collecting data that is more qualitative in nature using a quantitative survey model, other methodological approaches can be used to better understand how families participate in learning movements with the use of ICT, and ICT use in inclusive and special education. Qualitative approaches using focal groups, collective interviews and/or non-directive interview with family their children can be used to help understand the participation of each aspect.

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