Assessment Experiences in Digital Technologies in **Education**

Telefónica FUNDAÇÃO | vivo

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Clarification: UNESCO maintains, at the heart of its priorities, the promotion of gender equality in all its activities and actions. Due to specific aspects of the Portuguese language, this publication includes masculine words in order to facilitate reading, considering a large number of words of this nature throughout the document. Although some words were written in the masculine gender, they likewise refer to the feminine gender.

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Preface

The boundaries between ***education*** and ***technologies*** have become increasingly narrower. Many initiatives in this field have been devised and launched by social organizations, governments, and companies.

Still, not many studies and approaches have tackled challenges, dilemmas and opportunities of evaluations carried out in projects that combine ***education*** and ***innovation***. So, how to evaluate those initiatives? Which methods may be used? What do evaluations underway may inform about?

In order to answer these questions, the Telefonica Vivo Foundation and UNESCO Office in Brazil, aware of the importance of assessing educational projects, joined efforts in 2015 to form the **Evaluation Panel: Education and Digital Technologies**, with the support of MOVE Social. The meeting paved the way for an interesting debate on how evaluations have come close to initiatives that harness new digital technologies in education, by exploring challenges, dilemmas, and possibilities for methodologies and assessment practices. In this forum, national and international projects including evaluations within this context were submitted.

During the discussions, dealing with reality and challenges posed by methodologies of existing evaluations was possible, as well as exploring new possibilities. A new assessment paradigm must be shaped to produce results and data as complex as technology-related education projects. To achieve this, it is necessary to take project evaluation into account, seeking to highlight new methodologies which are being created, adopted and implemented in order to generate proper inputs.

The debates were so enriching that they resulted in a proposal aimed to include some reflections in this publication. We hope views herein presented may encourage readers to follow the path of innovation these experts, national and international, also travelled in search of a quality education and dialogued with the reality of digital world.

The Telefonica Vivo Foundation and UNESCO Office in Brazil share the commitment to point out innovative approaches.

The Telefonica Vivo Foundation stands out for projects that seek ***educative innovation***, with the aim of developing multidisciplinary and current skills, focusing on digital fluency. This includes forming a new generation of young leading societal figures, producing knowledge through new methodologies, tools and experiences that go beyond technology. Because innovating means that: transposing pre-established models. For its part, UNESCO has been supporting projects and developing guidelines to orient and stimulate mobile education.

About Telefonica Vivo Foundation

The Telefonica Vivo Foundation has been developing projects for 17 years in Brazil in the fields of ***education, social entrepreneurship and digital citizenship***, with the aim of interconnecting people and institutions to transform the future, making it more generous, inclusive and fair.

In order to form more responsible citizens, the Telefonica Vivo Foundation believes in the power of knowledge, and thus invests in research on digital culture and young people. To let people access information, the foundation provides a digital collection that includes free contents. The Telefonica Group owns foundations in over 16 countries across Latin America and Europe.

UNESCO

Since its creation in 1945, the United Nations Education, Science and Culture Organization (UNESCO) has worked to contribute with peace culture among peoples, poverty eradication, long-lasting development, and intercultural dialogue, regarding education as an essential course of action to meet these goals.

To achieve such goals, UNESCO takes a holistic and humanist view of everyone's right to quality education. In this connection, the organization understands the importance of technologies thus combining efforts to build a digital citizenship that fosters safe and responsible use of new digital technologies that encourages involvement and construction of critical thinking; that ensures equity of access and gender equality in the development of strategies to teach relevant skills for children; and that strengthens teaching work, favouring dialogue between formal and non-formal learning. Technology is an important tool to adopt an approach that encompasses school issues and allows the encounter of those two worlds.

Good reading!

Introduction

Assessment of digital technologies used in public education

Daniel Brandão[1] and Ana Carolina Vargas[2]
MOVE Social/Brazil

The use of technologies and digital devices to widen access to quality education is a phenomenon in full expansion, which invites people to reflect deeply on the future of teaching and learning processes. Knowing the real capacity digital technologies have to contribute to education is of the essence for this initiative to move forward. This requires regarding processes evaluation, results and impact as a key tool to undertake these actions. In this regard, the question arises about how efficiently and effectively these proposals may be assessed and what we can learn from ongoing assessment experiences.

The panel named Evaluation, Education and Digital Technologies devised by the Telefonica Vivo Foundation, UNESCO Office in Brazil, and MOVE Social proposed studying specific experiences involving the assessment of digital technologies used in education in Brazil and Latin American. Besides purely theoretical analyses, it was deemed necessary to consolidate learning methods by undertaking empirical actions through case study. A previous thorough mapping of experiences was conducted to select a wide and panoramic set of experiences – therefore called panel – which is capable of showing the state of the art in ongoing assessments.

This publication gathers articles relating to the experiences previously addressed and seeks a summary – knowing that any summary is limited – about aspects

1 MOVE Executive Director – Evaluation and Strategy in Social Development. <http://www.movesocial.com.br/>.
2 MOVE Project leader – Evaluation and Strategy in Social Development. <http://www.movesocial.com.br/>.

involving attention during the assessment of projects that target educational transformations through digital technologies. The divide in these analyses rests on the relation between digital initiatives and schools, escaping from the complex dimension of public issues and demanding dynamics for innovations in an education network. This includes topics herein discussed and other questions not mentioned during the panel's debates.

The following summary is organized in three categories related to assessment of use of digital technologies in public schools: (a) on the school's conditions to adopt technology, (b) the outcome of digital efforts in schools, which guides assessments approaches, and (c) approaches and methods defining assessment steps and operations.

Ongoing assessments revealed a structural aspect, related to conditions for the entry and continuance of digital trends in schools' environments. This aspect is called the ***three dimensions to adopt digital technologies in schools*** and primarily encompasses the infrastructure dimension. It is characterized by the school's physical and structural conditions to receive a wide range of equipment requiring power supply, Internet access and distribution, and security (to avoid theft). The school's physical conditions and existing equipment are essential to provide and keep an educational technological solution. This dimension becomes more complex in efforts targeting rural communities, where access to conditions is generally more limited. The second dimension has to do with the ***technical*** field, or in other words, the ability of students, teachers and administrators to deal with new digital technologies. Such dimension is related to development of competences for skilled use of technologies, as well as to different formative efforts intended by ongoing initiatives. However, this usability fully hinges on the third dimension, the ***political*** one, which according to studies, is the most complex. This aspect embraces the dialogue among people involved in the initiative to set the course of the proposal, in other words, what are their objectives and their relationship with the school project, and to what extent it is part of the desire and intentions of teachers and administration. The premise is that for digital technologies to be worthy, they must meet clear needs previously reckoned by the school. There were concerns noted from administrators in understanding that the trend initiatives to implement digital technologies must show ***themselves***. In other words, even though these projects are conceived as good ideas, many times they are structured under an approach with no grips with the reality of school, a fact that casts some doubt on its relevance.[3] A meaningful word used

3 ***Relevance*** and ***merit*** are basic concepts of assessment. In order to explore this research in depth, reading articles by Michael Scriven (1991) is recommended.

in assessments described such interventions as "gobbledygook," which means a contradiction in terms of contemporary identity that digital projects intend to reveal.

One of the analysed cases found that families' involvement is a pivotal element for the project, acting as a detractor in a scenario where they failed to understand school changes and new proposals, or as an enthusiast, when the meaning behind the inclusion of digital technologies in school environments is clearly understood. This arrangement, which makes up the political dimension, also relates to the coordination among initiative financial backers, many times foundations or business institutions, and technology implementing partners. Their expectations, in relation with time, nature and type of results or roles may be differentiated. In these situations, the assessment has shown to be a valuable resource when initiating the debate on the assessment approach, the intervention goals, logic and audience, thus using tools such as the ***evaluation model***, the logic framework or the ***theory of change***.

The space created by assessment allowed partners to renegotiate the orientation of digital intervention.

Carefully setting the project's goal for the school requires adaptation time in the institution's environment, as well as dialogue with the many players. Once the technology is installed, its outcome may take place in different time frames, which may exceed one school term. As for assessment, experiences that accompanied projects throughout the cycle and generated initial, partial and final information where all temporary evaluation typology was involved (baseline, formative, process, monitoring, result, impact), made large contributions when adjusting current strategies, and for allowing to modulate the perception of the results of deliverability for the period of time of the intervention. This led to greater understanding of what was possible and desirable within a context where initiatives were developing.

The relationship between the magnitude of results and their maturation time prepares the ground for new analyses. The panel dealt with two kinds of projects: the first one marked by activities ***stricto sensu*** associated with digital technology without parallel support actions or activities. Actions like these are more similar to the scale logic as they turn into a solution ready to be spread in a wide range of schools. The latter, however, may find different conditions of installation, as described before, which tends to reduce governance of results proposed. The

other sort of digital actions is greater and coordinates multiple efforts to help pave the way for ideal situations for technological use. This may be achieved through structural reshaping, training processes, establishment of bodies for democratic project management, strengthening of inclusion of proposals in other institutions, like pedagogical meetings, and actions seeking to make the school visible in order to influence other schools, among others. Such projects have increased the number of potential transformations and demand attention to clearly shape the transformation chain. In this chain, the different dimensions of a project's results are understood, as related to a particular audience, and strengthen the involvement of students in monitoring results. Students naturally tend to understand the pursuit of change, showing interest in new and relevant fields.

The panel contributed significantly to the development of this perspective when given the green light to the systematization of ongoing result dimensions among projects, presenting aspects of the assessment that demand attention. Despite some considerable internal variations[4], interventions proposed act on multiple and complementary axes, thus building up a systemic and comprehensive vision over education. The dimensions are as follows:

a) ***Students' performance*** – considers traditional academic skills shown through grades and standardized tests, as well as knowledge of other skills (regarding relationship, emotion, identity, among others), expressed through trends including skills for the 21st century (C21)[5], the four pillars of learning of UNESCO[6] or the Socio-emotional.[7] Undoubtedly, cognitive evaluation, besides school grades, is perceived as one the major challenges for assessments, for they deal with new concepts that did not obtain registered operation proceedings.

b) ***Teachers' skills and practical actions*** – reckons teacher's ability to lead a group of students and introduce digital technologies in classrooms or in

4 These variations are expressed and operated by indicators of each project.

5 According to the evaluation model of MOVE Social, the skills for the 21st century are mentioned: communication, collaboration, judgement and decisions, problem solving, creative thinking, joint creative work, digital fluency and autonomy (life plan), as well as basic skills: development of the Portuguese language and mathematical thinking. MOVE Social. ***Evaluation Report Connected Rural Schools Zeferino Lopes de Castro Municipal School***. First data collection (2014). MOVE Social and Telefonica Foundation. Project 570 BRZ 1012. UNESCO. February 2015. Available at: <http://gelpbrasil.com/wp-content/uploads/2015/05/Relat%C3%B3rio-final_MOVE_Viam%C3%A3o.pdf>. Accessed: July 27 2016.

6 The four pillars of learning established in the Delors Report are: ***learning to know, learning to do, learning to live together and learning to be*** (Delors, et al., 2012).

7 For further information, see: Instituto Ayrton Senna (n.d.); OCDE (2015).

other places regarded as educative. Teachers' training is well connected to the concept of ***Technological Pedagogical Content Knowledge*** (TPACK), quoted by members of the panel.

c) ***School's pedagogical management*** – the dimension that shows the existence of reflection and orientation about the use of technologies in institutional spaces designated to train teachers, with activities or meetings involving teachers. In this field, pedagogical coordination appears as the leading player and actions related to it to help use existing technologies among the projects mapped. When entering pedagogical management, experiences claim, through assessments, the need to deal with events that go beyond the digital field: support for organization of spaces for pedagogical management, collective assessment on the teachers' learning guidelines, among others. An unexpected result was the strengthening of the pedagogical coordinator in the identification and conduction of their training role. The planning or institutionalization of digital technologies within pedagogical management came with the presence of technological devices and uses in the framework of ***pedagogical political plans*** (PPPs).

d) ***School's management*** – the dimension that despite being taken less into account for projects analysed in the panel, has ongoing specific technologies being developed. It involves mainly the school's principal and his or her assistant, yet demands monitoring relations between such players and the pedagogical coordination, where the pedagogical administration-orientation balance lays its grounds.

e) ***Family-school relation –*** the dimension that overlaps with the others, yet stands out for its importance as a specific category. Parents' involvement in the school's adoption of digital technologies links aspects ranging from understanding the proposal to assessing situations with students who assumed responsibility for technological devices and took them home. In this way, the family was influenced to use such devices. Digital technologies may encourage new debates in family gatherings, which allows the consideration of school's pedagogical proposal as a whole.

f) ***Infrastructure*** – the dimension that assesses physical and structural conditions helpful for installation and maintenance of digital devices to undertake actions in pedagogical processes. In other words, it is both a field of tangible transformation that can be easily observed, and a determinant for making many ongoing projects viable.

g) ***Influence on public education network*** – the dimension about the relationship between schools engaged in the initiative and municipal networks they belong to. We observed clear interest in including in the assessment field questions connected with the potential of inspiration that schools branded as innovative prepared for technicians and public managers, or even their ability to influence decision-making in municipal or state-run secretariats, as in the case of Brazil, or bodies that protect departments and the like, in the case of other Latin American countries.

These seven dimensions of results clearly show the wide potential and diversity of the impact that digital technologies may have in the school universe. The assessment must back projects to arrange methodologies, coordinate these initiatives with expectations in changing times and create mechanisms able to report accurately and timely on progress and limitations of interventions. For such reason, it is impossible to avoid concerns about how to evaluate the outcomes and impact of digital technologies, entering the domain of assessment techniques and methods. The panel voiced hope that projects of that nature provide "digital evaluations," that is to say, harness technological resources to guide evaluation processes. To some extent, this is now possible in the evaluation of platforms that support trainers and trainees. This occurs once such scheme has generated a large number of data that may be analysed using contemporary approaches of network studies, for instance, by generating relevant information on access, use, relations, production, among others

However, this does not seem to be main question with regards to methods. In this connection, it is necessary to acknowledge once again the idea that there is no specific approach to assess the use of digital technologies in public schools. Basically, this is about discussing evaluations, their classification, definitions and forms, regardless of the object in question. The panel tackled, for instance, the well-known conceptual dispute over "impact evaluation" where econometric groups claim the studies that only responds to experimental or quasi-experimental criteria may be called as such. Advocates of the school of mixed methods and other approaches have put up resistance. This also brings into focus, in the field of digital technologies, a debate on the evaluation of ***causal relations*** and ***technical assessments***. In the following pages there is a great and strong plurality of techniques which are being used in projects; their systematization and debate may help strengthen mechanisms able to collect real data accurately and rigorously. In this process, digital technologies largely

affect solid progress on developing instruments to assess the performance of skills, apart from academic grades. Designing and trying questionnaires or qualitative resources, like situational focus groups and analytic rubrics, constitute a vast field multitasking professionals are to explore in the upcoming years. What is clear for everyone involved in the panel is that this development escapes from digital technologies projects, yet demands interaction with ongoing productions in the various fields of education.

Still, in debates over assessment ***lato sensu***, the ways to communicate and provide transparency to outcomes of evaluations must be a reason to give attention to digital initiatives. Structuring objective means that contain design resources to brief different audiences on findings, adding plural language and stories, is the responsibility of assessment teams. Transparency of items included in the current agenda of private social investors and governments, and public access to assessment reports is a highly recommended step. This transparency qualifies the reputation of publishing organizations, allows other projects to learn through evaluations, and helps enhance the very evaluation field when expounding forms and premises that guided evaluate processes

Finally, the panel reinforces the remarkable advance of this agenda in Latin America as this document gathers some experiences to inspire learning and guide solutions regarding assessment for initiatives leading with this challenge.

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Assessment of digital technologies applied to education

In this publication, aimed especially at Latin America, displays examples of programs and projects that, upon including digital technologies in planning, stimulated strong change processes in schools and intensified the debate on real possibilities and challenges of innovation. In scenarios preparing the ground for experiments, new practices and adjustments were recorded, different from those requiring teachers to stand in front of students looking at the blackboard and reproduce only book contents. However, even the initiatives perceived as successful – that led and lead school communities to changes in practices and contribute to the development of skills for the 21st century – still face many challenges, as revealed by results from previous evaluations using indicators and methodologies specifically about technological impact in schools.

As shown in this publication, the discussion and evaluation of perspectives to be adopted from the analyses of experiences involving technology in education are not ruled by regional or world standards. Projects herein mentioned were assessed in the way administrators perceived as necessary to meet parameters for local and national evaluation.

In their view, there is still a lack of information to prove that better results in learning curriculum are obtained if any digital technology is present. There is evidence on the contribution, yet no consensus between educators or researchers, on whether teaching with the support of ICTs is more effective. Francesc Pedró (UNESCO/Paris) and Claudia Peirano (Grupo Educativo/Chile) discuss the reasons why uncertainty has risen, coinciding on a crucial point: they believe that technology needs to be perceived as important and useful by teachers and

students within the educational context. The experts agree that nowadays there is a predisposition of society towards the use of digital technologies in personal life, yet this trend does not reach schools immediately. In formal teaching environments, changing traditional practices and methodologies requires both an attractive and effective pedagogical proposal for educators. The best laptop, distributed in large amounts, will not guarantee change if such device is not reckoned as an instrument able to make students learn more and better, like Pedró claims.

For teachers, managers and students to perceive the potential of technologies, they must be a true interest in restructuring the school. In this sense, we ask: who needs to engage in the restructuring? Pedró and Peirano show figures, quote examples and mention aspects that, in their view, are of the essence to answer that question. They talk about public policies and ponder on pedagogical models and how the issue of evaluations is resumed to debate projects underway.

Education, technology and assessment: towards an effective pedagogic use of technology in the classroom

Francesc Pedró[8]
UNESCO/Paris

Towards the perfect storm

All over the world, it appears that the endeavours made in the past decades to transform teaching and learning have not born fruit. We continue to have a school that is very similar to the one we had twenty years ago, precisely when the Internet was gaining popularity. In twenty years, digital technologies have made great strides that have altered, sometimes radically, our lives, from work to our daily routines. Yet, it seems as if the school has escaped from such transformation. In fact, there is much research and data that suggests the relative resistance to change in the educational system. Nevertheless, there are signs of a perfect storm approaching, that is, a combination of factors that could eventually lead to a window of opportunity for a pedagogic change that would finally utilize technology's potential to improve the quality and productivity of school processes at all levels, from administration to assessment of learning.

There are three fundamental factors. The first factor, referenced to for many years, regards to the rates of adoption of technologies for social and communicational uses amongst adolescents, and more and more, amongst children. This first factor, whatever its the effects on the cognitive, social and emotional development of young people, predisposes them to function differently in school, including, obviously, with the technology that is already part of their daily routine outside of the classroom and found even in their pockets (Davie, Panting & Charlton, 2004). The second factor, which is much more recent, is the surge of multiple firms that offer added-value services, such as contents and, of course, educational applications. The density of such offer, free or commercial, is so high that soon we will probably stop using the term "educational technology" and we will simply refer to them as applications and digital content (Pedró, 2013).

The third factor is the near universalization of devices for individual use, such as tablets and smart phones, that are within reach to an overwhelming proportion of students and virtually all teachers in developed countries. Paradoxically, teachers themselves are major users of those devices for activities they deem

8 Director of the Educational Policy Sector of UNESCO, Paris. <www.unesco.org>.

appropriate, yet they do not always include them in the processes of teaching and learning, but, increasingly use them in everything related to preparation of their lessons, let alone their personal activities (Purcell, 2013).

Therefore, we start to have data that attest to the significant levels of utilization of technology in the classroom in some countries. The data also suggests that first families, then teachers, are changing their attitudes towards the use of educational technology to transform teaching (Empirica, 2013). These are still incipient signs, but they invariably bring us closer to the pedagogic change that is so often advocated for and so few times materialized. Finally, some good news, albeit with some nuances: Will school systems and their administrators manage to weather the storm?

Both in Europe and most of Latin America, educational innovations have been possible only because of the latest developments of technological industries. The rule of thumb, however, is that these are specific cases. Nonetheless, the unavoidable question is about where school systems have managed to cash in on the opportunities rendered by technology, that is, where would one have to travel to appreciate in all its glory and complexities a systematic educational innovation due to technology does not have an easy answer. A review of the findings of the PISA study (2012), shows that the top rankings are distinctively occupied by countries with relatively little use of technology in schools (Finland, South Korea or Japan) along with countries with widespread use of technology (Singapore, the Netherlands or Estonia) (OECD, 2015). The conclusion drawn from such ambivalence is, simply, that rather than the presence or absence of technology in schools, the quality of the results in education mostly relates to the adopted pedagogy and the conditions for its implementation in the classroom.

In this regard, teachers' professional abilities, facilities, and incentives for their continuous development are the key. Thus, where such abilities are optimum, technological resources help upgrade the quality of learning and, concomitantly, expand the horizon of what can be learned. This is apparent, for example, in the case of experimental and social sciences. When void of such conditions, the use of technology in schools generally translates into new problems for teachers, rather than aiding their efforts.

When lowered to the level of the school or the classroom, nuances of the contribution of technology to the transformation of education fade away. There is indeed a transformation of the school, yet it is beginning behind the scenes. It is

quiet, almost imperceptible, yet real. In fact, data confirm that an overwhelming majority of teachers in European countries are customary users of technology in their private lives, but more surprising is the majority uses technological solutions to prepare their lessons.

Likewise, the use of technology in schools for administrative purposes is on the rise, including the use of platforms that facilitate communication between students and their families outside of school hours. Students, for their part, do not need anybody to explain to them how to capitalize on technology to do their homework, although they do not always do it accordingly as they lack educational support for that matter. In the work of teachers in the classroom, technology has amassed a fortune as a presentation tool, yet not for personalized learning, let alone for the longed transformation of educational processes. Notwithstanding, little by little, slowly and quietly, the circle is narrowing.

This window of opportunity needs to be seized. Making a push towards this pedagogic transformation means, once again, to move closer to teachers, analysing their needs together with them, and, based on the findings, suggest pedagogic solutions that, in many cases, but not always, should include technological components. This is the reason why technology initiative prevailing in education are those that mostly offer relevant and efficient services to teachers to help solve problems or meet the needs of students. In addition, the purpose is to not have more technology in schools, but something more important, which is that the students can learn more and with better quality. In such cases, this depends on two variables: appropriate working conditions in the classroom (equipment, connection, schedules, etc.) and the professional skills of the teacher that can be used to their advantage.

Why, in the end, does it not work? An explanatory model

Multiple models attempt to explain the factors that influence the acceptance of innovative technologies of well-known processes in the daily routine of many users. Davis' model is the most commonly used in empirical research in education (Davis, Bagozzi & Washaw, 1989). Based on this model, two fundamental factors help to anticipate whether a technological solution will be successfully adopted or not. These factors are: ease of use, which is largely related to the required professional or personal skills; and the perception of the usefulness of the proposed solution. In other words, the user should feel capable of technically mastering the proposed solution. More importantly, there needs to have a clear perception of the benefits

brought by the solution. In the absence of one of the factors, positive perception about the use or of the required abilities, the proposed solution will never be adopted.

Davis' model has been successfully applied to the analysis of teachers' expectations (Colas & Casanova, 2010). This has been done similarly to recently implemented models (Teo, 2010), in regard to the implementation of technology in the classroom. However, students largely implicated in the success of such implementations, noting that the position of students and teachers in the classroom is quite different. Therefore, their expectations or needs may not always coincide. Perhaps for this reason, it would be rather advisable to start by analysing a subject seldom acknowledged in the discussions on technology for education. As surprising as this may seem, reference is made to students' refusal to technological solutions in the classroom. This shifts the traditional dynamics of teaching and learning in the classroom. Despite their different roles and duties in the classroom, this is an interesting and useful perspective in many of the processes that involves both students as well as teachers.

Students' refusal to technology schooling

How can student's refusal to high-tech educational innovations be explained? While evangelist or messianic literature on educational technology has for many years suggested that students are potential agents of change with everything regarding education technology, empirical research proves that, in reality, students are somewhat reluctant to the so-called "technology schooling" (Cerisier & Popuri, 2011a). Surprisingly still, people would have a difficult time keeping their lifestyle if they were not connected by technology. Thus, for example, only 40% of French high school students would like to see increasing implementation of technology in the classroom, whereas the rest remain indifferent (Cerisier & Popuri, 2011b). How then, can adolescents who are so dependent on technology in their daily routines, resist its introduction into the classroom?

The refusal of technology schooling by high school and higher education students can be fundamentally explained by four reasons. The first reason concerns the relevance of the uses proposed by technological solutions. Students claim that such solutions are irrelevant. Furthermore, and this is the second reason, an additional effort is generally required for any innovation in the classroom. In fact, an extra effort is being demanded for a gain that is not very clear for them. Third, as students get older their expectations about high-quality teaching paradoxically become more conservative and favourable to what they already know, to the

methodologies they are accustomed to from their preceding educational stages. Lastly, their refusal also holds a substantial element of defence against what they consider adult meddling in their privacy. This idea of privacy, which is so important in adolescence, can take shape as an exclusive space that technology allows them to build with their peers to interact with them and keep teachers and parents at a distance.

Teachers' adoption of close solutions

Interestingly, the reasons provided by students, albeit with different formulations, also explain the behaviour of teachers regarding the adoption of technology (Colas & Casanova, 2010). In short, most of them believe that the adoption of technology fails to bring relevant solutions to improve learning results or the quality of teaching. Therefore, the adoption of technology does not offset an additional effort. Furthermore, the majority practices, which are mostly dependent on the training received and the contextual pressure exerted by colleagues' practices incorporate technology in a marginal way. Turning the situation would mean fighting against all odds. As stated by Alonso, teachers who use technology are "small pockets of innovation and change that barely go beyond the dominant institutional dynamic" (Alonso et al., 2010, p. 71).

But, compared to students, teachers' perspective is further complicated because of the proximity factor. Based on the theory of close development zones, some authors argue that the peculiar way in which teachers gradually adopt technology suggests that they are only able to include those perspectives and methodological strategies they already have mastered (Mominó, Sigalés & Meneses, 2008). In other words, no effort can be expected from any teacher to adopt technology beyond the boundaries of their knowledge and professional practice in terms of teaching and learning strategies. This would explain why teachers are very likely, for instance, to accept tools such as interactive blackboards over other technological solutions. In this case, immediate possibilities of use are much more similar to their standard strategies and are not necessarily challenging. Not only that, such tools consolidate their strategies and improve without breaking the boundaries of teaching practices and common learning.

How to explain what works?

According to not only Davis' model and his colleagues (1989) but also other more sophisticated models (Schwarz & Chin, 2007; Venkatesh, Davis & Morris, 2007),

what moves a subject to change the usually applied processes is nothing other than the expectation of higher efficiency. Moreover, any consideration that has to do with the initial effort to do, either in terms of training, planning or funding should be offset eventually, otherwise, the equation yields a negative result for the professional. More work to attain the same results? The question, therefore, is simple: why should a technological solution demanding a larger effort be accepted if it does not lead to greater professional teaching efficiency?

Both the research on students' refusal to educational innovations based on intensive use of technology and the research into the factors that favour the professional use of technology by teachers confirm this idea. If the appropriate skills are available, the decisive judgment will be the perception of usefulness. Such perception can be defined as the anticipation of the expected efficiencies adopting a technology solution would achieve. Moreover, this has a lot to do with training of teaching skills.

Are the current mechanisms for training teachers in this field appropriate?

Everybody regards the training of teachers as a core requirement to promote technology driven innovation. We can say that, so far, the necessary technical-pedagogic training has mainly taken place in two phases.

Initially, the most substantial part of training addressed literacy and training for elementary pedagogic and professional applications. The goal was to ensure that as many teachers as possible could acquire the most basic technological skills to manage word processing, spreadsheets, and Internet research, etc. In one way or another, most governments have set minimum qualifications in technology for teachers, such as the pedagogic certificate of technology implemented in Sweden, Denmark, and the Netherlands. Many of these initiatives have been inspired by the competency framework for teachers created by UNESCO (2009).

Later, the emphasis shifted to training qualifications of an intrinsically pedagogic nature, that is, related to the pedagogic applications of technology. This includes training for a specialized curriculum use for subjects (use of specialized software, simulations, and participation in networks of teachers of the same subject, among others). In short, the effective use of technology in the classroom requires increasing opportunities for teachers to learn how to make it happen. Moreover, nowadays, rather than knowing how to utilize technology, it has to do with the way of applying it to teaching and learning.

Most developed countries have already passed the first phase. In some countries, training alternatives are offered as an a la carte menu with the very schools deciding which offer suits them best as in the case of the Netherlands. In other countries, there is a centralized framework for training. This is the case for continuous training in Sweden or Denmark. In other countries, like Spain, responsibilities related to teachers' training in this area fall to the authorities of autonomous communities.

But the question is whether all these training efforts truly enable the effective use of technology. Clearly, the current levels of teachers' use of technology in the classroom have not improved over time. One of the latest studies in Europe compares the situation in countries of the European Union and the transformations occurred during the period 2006-2012 in lower secondary education, equivalent to our ESO[9] (Empirica, 2013). Paradoxically, while the ratios of student to Internet-connected computer almost halved in this period, the number of teachers that claimed to use technology in 50% or more of their classes did not significantly increase and remains around 14%. In contrast, the same study found that the percentage of teachers that use technology to prepare their lessons is higher than 90%.

This indicates that the endeavours made for an effective use of technology in the classroom does not really meet the current needs of teachers or take into account their real work context. The most glaring evidence of this situation is given with the results of the TALIS[10] program, which also focused on lower high school teachers. When asked in which areas of their professional development they regard as insufficient, interviewees replied that the first area is the treatment of students with special educational needs in the classroom. However, the second and third areas refer directly to the pedagogic and professional use of technology (OECD, 2014).[11] That is,

9 The author here refers to the Compulsory Secondary Education of the Government of Spain, which takes place between 12 and 16 years old, and is equivalent, in the Brazilian educational system, to the 7th grade of primary school to the second grade of high school. In Spain, since 2015, this school stage comprises two cycles: the first three school years and the second of one year. The latter has a propaedeutic character, being able to attend high school or start vocational training.

10 TALIS (Teacher and Learning International Survey) is a survey by the Organization for Economic Cooperation and Development (OCDE) since 2008 and is coordinated in Brazil by the Anísio Teixeira National Institute for Educational Studies and Research (INEP), that is aimed at understanding the working conditions of teachers in learning environments in schools in the final years of elementary school. Available at: <http://inep.gov.br/web/talis>. Accessed: July 27 2016.

11 "In Brazil, 60% of teachers reported having a 'high need' for professional development to teach students with special needs, followed by teaching in a multicultural or multilingual environment (46%)." On the other hand, in ICT for education, 27.5% of teachers said they needed professional development in that area. INEP. TALIS National Research Report. Brasilia, 2014. Available at: <http://download.inep.gov.br/acoes_internacionais/pesquisa_talis/2013/talis2013_relatorio_brasil.pdf>. Accessed: July 27 2016.

despite continuing efforts, the training offered is not enough or is not suited to fit in the real needs or work contexts of teachers.

A gradual approach is of the essence to satisfy the needs for development of teaching skills to promote a transformative pedagogic use of technology. As repeatedly stated teaching change should not be conceived under the same formula for everyone. There is the need to identify teachers' expectations surrounding these tools, and with their help, establish a clear methodological route where they can implement their own ideas, reflect on the obstacles they face, and consolidate their successes. All of that will lead to more activities involving constant challenges to be continuously improving (Kugel, 1993; Briceño, 2013).

Radical change of practices is not easy for any professional particularly when time availability is constrained. It is quite possible, as explained elsewhere (Pedró, 2012), it would be better to start by getting to know technology solutions that solve immediate problems which will give opportunities to discover what might come next. It would be, in short, an approximation in concentric circles, gradually expanding the limits of comfort and demanding a little more each time. However, none of this is possible if work environments amenable to change are absent.

Conclusions: closing a virtuous circle

It can be said that some technology policies in education and their outcome on teachers' training have been fairly successful when compared to other policies who were most likely unsuccessful due to poor design, mistaken objectives, or unfounded expectations (OECD, 2010). Thus, for instance, the headway made with access to technology in schools, initially, and later on, in each classroom, is undeniable. Taking this into consideration, it can be said that the implemented policies have been successful. Schools, for the longest time, have been represented as a privileged site for access to technology. Yet, due to the rapid dissemination of technology in the residential context, mobile devices tend to turn households into opportunities where access to technology is much easier than in schools.

Nevertheless, least successful policies thus far are mostly related to the effective use of technology in the classroom. The results seen today are still largely trailing the initial expectations. Levels of technology use in schools are extremely low, to such an extent that they do not catch up with the levels students use outside of school. Available data demonstrates a poor balance in relation to use and a scarce deficit of public investments. It is probable that the poor ratios of students

to computers, equipment conditions, as well as the obsolescence of installed equipment are valid reasons for the low balance. The most important reason may possibly be the teachers' perception of the effective use of technology. This may be because teachers have enjoyed neither the appropriate training nor professional incentives. With all of these factors, transformative pedagogical policies are gambled away.

Theoretically, in terms of public policies on education, it seems as though everything has been invented already. If a country has to improve the qualitative nature of technological use in education, it is advised to create a virtuous circle where important elements are missing, namely:

- Precise identification of the features and operations of targeted pedagogic models.
- A base of knowledge derived from empirical research that denotes the superiority of these models compared to existing models.
- Conditions for dissemination of the models in additions to their strengths, including:
  - Appropriate equipment and a technological infrastructure for such models.
  - Teachers' training in real situations, in line with the particulars of the context and the educational project.
  - The setup of an appropriate system of technology and pedagogic advice.
  - Monitoring mechanism of the progress made, as well as incentives suitable for schools and teachers.

Such a virtuous circle should contain four fundamental elements, namely: an accurate definition of objectives, an effort at dissemination and visualization of working practices, assessing pressure, and finally, the support of change, including the most appropriate incentives. In order for all of this to work, there needs to be a favourable political context as well.

1. *Defining objectives*

The first step is to clearly define the objectives and express them into proficiencies to then later be able be assessed empirically. This means it is not sufficient to have clear ideas over, for example, the 21st century competences, but should translate into useful baselines. Most importantly, they should be formulated so that they can be assessed externally.

2. *Disseminating good practices*

Next, let us recognize that for many schools such requirements represent a new challenge. For many schools, there is probably a lack of reference both in terms of pedagogic approaches and technological solutions. These technological solutions give them assurance and confidence as well as allows them to guide their actions. Therefore, it is equally important for public administrations to strive to spread the practices that work.

Such a dissemination effort should basically translate into a vision that can take different shapes. Firstly, start from experiences, which in turn contributes to make them more visible, which is the most convenient. Secondly, a feasible idea is to start a transparent pilot experience where there is a certain amount of schools that can be used as the baseline. Thirdly, foster teachers' networks to share related experiences. Fourthly, there is a necessity to trust more in educational research particularly if horizontal transfers of practices reveal which factors contribute to success. Lastly, technologies should be used to largely amplify dissemination of everything to more or less the right direction.

3. *Assessing the target*

Political statements or dissemination of good practices does not suffice to prompt schools and teachers. Exerting pressure on the system is also important. By exerting pressure, schools will understand that the definition of these objectives and standards of proficiencies will be subject to external assessment. The assessments can monitor the students learning at the national level which can be conducted regularly in most countries. Assessing on this level is much more advisable than assessing on an individual basis. Some international assessments, such as the OCDE PISA Program, tend to increase the references of such proficiencies.

Additionally, another way of exerting pressure with the same objectives includes advocating for the use of technology both in assessment mechanisms of school learning (i.e. high school completion tests in Denmark). We can also exert pressure on everything related to the relations amongst teachers or between schools and their educational administration, whatever the level may be. School files are a good example of such practices, and as in other areas of public services they could be online and thus facilitating their management.

4. *Supporting change*

Even the most dedicated and committed professional need continuous support. In this regard, assessment should look like an opportunity of diagnosis for improvements. The modes of such support and their effects deserve special attention of educational authorities. For the longest time, teachers' support has rested solely on permanent training courses.

A customized support service for teachers or teaching teams at the workplace would be far more efficient rather than the attendance of theoretical courses in relation to technological changes in teaching practices. In this way, teachers' working context will be better comprehended and dually contextualized support will be afforded.

Last, but not least, we raise the issue of incentives. Teachers, like any other professional, counts on two powerful incentives. The first set of incentives is whether the adoption of a new pedagogic or technology solution will necessarily translate into a benefit, in terms of efficiency or professional satisfaction. To convey the message clearly, much investment needs to be made in empirical research on the subject matter to prove it. Furthermore, there has to be a sufficient number of channels of dissemination with the appropriate modes and languages. The second set of incentives is related to career and professional development. In a perfectly rational world, teaching incentives should contemplate the incentives that take into account not only dedication and profession commitment but also achieved results, or in other words effective practices.

Actions intended to boost computer use at a more personal level, by offering the appropriate equipment (laptops or PCs) are less common. If computers are used, they tend to target only teachers and go in tandem with the training programs. Meanwhile, similar incentives for students remain uncommon. In Italy, for example, there is an initiative that aims at granting interest free loans to teachers for them to buy computers. The Flemish community of Belgium has established consortiums that enable schools to buy computers at low costs through large demand. In Germany, a partnership of more than one hundred twenty high-tech companies is helping schools develop their own IT&T infrastructures at lower prices. They also offer technical assistance. In Sweden, around seventy thousand teachers have received free computers for their own personal use if they can successfully complete the course. Moreover, much support is given to the creation of figures equivalent to pedagogical, not technological. They provide

support for development of specific projects, so that support is more educational than technological in nature

5. *Setting a favourable political context*

Para llegar a completar este círculo virtuoso es preciso que estos cinco elementos se den en un contexto político favorable. Esto significa que es muy importante que los responsables de la política educativa transmitan mensajes claros que reiteren la importancia de la modernización de las prácticas educativas gracias a la tecnología y que lo hagan de forma que se apoyen en evidencias reales de los éxitos que progresivamente se van consiguiendo. En definitiva, es muy importante que este apoyo político sea sostenido en el tiempo para que no sea vivido, una vez más, como una moda pasajera. Y, sobre todo, que el impulso al cambio no se traduzca en un entorno de trabajo inestable sino, al contrario, que tenga la garantía de contar con la tranquilidad de una perspectiva a largo plazo que ofrece oportunidades de experimentación y de progreso.

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Challenges in evaluating educational innovation programs

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The assessment of education and technology programs in Latin America, until recently, has failed to provide relevant information in order to determine which processes help enrich student learning and improve future program designs. Perhaps, it is time to revise the way of designing projects, the baselines necessary to advance innovative policies and, therefore, assessment mechanisms.

Latin America and the Caribbean have been at the frontline in digital investment in the past few years, exhibiting the world's fastest growth in the incorporation of technology and connectivity rates. Nevertheless, there is still a long way to ensure equitable and universal access. To date, it has not been an easy task to connect such a hefty investment and dramatic progress to a larger and more just model of development, such as connecting educational systems with their students' learning results (IDB, 2012).

The challenge of grasping the impact of technology is not only about the world of education. It is worth noting that the added impact of digital technologies on global development has been lower than expected. Enterprises are more connected than ever, yet the growth of world production has slowed down. Digital technologies are transforming the work environment. However, labour markets have polarized and inequality in each country is on the rise. Moreover, while internet paves the way for an ample public debate, some governance indicators – such as the proportion of free and fair elections – are worsening. Such trends are worrisome, not because they are caused by the quick dissemination of technologies, but because they have remained in spite of technologies (World Bank, 2016).

The view on projects that make use of technology in education in the region has been centred on comparative descriptive studies and impact assessment studies.

Comparative analysis has been helpful to identify in most countries in the region the prevalence of weak national education and technology policies and lack

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of coordination among decision makers and enforcement agencies. Only half of the countries in the region have national policies, and in most of them, the agencies responsible for implementing the initiatives act in an isolated manner and detached from the educational processes of the ministries of Education and the State modernization policies. It has been recorded as well that IT&T skills have been added to the national curriculum. In most countries, however, there are no policies to assess their progress (Hinostroza & Labbe, 2011).

Furthermore, it has been identified that most education and technology policies and processes implemented in the region lack a baseline pedagogic model. Countries have been investing in the provision of educational technology, mainly invigorated by the political motivation of short-term return without the need for a model able to connect access to technology with students learning. In many cases, there has been the temptation as well to import pedagogic models that might have worked in developed countries, with no evidence of their potential to accomplish their goals in developing nations (Hinostroza et al, 2014).

Moreover, a number of assessments recently conducted seek to analyse the impact of programs or policies mainly in terms of learning, measured through standardized exams.

The evaluation of the program ***Computers for Education*** in Colombia was a pioneer study (Barrera-Osorio & Linden, 2009). The objective of the program was to introduce the use of computers granted by private sectors in public schools for educational purposes. The trial lasted two years for a sample of 97 schools and more than 5,000 students. The findings showed minor effects on the outcome of students' learning and other educational results. The results were consistent with other educational levels such as gender and the subject matter of the students. The research also helped ascertain that the main reason for the results seem to be the troubles of incorporating computers into the educational process. The program was effective in enlarging the availability in beneficiary schools, and also to train teachers in the educational use of equipment and give technical assistance to schools. However, data collected through surveys among teachers and students suggests that computers did not add to learning. This study proved the importance of the implementation of educational technology programs because the availability of equipment and training of teachers are not enough to ensure their pedagogic use. Additionally, the authors stress the importance of evaluation process to identify the reasons for the negligible use of the equipment in such programs.

One year later, Carillo, Onofa and Ponce (2010) released the findings of a study on the relationship between the use of technology and the learning outcomes of children in Ecuador by means of an experimental design. The research provides sound evidence on the effects of the introduction of a computer-based teaching program in elementary schools at Guayaquil. There were significant gains on Math exam results attributed to the program. This progress was not seen for language exams.

The authors hypothesized that the better performance in mathematics was the result of a comprehensive approach including the supply of computers, a learning platform (APCI Platform), and the training of teachers. Furthermore, they inferred that poor performance in language could be because the associated software was not that effective, or because the interest in working on mathematics took away students' time for reading. The authors suggest that better understanding of students' technology use and interest in software or systems should be subject of future research.

A team linked to the Inter-American Development Bank (IDB) subsequently released the findings of an experimental assessment of the program ***One Laptop per Child*** in Peru (Cristia et al., 2012). The assessment aimed at measuring the impact of the program on students' learning and skills, as well as analysing the program's implementation. The assessment has two components: a qualitative component which entails the views and reactions to the delivery of computers in some schools as well as report on the design of tools for data collection, and a quantitative component, based on data collection in the schools that received the computers and a control group.

The qualitative evaluation spotted relevant aspects to be considered in implementing the program and eventual impacts. The following conclusions were made: lack of teacher training, low rate of students with the possibility of taking home the computer, low connectivity of the local network in schools, and lack of technical and pedagogic support in schools. Furthermore, it was found that students in the targeted schools are more critical of education, their schools and their own educational performance, which is likely related to heightened expectation for the program. The evaluation also found the decreasing utilization of computers in the classroom, probably caused by the teachers' lack of technical-pedagogic training. The quantitative evaluation did not find significant differences in the students that took part in the program. The reasons described above could provide an explanation for this, as well as the short time that had elapsed between the implementation of the program and the conduct of this study.

A fourth study relevant in the region was the first assessment of the educational results of the Ceibal Plan of Uruguay (De Melo et al., 2013). The Ceibal Plan is modelled after the "one computer per student". It is the first and only plan of national coverage. Such a plan is capable of making a difference in children, their homes, schools, and local environment. The primary objective of this study is to measure the impact of the Ceibal Plan on the academic performance among elementary and high school students in standardized tests of mathematics and reading. Other objectives include determining whether the effect of the Ceibal Plan is different according to the students' socioeconomic context and to analyse the impact of the Ceibal Plan on study habits and self-perception of skills in mathematics, reading and various applications linked to computer use. Considerably, a panel analysis was made of four cohorts that started the program in 2006-2012, using a methodology of ***differences*** in ***differences***. This was possible because it has the exact day each student received a computer since the distribution of computers followed geographical criteria instead of performance and socioeconomic level indicators.

The findings suggest that the Ceibal Plan has made no difference in mathematics or reading, comparing generally, or according to the socioeconomic level. Nor does there seem to be an impact on self-perception of skills in the targeted subject matters or in any computer related skills.

The authors deduct that such findings are likely associated with low frequency of laptop use in the classroom, particularly in elementary schools and the preferred search of information on the internet. It is also important to consider that this research relies on the first students that received a laptop, which spans the first stage of the expansion of the plan, where the objective was to give widespread and fair access to technology and bridge the digital gap. In this context, follow-up and assessment of the new stage of the Ceibal Plan are warranted, with an emphasis on learning and increasing pedagogic resources and teachers' training.

In Chile, two recent studies have been reported. The first one is an evaluation of educational programs (software) for easier learning of mathematics and English made available by the Ministry of Education to some schools. The study failed to report on results because the systems had negligible usage rates in schools (Centro de Microdatos, 2014). The second study queried about the use of the Khan Academy platform in the selected group of schools and reported positive results on mathematics tests. Nevertheless, the findings of this study cannot be extrapolated to other realities (Pierson & Light, 2014).

To sum up, the aforementioned evaluations have been helpful to contemplate on the constraints of trying to measure the impact of education and technological programs by traditional means. Firstly, in default of pedagogic models in many cases, measuring the impact of the process through learning tests looks inconsistent, no matter the results. In the absence of models, it is not clear how long the results must be expected. On the same token, results are expected in other aspects, yet there are no mechanisms to assess them accordingly.

Moreover, the expected use of technology devices in a learning environment usually requires reliable connectivity, equipment in good working conditions, systems availability, pedagogic resolve to use it for learning purposes and teachers' proficiency to guide students. More frequently, the development level of every such condition is heterogeneous and not distributed at random. Therefore, even if we have the ideal experience with all those programs spurring innovations in a teaching-learning ratio, the efforts at assessment have provided little in public policy making.

From 2006-2012, over 10 million computers were distributed in the region and this continues to be an upward trend. The challenge is then how can we learn from several initiatives and retrieve substantial lessons able to guide educational policy making into the next decade. Data availability is not enough. The challenge is to amass useful information for comprehension and feedback of processes.

In this scenario, some ideas can be brought forward; ideas aimed at improving the program design strategy and enhance assessment processes.

Primarily, there are desirable background conditions for the design and implementation of programs intended to fortify technology backed learning. On one hand, schools appear increasingly boring for students and look like a senseless workplace for teachers. On the other hand, technology is enticing omnipresent and accessible outside of school. There is a need to advance a change able to combine the above-mentioned forces to attain deep learning. Against this backdrop, directive and pedagogic leadership should consider the following suggestions (a) set clear learning objectives; (b) build on precise pedagogies, and (c) change practices by means of capacity building (Fullan & Queen, 2016).

Ideally, territories should elaborate on a shared vision of the expectations for men and women for the upcoming decades and lay the conditions to ensure that every child, young man and woman will have the opportunity to accomplish that vision. A shared vision enables us to match policies and resources around common

objectives and create a global sense of the educational architecture. Why do we do what we do?

Next, territories should break down their baseline pedagogic models and the certain possibility of funding infrastructure and educational resources within a framework where these elements can interact consistently with the vision.

In regard to the pedagogic model, the design of educational and technological programs should spell out their connection with the current curriculum and the repertoire of pedagogic practices envisaged to form part of the innovation.

In this regard, it is important also to explain the expected learning, including skill development, behavioural changes, development of a new mind-set, and development of deep learning opportunities and learning new ways of relating as a society. Assessment mechanisms should not limit program design, but on the contrary, programs should feed the discussion on new ways of assessing what society deems important. Presently, there are several international initiatives focusing on defining what is most important for the education of children and adolescents to subsequently think, along with teachers, about the most appropriate devices for assessment, understanding that many of them are still inexistent. ***Learning Metrics***, for instance, is an international task force that jointly works to improve the learning results of children around the world, with a focus on strengthening assessment systems and the use of information to ensure high-quality and inclusive education[13]. ***Measuring what Matters*** is an initiative by ***People for Education*** in Canada seeking a new way of thinking in relation to competences and how to measure them[14]. The set of competences in which they work include creativity, citizenship, socio-emotional learning and a healthy life. Another interesting case is the development of ***New Pedagogies for Deep Learning***[15], This organization has developed a competency framework for deep learning with six elements: communication, critical thinking, collaboration, creativity, character and citizenship. According to Fullan & Queen (2016), deep learning takes into account the use of new knowledge to solve routine problems and includes a range of skills and attributes. The challenges set for their future work are to further define in a specific manner those six competences, describe how learning of each of them should be envisioned and which pedagogic strategies foster those competences, and devise tools able to ascertain their

13 Available at: <http://www.brookings.edu/about/centers/universal-education/learning-metrics-task-force-2>.
14 Available at: <http://peopleforeducation.ca/measuring-what-matters/>.
15 Available at: <http://npdl.global/>.

progress. The mechanisms for evaluating the next generation of educational programs are likely to be the result of rigorous work and visionaries like these.

With regard to infrastructure, there is the need to specify the effective coverage of the goods and services of programs. In some countries, such definition begins with the available electrical grid. Being honest about the reach of programs in terms of equipment availability and connectivity gives sense to the discussion on expected results. At the same time, transparency regarding infrastructure conditions makes territories better plan the necessary investment to improve operation standards. This view also includes the recognition of infrastructural resources presently brought by teachers and students in schools, or that allow them out-of-school spaces that can be utilized.

Finally, in terms of educational resources, it would be advisable to count on definitions of the suggested pedagogic use of the available resources and the supply of digital educational resources consistent with learning objectives available to users. The hub of resources is probably the weakest in our region, as most countries have opted by default from the industry to produce resources detached for programs or projects. Strategic technology and education plans from countries, such as South Korea and Singapore, report on long-term creative partnerships with the providers of digital resources in order to build digital learning environments in line with the objectives of their programs. The region could explore this space, particularly with the advantage that significant groups of people share a common language.

Secondly, expanding the scope of programs or projects of educational innovation seems necessary. Traditionally, the creation of public policies takes into account national and state programs, with subsequent pilot applications to make them universal. On one hand, if educational innovation is to be proposed as programs focused on students suitable for several contexts and interests of different human groups, the idea of a single program will lose momentum. One the other hand, isolated innovations at the level of teachers or schools will neither manage to be visible nor convey their experience. In the region, we have a long experience with programs devised by the Ministries of Education, expected to "go down" and be implemented in schools. In reality, the gap between what is thought at the central level and what actually happens in classrooms can be substantial.

The new generation of programs should have additional components of collaborative design with educational communities at the level of intermediate territories, or the possibility of choosing several design alternatives if we want the

innovations to make sense for teachers and students. The mission, curriculum, infrastructure and educational resources are pivotal conditions to advance the design of projects that satisfy common objectives. Undoubtedly, opening program options strains public policy making and complicates assessment of tools and comparability of results. Nonetheless, it feeds teachers' zeal for their work and students' zeal for learning.

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Experiences and assessment cases

With the Ceibal Plan, Uruguay has set an example for Latin America of public policy that positions ICTs in a prominent place in the school restructuring processes and the search of better quality public education. Experts familiar with the Ceibal Plan have highlighted that such initiative goes beyond the school context and aims to foster ***human development***, raising the questions of ***digital inclusion*** and ***access to knowledge***. Being that ***equal opportunities*** is the project's major premise, it was the first American country with a universal and compulsory primary education and was also the first nation that provided 100% of elementary students with access to computers and Internet. On the other hand, in Brazil, a country with continental proportions, projects are more localized and there is yet to be nationwide case. There are, however, ongoing network initiatives like the Connected Rural Schools Project implemented by Telefonica Foundation and partners that have yielded some positive results regarding online courses and schools with project-based learning methodology.

With the materialization of these projects, which have completed their initial phases, the way to assess them has been reviewed and extended as local administrators and educators claim to have witnessed progress on the school context including ICTs, as stated in articles by Gustavo Valentim (MOVE Social) and Cristóbal Cobo (Ceibal Foundation). The evaluation has been revised because measuring the impact of the use of technologies in schools requires considering aspects not always taken into account in a test of the Program for International Student Assessment (PISA) or even local tests. There is a discussion on digital culture, new skills and cognitive, social and emotional development that cannot, as some researchers have reiterated, be on the side-lines of the assessment. To have an idea of the extent the assessment is becoming pivotal, the Centro de

Estudios – Fundación Ceibal was established in Uruguay in 2015. The South American nation deemed it so necessary to enquire independently and deeply into the impacts of the Ceibal Plan.

Ceibal Plan: new technologies, pedagogies, ways of teaching, learning and assessing

Cristobal Cobo[16]
Ceibal Foundation/Uruguay

The Ceibal Plan, in its quest for digital inclusion as a means to improve the quality of education, provide equal opportunities, and promote digital literacy in the educational community, provides technological devices and connectivity to Uruguayan students.

Since its inception in 2006, the Foundation set a goal to provide laptops to all students and teachers in public primary education[17] (85% of school enrolment in the country), in order to give them access to information and communication tools within a framework of equity. The objective was for the impact of technology to cut across schools and reach households, the community and overall society.

Uruguay, a country with 3.4 million inhabitants and a literacy rate of 99.4%, achieved such goal in a few years. By 2010, Ceibal began to include junior secondary education, and provided laptops to students and teachers as well as connectivity to schools.

Ceibal has managed to provide and maintain laptops for 100% of students and teachers in primary and junior secondary education. In urban areas, the availability of connectivity services stands at 95%. Mostly found in non-urban areas, connectivity problems are addressed through a broad network of technical support. Nationwide, for 80% of the student enrolment in primary and secondary education, the availability of connectivity services exceeds 95%. Furthermore, Ceibal has implemented free internet access points in town squares, public libraries, and clubs, so that children in the most vulnerable sectors can have Internet access outside of school.

The technological context has changed dramatically. The gap between the poorest quintiles and the richest quintiles decreased radically in terms of access to technology. In 2006, 25% of households had a computer and 14% had Internet connection, while 25% of schools had Internet access (Vaillant,

16 Director of the Center of Studies for the Ceibal Foundation, Uruguay. <www.ceibal.org.uy>.
17 In Uruguay, primary education ideally includes students from 6 to 14 years of age in regular, special and rural education. It is free and obligatory.

2013). In 2013, the numbers increased substantially: 67% of households had a computer, 53% had Internet connection and 96% of schools had Internet access (International Telecommunications Union – ITU, 2014). Given the technological impact, the Ceibal Plan was able to focus its priorities on a new culture of teaching and learning through technology.

For example, since 2014, Uruguay is one of the seven countries participating in the ***Global Learning Network,*** an initiative promoted by Michael Fullan, that is within the framework of a project called New Pedagogies for Deep Learning. In this network, teachers, managers, and decision makers are encouraged to exchange ideas, experiences and education innovations based on new technological contexts. Uruguay plays a strategic role in the Global Learning Network by collaboratively exploring the new teaching and learning methods the Ceibal Plan intends to develop throughout the entire education system.

The ***Digital Technology Laboratories*** (LabTed) are another example of the latest educational developments of the Ceibal Plan. The LabTeds are project-based working bodies that intend to answer or address students' questions or needs and whose final product is the manufacturing of a technological device. Technological devices are manufactured using components provided by Ceibal, such as robotics and sensor kits, video game programming, and audio-visual editing, all technological developments that bolster creativity, critical thinking and collaboration.

Another initiative developed by the Ceibal Plan, the ***Ceibal in English*** program, adopts an English teaching model combining online and classroom learning. As part of an agreement with the British Council, students of the fourth, fifth and sixth grades of primary education attend English classes taught online by an English native speaker via videoconference. Furthermore, classes are also taught by a local teacher who acts as a facilitator for the online classes and who is also in charge of implementing the guidelines and programs prepared especially for these courses. Teachers participating in this program receive special training to help them implement this model training.

The most recently published evaluation of English showed that this method brings about cross-cutting benefits for students, regardless of their socioeconomic context and demonstrated that learning is as rich as that of in-classroom learning.

Since 2012, the year the Ceibal in English program was launched, the number of English language students increased from 33,000 to 106,000 schoolchildren. Sixty-six percent of 6th graders achieved a proficiency level of A2 (advanced beginner, according to the Common European Framework of Reference for Languages: Learning, Teaching, Assessment). In other words, they graduate from primary school with such proficiency level. These results are good news, a real motivation to keep working on both of these learning models and assessment mode.

The creation of an independent research centre, the ***Ceibal Foundation Studies Centre***, in 2015, is another example of the new steps taken towards learning and technology mediation inside and outside the formal education system. The generation and promotion of independent research and excellence will be a unique opportunity for analysis, discussion and knowledge transfer that will help support decision-making by the various stakeholders in the education system as well as understand the use of digital technologies in training and promotion of better opportunities.

The Ceibal Foundation has defined priority research areas for projects and agreements, namely:

- ***Social use of ICTs and digital culture*** – use practices and knowledge generation; literacy, digital fluency and maturity; individuals, citizenship and digital identity; communities and social networks; changes in schooling culture.
- ***Resources and platforms*** – Production and appropriation of educational resources; accessibility, usability and inclusion; mobile devices and ***bring your own device*** (BYOD); ***do it yourself*** (DIY) technologies.
- ***New ways of knowing, learning, teaching and assessing*** – new pedagogies and technologies; cognition and meta-cognition; new syllabus approaches; multiple learning environments; formal, informal, and non-formal learning; self-learning and personalization.
- ***Extended learning achievements*** – performance and efficiency; evaluation of achievements in both formal and informal learning; effects on school learning; new headings, metrics and indicators.
- ***Teachers in the digital age*** – basic training and use of technology; innovation in teacher professionalization; the teacher as a knowledge worker: motivation and recognition; teacher profiles in the 21st century; new ways to boost performance.

The Foundation has engaged in training and discussion efforts, and has funded research projects under agreements with various national and international bodies. For example, in 2015, the Ceibal Foundation Studies Centre financed, together with the National Agency for Research and Innovation (ANII, by its acronym in Spanish) 12 research projects aimed at providing original data on social and/or educational aspects of the Ceibal Plan in line with the research areas of the Foundation.

Agreements with universities, educational foundations, technology industries, and foreign governments are also part of the plans the Foundation has to achieve national and regional recognition as well as internationalization of the research carried out under the Ceibal Plan.

The evaluation culture has evolved and improved as the Ceibal Plan has evolved. On one hand, there are evaluations to determine the effectiveness of technology use, the use of "Ceibalitas" (laptops), and the educational platforms and infrastructure implemented. On the other hand, there are evaluations linked to the degree of performance of students whose education has been supported by various learning technologies.

For six years now, and upon request from the Public Education National Agency (ANEP)[18], the Ceibal Plan has worked with the Learning Evaluation System (SEA), an online evaluation system for Math, Language, and Sciences[19]. SEA is designed to provide teachers with a complementary view of the evaluations they perform on a daily basis in their classrooms and to help them reflect about learning and teaching. In collaboration with teachers, specialists in the subject matter and inspectors designed items that evaluate the most important information in each of the subjects mentioned above. Some learning assessments are conducted at the end of the school year in order to evaluate students' achievements, while other learning assessments are conducted during the school year in order to improve teaching. Students access the SEA platform and complete the exercises. At the end, the teacher can display the results in a matrix that allows a double analysis, per student and per activity.

18 ANEP is a state institution responsible for the planning, management and administration of the public education system in initial education levels, basic, average, technical and higher throughout the Uruguayan territory. Available at: <http://www.anep.edu.uy/anep/>.

19 The online assessment is the responsibility of ANEP. Available at: <http://www.ineed.edu.uy/sitios-de-interes/organismos-nacionales>.

Instant Results: Real-time Output

Domain: All
Content: All
Sub-content: All
Competence: All
Difficulty: All — Search

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	✓	✓
Valentina	–	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✗	✓	?	✓	✓	19	0.0
Martina	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	?	✓	✓	22	0.0
Marina	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	?	✓	✓	✗	✓	✓	✓	✓	21	0.0
Nicole	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	?	✓	✓	✗	✓	✓	✓	✓	21	0.0
Kucia	–	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	?	✓	✓	✓	✓	✓	✓	✓	21	0.0
Facundo	✓	✓	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✗	✓	?	✓	✓	20	0.0

Sample output for analysis by teacher

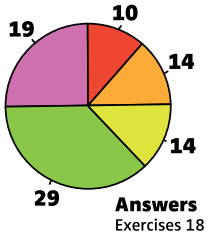
Source: http://www.anep.edu.uy/sea/

This analysis includes another chart showing how students were distributed according to the possible answers.

Analysis Capacity

Answers

Option	Number of Students	Students
A	2 students	Camila Peña, Belén Breeze, Melani Romero
B	8 students	Zoe Tambasco, Carolina Rabasquiño, Fernanda Paiva, Andy Garcia, Jorge Añon, Maximiliano Leivas
C	4 students	Belén Rodriguez, Romina Perugorria, Hiroshi Soca, Santiago Staino
D	3 students	Leticia López, Valeria Barros



Sample analysis of answer to a particular item for a group

Source: http://www.anep.edu.uy/sea/

Among traditional evaluations, SEA is a formative assessment that provides information on the learning process as it takes place. Formative assessment measures student's progress in a way that identifies areas that need improvement. Since SEA works as a progress indicator, teachers can measure the effectiveness of their teaching and refine their work plan accordingly.

Additionally, Ceibal has an *Adaptive Platform for Mathematics* (PAM, by its acronym in Spanish), an adaptive platform for learning math containing more

than 100,000 activities for the third grade to the third year of high school. Interestingly, the interactive exercises presented in this platform adjust their level of difficulty automatically based on students' performance. In this way, there are adaptive learning paths that boost the capabilities and specificities of every student and help monitor students during learning.

For example, teachers can send homework assignments to students, series of existing work choosing from the PAM platform. Based on the reports PAM provides on homework results, teachers can prepare a class in advance that addresses the difficulties found in such reports. Similarly, as they work, students can see what are their problems and how serious they are. The PAM platform adapts to students' level; for example, it presents easier exercises on the same subject (for example, adding fractions) or exercises on related topics (common sums and subtractions), which are the key in solving correctly the homework students should be able to solve.

Furthermore, Ceibal currently has ***adaptive assessments in English***, which can be adapted (educational customization) to each student's English proficiency. Adaptive assessments of English learning (2014-2015) for elementary students in the skills of ***vocabulary***, ***reading***, ***grammar***, ***listening*** and ***writing*** showed clear achievements in English learning in both the classroom program and in the program by videoconference, with significant inter-annual progress in all socio-cultural contexts.

Finally, it is important to highlight that the Global Learning Network along with the Ceibal Foundation are working on the ***design of new metrics***. The growing use of information and communication technologies and their progress in the field of education not only enable different ways of learning, but they also have helped to diversify contexts and what is today ***understood*** as learning. Appropriate use of ICTs can bring about new ways to analyse and promote learning from perspectives that go beyond the traditional fields of knowledge and typical methodologies of assessment and intervention. However, this requires developing multidisciplinary professional skills and undertaking inter-institutional efforts to integrate, process and analyse this information, not only for the development of new knowledge but for making decisions on related policies and preparing tools for improvement.

Consequently, efforts are under way to design instruments measuring non-cognitive skills, such as the representation of thought patterns, feelings and behaviours, which people develop both in school and throughout their

lives. Reference is made to cooperation, empathy, leadership, responsibility, perseverance, which can be addressed through different means such as experimental games, quizzes, performance skills, administrative records, evaluation of parents and teachers, among others. Santos and Primi (2014) say that research conducted in recent decades by economists, psychologists and teachers show that non-cognitive skills have a significant impact on the performance of individuals. The stronger they are, the better the performance of students regardless of their socio-economic context.

These skills are important not only because they have an impact on the academic performance of students, but because they also match the skills employers seek given their correlation with good job performance (productivity, income). The education system, together with the family and the community, play a decisive role in the development of these skills, therefore, the Ceibal Foundation believes there is a clear challenge in defining and consolidating the related metrics. To what extent and in what context can these skills have a positive impact on performance? How do these skills grow and develop both in school and other contexts? What role do extracurricular activities play? These are some of the questions that should guide the design of new instruments to represent, measure and quantify these skills.

Finally, efforts are under way to ***consolidate learning analytics*** that may provide strategic information on teaching and learning with technology. Some examples include the mechanisms to provide information on online behaviour, people with learning disabilities, school retention, customized learning, students' enhanced records, their contexts and consequent interactions. The objective is to expand our understanding of learning as well as providing relevant information that can be used to optimize learning environments.

The objective is the strategic use of learning analytics in a way to adjust contents and support levels, and to customize services (processes and tools) to improve both learning and teaching. Learning analytics can be very helpful to make sense of the interactions and actions taking place in a given learning environment (Lias & Elias, 2011).

While delving into the issue of learning analytics involves a number of challenges, there are yet other challenges. For example, the conflict between creating analysis models that provide reliable results and developing transparent models for users. The use of private data (in this case, data on minors), the adoption of

data privacy policies, information transparency and anonymization are some of the challenges linked to data analytics.

In short, the Ceibal Plan is not limited to the subject of new technology but it has expanded to new pedagogies, new ways of teaching, learning and assessment. Moreover, the Ceibal Plan has shown that it is possible to build a project transversal to the education system that involves students, teachers, principals, families, communities and society in general. This must come hand in hand with efforts to bring about spaces for independent and autonomous evaluation and research. For this type of program to succeed, efforts should be made for research to aim at designing and improving public policies. Systematic studies should not only delve into complex phenomena, but also help identify critical factors to be improved.

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Evaluate means to create conditions to broaden the use of technologies in education

Gustavo Valentim[20]
MOVE Social/Brazil

Introduction

MOVE's history in the assessment of the Connected Rural Schools Programme (PERC) and the Innovative Schools Project (EQI) began in 2013, the year the projects were launched. Back then, both projects were outlined in the large field of Education of Telefonica Vivo Foundation. Thus, MOVE prepared a number of workshops along with the foundation's professionals, companies and non-governmental organizations – associated executors of intervention – and public schools that engaged to build ***evaluation framework***[21] and evaluation plans for the projects. Therefore, this original process was helpful to map, make visible and set guidelines between those responsible for both projects around the strategies and results sought in initiatives of this nature.

Although the actions in projects may have differed fundamentally from one another, their final goals were the same and came in line with the foundation's mission: "Promoting innovative use of digital technologies to boost learning and knowledge".[22]

In sum, five assessment questions were outlined to map out evaluate frameworks of the projects involved:

a) What are the conditions created for the adoption of digital technologies?
b) How does the project influence school organization?
c) How does the project influence educational practices?
d) What skills of the 21st century have students and teachers developed?
e) Did the project inspire actions in other contexts?

20 MOVE Project leader – Evaluation and Strategy in Social Development. <http://www.movesocial.com.br/>.
21 An evaluation framework is a device that allows teams, programs and organizations to clearly articulate the results their social interventions intend to produce, as well as indicators related to such results (Silva & Orban, 2016).
22 Available at: <http://fundacaotelefonica.org.br/a-fundacao/locais-de-atuacao/>.

Thus, the use of this instrument has led to the challenge of evaluating the outcome of initiatives adopted both within schools – in the way they are organized, the performance of teachers with students, and students' competences – and outside of the school, in other words, its influence in other contexts. A review of each project found that each question rendered a number of indicators and descriptors of results in line with the characteristics of each intervention. For instance, in the question "What are the conditions created for the adoption of digital technologies?," the infrastructure indicator was created including the following descriptors: "type and quantity of digital technologies available for pedagogical use involving Internet access per student" and "percentage of damaged or obsolete technologies".

Such reach made a methodological challenge emerge in order to conduct the assessment in 2014 and 2015. Based on the concept of ***mixed assessment methods***[23]. MOVE created a series of qualitative and quantitative methods that could be combined into narratives about the effects of digital technologies, Internet, and training in pedagogical practices in schools over time.

Experience in projects

The Connected Rural Schools Program (PERC) aims to boost diversified education processes in rural schools, providing technological infrastructure, teacher training, methodologies, and varied contents.[24] The program provides online training for teachers/educators from rural areas and promotes the creation of a laboratory-school in the rural town of Viamão in Rio Grande do Sul state (RS), where infrastructure, connectivity, and training conditions were fulfilled for pedagogical innovation.

For its part, the Innovative Schools Project (EQI) intended to support the implementation of Information and Communication Technologies (ICT) as part of the educational project of schools recognized as innovative by the São Paulo-based Telefonica Foundation. Its actions were along the lines of the PERC laboratory-school, making infrastructure, connectivity and training available for Amorim Lima and Salles Campos municipal schools in São Paulo.

23 ***Mixed assessment methods*** have to do with combining quantitative and qualitative tools to explain complexity of programs and projects based on the principle under which events are, normally, unforeseeable and cannot be easily explained by linear causal mechanisms. These methods combine identification of final results of an intervention with those yielded during the use of processes and dynamics (cultural, economic, political, social) that influenced upon the effects of such intervention (Mertens, 2013).

24 Available in: <http://fundacaotelefonica.org.br/projetos/escolas-rurais-conectadas/>.

Experiences herein recorded are better understood if followed by, on one hand, a different division from that outlined between the projects, and on the other hand, more faithful to specifications of evaluation plans and methods used; in other words, establishing a dividing line between ***teachers online training and laboratory-schools***.

Online training for teachers – PERC

Online training for rural teachers/educators provided by PERC began in 2013 with the objective to create a network of educators in the countryside to qualification of practices and the development of skills for the 21st century. Collection of data was conducted at the end of 2014 cycle, including 2013-2014 cycles.

The set of methodologies obtained data from participants enrolled in the virtual learning environment for online training in 2013-2014 cycles. The data gathered found:

a) Interaction data of 2,000 people (among trainers and trainees; per type of tools and training year) 25 registered with the platform for network assessment;
b) 132 educators responded to an online questionnaire;
c) 21 educators were interviewed by phone.

In this regard, the research over the conditions for technology adaptation confirmed a biased diagnosis of situations of access to technologies by course participants and profile survey of these people, given the lack of strategies to develop requirements by the program. All of this because further information on trainees' conditions was needed by the program in order to define more suitable subject matters, strategies, and approaches to make teachers engage in the training.

Online training-related results were obtained mainly from poll data: 87% of respondents were females, 74% had completed post-graduate studies, 97% owned a computer at home, and 97% had access to Internet at home while 53% of them did their online training in the school they worked. These data show that online training was reaching rural teachers who may access technologies. Regarding the profile, a finding of the qualitative study crucial to redefining the program strategies was the existence of experts from different areas of municipal education taking part in the available courses.

25 Interactions materialized through shared files, activities, blogs, bookmarks, "likes," forums, messages and access to pages.

The assessment found that online training had an impact on around 90% of poll respondents and interviews in the development of teaching practices inspired both in course activities online-training educational principles. During the interviews, educators gave true examples of such practices. Also significant were the results of the planning of teachers, mainly in two aspects: consideration of students' interests in devising activities and increased search of new online references and activities to be carried out in classrooms.

The number of workshops[26]held was an important variable for some results obtained. The statistical study[27] of the questionnaire revealed that teachers who completed more than two workshops were more consistent with remarks that online training helped them engage in new activities in the classroom and allowed to foster multimedia production in students. On the other hand, teachers who completed more than four workshops indicated greater sharing of knowledge learned in training with other teachers in the school or the teaching network. Finally, teachers who completed over eight workshops understood the influence of training in discussion with students about sharing content in social networks.

Collaboration and communication in question

The skills of the 21st century assessed in this evaluation were collaboration and communication. The method used to analyse networks aimed to understand if there was collaboration and communication between trainee professionals through resources provided by the online training platform. Tools allowing course participants to interact with one another were designed; interactions were quantified and classified, and charts showing interactions made through such tools were drawn, as shown in Figures 1 and 2:

Figure 1. Interpersonal interaction network through the platform's resource named activity involving trainers in 2014.

Figure 2. Interpersonal interaction network through the platform's resource named activity in 2014, without involving trainers.

26 In 2013, four training phases were conducted, each including six workshops. Every workshop tackled a question regarded as relevant for rural education. The group was closely supervised by a trainer and examples of activities to be carried out in the classroom were discussed.

27 Comparisons about the number of workshops per pedagogical practice were made using the Kruskal-Wallis non-parametric tests. In order to identify cut-off points that distinguish consistency in every pedagogical practice, a multivariate analysis was used through decision/classification tree, using CHAID algorithm (Chi Square Interaction Detector).

In summary, the figures above show the main result of this study: mainly trainers and trainees engaged in collaboration and communication. As can be seen, in the tool named activity[28], in 2014, only five people interacted with each other, a result very similar to all other interaction with resources of the platform. This affirms that collaboration and communication between rural teachers/educators failed to materialize that year via distance teaching platform. Therefore, the goal of a rural educators' network was not accomplished that year, due to a low level of direct interactions between the trainees. The project thus began to revise strategies, which led to changes in methodologies, platform used, and resources available for online interactions.

Laboratory-schools

The laboratory-schools are municipal elementary schools where the Telefonica Vivo Foundation has invested in technological infrastructure and training in order to enable innovation in current teaching practices through digital technologies. As previously stated, the Innovative Schools Program was applied at the Amorim Lima and Campos Salles municipal schools in São Paulo, while the PERC was implemented at Zeferino Lopes de Castro school in Viamão-RS.

Table 1. Teaching level and number of teachers and students from laboratory-schools of the EQI* and PERC projects in 2015**

Campos Salles Municipal School*	Amorim Lima Municipal School*	Zeferino Lopes de Castro Municipal School**
• Fundamental I and II • 49 teachers • 935 students	• Fundamental I and II • 39 teachers • 741 students	• Fundamental I and II • 9 teachers • 120 students

The design of the assessment conducted in the three educational institutions was non-experimental as it intended to seek changes in the same population during the project implementation. Each collection produced the figures listed below:

28 The tool named ***activity***, which consists of an activity header with blanks for teachers' comments, was the most used resource in the platform during both training cycles.

Municipal schools	Campos Salles		Amorim Lima		Zeferino Lopes de Castro	
Data collection	1ª	2ª	1ª	2ª	1ª	2ª
Total	N = 368	N = 250	N = 205	N = 155	N = 39	N = 86
Teachers	33	25	39	14	9	10
Students	328	216	160	135	16	66
Board	1	3	–	4	1	–
Municipal secretary	–	–	–	–	–	1
SME representatives	–	–	–	–	4	–
Implementing project partners	6	6	2	2	9	7
Pedagogical coordinators	–	–	2	–	–	–
Assistant director	–	–	1	–	–	–
Director	–	–	1	–	–	–
Outsiders	–	–	–	–	–	2

With regards to the conditions created for adopting digital technologies, assessment data revealed that the infrastructure enabled by the project (Internet access, tablets and netbooks, and power supply refurbishment) positioned these schools among 1% of Brazilian state-run schools with better Internet connection (2014 School Census) and between 10% of Brazilian state-run schools with more computers available for pedagogical use for students (CGI, 2014).

The effects of the presence of technology in each school accompanied the contextual diversity. The three models of technology related to teaching practices were defined from the negotiation between school players, Telefonica Vivo Foundation, and implementing project partners.[29] This said, analysing the projects from the assessment questions affords the single opportunity to see that the reach and strength of results of digital technologies in an educational institution depend on the meanings attributed to them by the people engaged in the process, as well as their openness and level of involvement during every day practices.

29 Non-governmental companies and organizations hired by the Telefonica Vivo Foundation to engage in the project. Each school counted on a specific group of players.

Campos Salles Municipal School

At Campos Salles Municipal School, the perspective chosen for technology integration in everyday school life was hand in hand with the development of school plans[30] mainly in two ways: allowing the conduction of scheduled activities and integrating such arrangements into a virtual learning environment customized by the project. The training[31] provided by the project focused on teachers and intended them to increasingly adapt to ICTs resources and the virtual learning environment for use in school plans.

Results obtained in this school were in line with the perspective chosen. The questionnaire administered to teachers, which was aimed at assessing the project's influence upon pedagogical practices, found that the indicator named plans design and implementation[32] yielded the most significant results. In connection with such quantitative outcome, results obtained in qualitative methods led to the qualification of plans most searched by teachers for their preparation as well as the integration of new sources of information and multimedia contents in their structure.

The online platform helped prepare plans. 90% of those evaluated[33] contained information related to platform activities and contents. Out of these activities, 42% included multimedia contents supporting proposals from printed plans, while 48% involved activities to be developed in the platform.[34] At the end of 2015, plans in Campos Salles elementary school were structured with an online platform either as a bank of multimedia content to broaden the planning approach or to carry out the activities. Therefore, the technological trend in this school explored the potentials of ICTs to access information.

30 The school's political-pedagogical project is complex and different from the whole teaching network. In accordance with the school's pedagogical proposal, students are distributed in large classrooms depending on school year, averaging some 90-120 children per classroom. The students sit at desks for four people and, as from Elementary I, they prepare learning plans throughout the school term. Such plans are drawn by teachers on a yearly basis and combine multidisciplinary content and activities. Some nine plans are prepared in one year. Expositive classes are not given in everyday's school life and until completed the first half of 2015, any proposed activity should involve all students in a classroom. During the second half of 2015, the routine included that the classroom could be divided into three sub-groups, each undertaking an independent activity: arts, English, robotics.

31 On a weekly and collective basis with teachers included in the collective planning schedule in 2014. Every two weeks and using the individual monitoring format in 2015.

32 The other indicators inherent to question "How does the project influence pedagogical practices?" are: customization, engagement in the process of pedagogical changes and use of ICTs along with students. Even though the major differences between the medians of indicators in 2014-2015 were found in indicator named plans design and implementation, such gap was not significant statistically.

33 18 out of 36 plans prepared in 2015 were analyzed for 5th to 9th grades.

34 The remaining 10% included activities proposed in the platform to be performed without this tool.

Regarding the skills for the 21st century, the poll revealed positive results in all competencies evaluated in the main trainees: the teachers. Statistically and positively speaking, there was a significant difference in 2015 for ***communication***, ***collaboration***, ***creative thinking and competencies in ICTs***. These same skills were assessed in those students who, in turn, obtained similar results in both questionnaires.

In summary, inside of the school, the EQI Project yielded results over the application of current pedagogical practices by teachers (pedagogical planning), thus having effects in educators who described themselves as communicative, collaborative, creative, and skilful people in ICTs as of late 2015. However, the perspective for such effects to reach students poses a challenge to be overcome by the EQI and the school community.

As the inspiration for other contexts, results were produced in project systematization and presentation at several events. However, the research on the implementation of the project, which was undertaken by the Education Municipal Secretariat, São Paulo municipality, to broaden knowledge and efforts made by the EQI, produced no results. This presents two challenges to continue with the project in the upcoming years in this school: strengthening ties with the Secretariat to lend visibility and stimulate reflections over its policies from the experience of Campos Salles Municipal School; and coordinating along with the Secretariat the necessary support for the project's sustainability in the school in question.

Amorim Lima Municipal School

Should the project in this school be analysed only under the aspect of conditions generated to adapt to technology, we have the impression that the project offered a course very similar to the one performed at the Campos Salles municipal school: netbooks for students, excellent Internet connection, and a platform to support the ongoing pedagogical vision in the school. Although both projects have identical conditions, they are shaped very differently in practice.

Despite the fact that the school also makes use of multidisciplinary pedagogical planning[35] – which must be applied by students according to pace and interest –, the choice of the online platform was to build it in line with school organization, in order to boost supervision of students by teachers. The goal was to make

35 Plans at the Amorim Lima Municipal School are drafted every three years, in accordance with the cycle of educational books available for every school.

educators and students start informing the system of activities previously undertaken by trainees and relevant evaluations. The platform, which was named Amorim Lima Education Platform[36], was designated to create monitoring graphics mainly on two levels: (a) teachers with general vision of their trainees[37]; (b) the governing board with summary graphics over the school. However, the training focused on the adoption and utilization of the platform by teachers and students.

Besides the drawing up of plans and the establishment of trainees, the school perceives workshops[38] as a fundamental pedagogical moment in its routine. This pedagogical moment lacked strategies including training or specific digital resources provided by the project. Still, the first results of the EQI emerged in the Amorim Lima Municipal School.

Following the first data collection, when participants had not yet adapted to the platform, the assessment data showed different emerging practices in workshops with the use of technologies. According to figures from qualitative methods, this occurred mainly with the help of combination of computers available and Wi-Fi connection at the school, as well as the freedom given to teachers to run such workshops. Teachers who were more adapted to technology used videos, images, online education platforms, and university-based virtual learning environments. Additionally, the students' autonomous growth was recognized regarding plan drafting as well as the optimization of time of all pedagogical moments thanks to the possibility of real-time research on the Internet.

These results, which remained unchanged in the second data collection, added adaptation of teachers and students of the Amorim Lima Education Platform. At the end of 2015, all of the school's teachers entered the platform: 48% got connected more than three times a week. In regards to students, 43% of those registered with the platform accessed it on a monthly basis by the end of the second half in 2015.

Even though these outcomes are significant, the project in this school gives rise to some important considerations for other interventions of technologies

36 The platform project became more and more personalized to meet several conditions of the Amorim Lima Municipal School, increasing its reach in 2015. Sections for inserting administrative, professional and social data from the school community were created, thus providing online plans, files uploaded by students, and messages between users.

37 The students are divided into trainee groups under the responsibility of a school's educator (teachers, pedagogical coordination and principal ship also play the role of trainers). These groups belong to different education levels. They meet on a weekly basis, when their development and learning is tracked.

38 Workshops are activities guided by teachers and related to disciplinary curriculum content. Each workshop involves around 30/40 students.

in education. Many of these results originated from individual initiatives of teachers. The school, until the end of 2015, had not included digital technologies or ICTs in a debate at an institutional level. This mainly resulted in difficulties for broader transformations and outcomes that demand a change of culture, whether organizational or previously related to technologies. An example of this is that the use of platform resources for the organization of bureaucratic-administrative information had not yet been established; for this, the school would have had to change its whole administrative culture to include and keep information updated. This question was not raised until late 2015, despite the platform's readiness to receive such information.

Given that Amorim Lima Municipal School and Campos Salles are both under the responsibility of the Education Municipal Secretariat, the situation was similar concerning with regards to the expected results; in other words, Amorim Lima faces the same challenges of sustainability, replicability and expansion of the project.

Zeferino Lopes de Castro Municipal School

Knowing that the two previous labs consist of schools deemed innovative by the fact that they already outlined and implemented proposals along with the school community, the experts of the Zeferino Lopes de Castro laboratory-school saw in PERC the opportunity to launch their own pedagogical innovation process.

Before launching the program, the research carried out by implementing project partners revealed schools with teachers routinely teaching expository classes specializing in their specific disciplines, and attending a monthly meeting between educators and the school board to solve administrative issues. Upon PERC's proposal, teachers decided to take on jointly the responsibility to build a new education political project for the Zeferino Lopes de Castro Municipal School, regarding digital technologies as one of its pillars in order to develop pedagogical activities along with students, despite limited technological knowledge.[39]

Unlike the experiences shared above, the first results of the project were produced in the ***educational management*** field, an institutional framework where changes arose to progressively give way to the introduction of pedagogical practices in classrooms.

39 A political link is crucial at the moment: The teachers created a series of working and school organization conditions to develop this work, including comprehensive class load, schooling in comprehensive terms for students, weekly team meetings. The Municipal Secretariat of Viamão makes available requirements and prepares the ground to make bureaucratically viable the school's innovative proposal.

Then, a project model was implemented based on the principles of the ***One Laptop per Child*** program.[40] Each student from the first to third grade of elementary school received a tablet, while students from other levels received a netbook. Training was responsive to the school's pedagogical or technological demands involving robotics and programming.

The project has passed through different phases since its launch year in 2013. The breakthrough was radical, for it started from scratch to an education model with students experiencing new routines and activities almost on a weekly basis in order to explore technological potentials and possible changes in disciplines[41] for the group of professionals.

The data collection as of 2015 revealed the consolidation of the school's pedagogical proposal, which resulted from decisions made from initial experiments. The school divided its class schedule into project development moments – named "learning projects" – and curricular content teaching moments. These learning projects[42] were the spotlight in school activities, where all school community players and families took part.

Upon knowing that ICTs were included from the start of the research and systematization of information and knowledge obtained under the project implementation, including multimedia content production, the assessment found the creation of the prototype of the projects to be the most complex outcome regarding the use of technologies in the three laboratory-schools. This is because some prototypes resolved to find technological solutions to emerging project-related issues.

These new practices had a direct impact on the skills for the 21st century of students and teachers, both in terms of development and challenges. From 2014 to 2015, through the results of assessments, aspects of competencies were

40 For further information, go to: <http://wiki.laptop.org/go/OLPC:Five_principles>.

41 In the sense of "curriculum discipline."

42 In 2015, the school arranged the school term in project rounds lasting some 6 weeks each and alternating one project cycle from topics proposed by teachers and another one including topics suggested by students. On every cycle, the students should plan a project, investigate, systematize information obtained and build up a model helpful to materialize a research aspect over the topic within a concrete context. The groups outlining the projects come from different education levels, with a teacher's guidance. Interest in or affinity to the topic were key to choose the project.

observed: communication, collaboration, creativity and ICTs skills[43] – highlighting communication and collaboration between students, who worked effectively as a team in 2015.

For teachers, these two competencies (communication and collaboration) had been a major focus. In other words, the new collective decision-making entities, such as weekly pedagogical meetings and new trainer-trainee relations, compelled us to focus more on aspects of sharing, listening and negotiation. The outcome in 2015 suggest that the institution's teachers and students failed to develop such skills satisfactorily, despite development stimulated in 2014 to 2015. As for creativity and skills in ICTs, teachers obtained meaningful results in 2015. They succeeded to master several techniques to generate ideas, which is a developmental process to assess their implementation in the everyday school setting that is constantly pervaded by unforeseeable pedagogical topics and strategies. The technological solutions also became more complex with the production of technology.

Finally, the implementation of this laboratory in the Viamão municipality, in constant monitoring by the Education Municipal Secretariat, encouraged an innovation process for education public policies under construction in the municipality. They include purchasing tablets and notebooks for all teachers; establishing a technological group within the Secretariat; incorporating technology as milestone for the Municipal Education Plan; teaching school partners and secretaries to use technologies; and creating more than eight laboratory-schools in the municipal education network, among others.

Reflections so far

According to research conducted by Spanish ***El País*** daily (2014) – in cooperation with several institutions – on the assessment of projects aimed at implementation of technology in education, most of the documents published target the verification of equal access to equipment and Internet. In cases involving the analysis of pedagogical practices[44] most of the time, results obtained show no evolution in performance in official standardized tests. These data may make

43 Given the reduced number of students over 12 years, situational focus groups were formed to assess students' skills in 2014-15. The eight-student groups, 6th and 9th grades, were assigned different tasks they had to complete jointly. In 2014, the students held a short initial dialogue about the activity, but the final outcome resulted from the individual efforts by one or two members of the team. In 2015, from the get go, the groups debated collectively both the activity and the way to carried them out, agreeing on perspectives and obtaining information on the process.

44 Generally, experimental studies focus on the students' performance.

one believe, mistakenly, that harnessing technologies in education systems produces no significant effects in improvement of students' learning.

In that sense, challenges have arisen in the field of assessment to exceed expectations around quantitative results, particularly those linked to performance on national, state-run or municipal standardized assessment tests. It is necessary to reflect on the underlying assumption that there is a causal linearity between the use of technologies in schools and enhanced performance on standardized tests because they are able to include in its analysis elements below what is necessary to show the complexity of the transformation process and intermediary benefits.

The course of experiences herein presented are in line with the views of Vivanco (2008) and Rosa and Azenha (2015): in projects of this nature, it is necessary to conduct research on the integration of digital technologies in education in a more complex and dynamic manner, shedding light on the context and revealing transformations of processes that do not necessarily have an impact, in the short or medium term, on the students' performance. Still, they may modify habits, routines, and the way education players relate to each other and share knowledge with one another.

In experiences in question, particularly in laboratory-schools, the most significant results are produced in educational institutions that embrace more fundamental transformations within a pedagogical design and school routine. However, it is essential to consider that such changes require a process to build up trust among all those engaged in the process – funding agents, implementation teams, school communities and the Municipal Education Secretariat – and to gradually change the culture implemented for years in the educational institution involved. However, besides yielding results, disruptive processes also create insecurity and conflicts. In order to face this, precaution and time are necessary, as well as trust in agreements signed in new relations established.

Therefore, the assessment of this kind of projects plays an important role in including all actors, the scope of potential transformations, and the time for cultural changes in the creation of the evaluation plan, thus, help to match expectations of participants with necessary arrangements to ongoing strategies of projects.

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Chile and its school system

Chile is a country of 17 million inhabitants and a per capita income of US$ 22 thousand (World Bank, 2016). The Chilean school system is comprised of approximately 12,000 schools and educational institutions and serves 3.5 million students, 9% of which attend rural schools. The system is organized into two main cycles: primary education, from 1st to 8th grade; and secondary education, from 9th to 12nd grade. Vocational or technical education breaks off from the general education stream at the end of the 10th grade. Coverage for primary education is virtually universal, while secondary education reaches 88% of the age group (MINEDUC – Ministry of Education, 2013).

Enlaces

Enlaces (Links) is the name of the public policy carried out by the Ministry of Education of Chile since the early 90's with the goal of incorporating information and communication technologies (ICT) into the country's school system. The endeavour was gradual and sustained over the long run and currently reaches virtually all public primary and secondary schools having become part of the institutional framework and permanent agenda of the education sector.

The objective of Enlaces is to contribute to the quality and equity of education by integrating educational computer sciences in the school system, providing the technological infrastructure, digital resources, as well as training and support for teachers. Enlaces promotes and encourages all teachers to deploy the computer resources available (in particular computer labs with Internet connections, educational software and productivity tools) to improve children's learning of school subjects (language, math, science, etc.). The focus of Enlaces' work has been the use of technology in different

45 Advisor of the Education and Technology Center of the Ministry of Education of Chile, and vice director of the Center for Studies of the Education's Policy and Practice at the Catholic University of Chile. He was the director of the Enlaces Network in the Ministry of Education of Chile. <http://www.mineduc.cl/> <http://www.uc.cl/>.

school subjects to improve students' curricular learning and the development of skills required to work in the knowledge society (Hepp, 2003; Enlaces, 2012).

Enlaces has evolved from a very limited and experimental project to an institutionalized national public policy. This policy has achieved taking technology and training to all Chilean schools. It is estimated that during its two decades of existence, Enlaces has trained over 120,000 teachers out of the country's approximate total of 180,000 (Donoso, 2010). Also, thanks to this policy, primary and secondary schools have at least one 20-computer lab, as well as computers for teachers and in libraries, and portable projection equipment for classrooms. Many schools also have carts with laptops or sets of tablets for 1:1 work in classrooms as well as interactive whiteboards. In addition, Enlaces provides computers to students in disenfranchised households. As a result, there is an average of 9 students per computer in schools and 80% have broad band Internet connection[46]; and almost 9 out of every 10 students have computers at home (Enlaces, 2013).

To date, the total investment made by Enlaces throughout all its history is estimated at around US$ 650 million; for comparison purposes, we can roughly estimate an average of about US $ 10 per student per year. The annual budget of Enlaces has not been consistent, ranging between US$ 20 and $ 60 million a year, representing less than half a percent point in the total budget of the education sector, equivalent to the investment, for example, of textbooks (US$ 50 million) (DIPRES, 2010).

Since its establishment, Enlaces has continually monitored its progress and assessed its impact, implementing national metrics and participating in international studies on use of ICT in education (Hinostroza & Labbé, 2010). Among national studies that gauged access and use of ICT in schools, the ***Encuesta para la Sociedad de la Información*** (Information Society Survey) conducted on a nationwide sample of schools in 2003 (ESI, 2004) and the ***Censo Nacional de Informática Educativa*** (National Census of Educational Informatics) undertaken in 2009 and 2012 (Enlaces, 2013) stand out.

Chile also participated in the international 2000 and 2006 SITES - Second International Technology Educational Study[47], directed at providing comparative

46 It is worth adding that the so-called "broadband" does not guarantee reasonable speeds in all schools. Even though official data are unavailable in this regard, it is believed that current available Internet services fail to meet standards required by the schools for intensive use of this kind of technology.

47 SITES is an international comparative study by the International Association for the Evaluation of Educational Achievement (IEA) on the use of ICT in teaching and learning in mathematics and science classes. Available at: <http://www.iea.nl/sites_2006.html>. Accessed: 29 July 2016.

descriptions of the infrastructure, visions and uses of ICT in schools (Law et al, 2008) and applied ICT questionnaires in parallel with the PISA tests since 2001 (Claro et al, 2011). As a result, Chile has a wealth of information about what happens with ICT in schools that have been applied in a number of papers and publications.

In addition, Enlaces has sought to measure the impact of its policies on students' learning. Several studies have attempted to establish relationships between access and use of ICT and academic achievements of students in the National Education Quality Measurement System (SIMCE for its acronym in Spanish)[48] tests and international tests such as PISA. In a slightly different approach, in 2009, Chile participated in PISA ERA (***Electronic Reading Assessment***)[49] designed to measure the degree of reading fluency in digital media (OECD, 2011). Finally, for the purpose of assessing digital communication skills and information management achieved by Chilean students, in 2011 and 2013, Chile applied SIMCE ICT test (Enlaces, 2014); and in 2013 Chile participated in the International Computer and Information Literacy Study (ICILS)[50], sponsored by IEA[51] (Frailon et al, 2014).

The image that emerges from these studies is that after twenty years, Enlaces has successfully established an extensive base, albeit still limited, of technical and human capabilities in the use of technology in education. The overall balance can be summarized into three main dimensions:

a) The social gaps in access to ICT through schools have been reduced, but major differences in actual usage persist due to differences in Internet access in homes.

b) Students have developed digital skills directly linked to ICT use and to a lesser extent, management and communication of information in digital environments, but significant differences remain among the social strata.

48 Since 1988, the Education Quality Measurement System (SIMCE – ***Sistema de Medición de la Calidad de la Educación***) has been regularly carrying out evaluations to measure the learning of Language, Math, Social Sciences and Natural Sciences; every year, this instrument is applied in 4th grade and every two years, alternately, in the 8th and 10th grades. Since 2011, English, Physical Education and ICTs evaluations are also included (SIMCE, 2012). Available at: <www.agenciaeducacion.cl/>.

49 In 2009, PISA's ERA Test (Electronic Reading Test) evaluated students online reading skills from 19 countries, including Colombia and Chile in Latin America (OECD, 2011).

50 This international study examines student's individual skills in the use of computers for research, creation and communication.

51 International Association for the Evaluation of Educational Achievement.

c) While to a certain extent the use of ICT has been incorporated in teaching practices, it has not had major impact on learning achievements of students in the traditional curriculum subjects.

Digital skills

One of the main objectives of the ICT policies for schools is to equip upcoming generations with the digital skills that will enable them to successfully develop in the 21st century. For some years now, the international focus has been in assessing the development of these type of skills. Twenty years ago, the concept of digital skills was basically understood as the ability to operate computers and its different softwares. Later, a new concept in ***digital literacy*** emerged transcending the mere technical deployment of ICTs. This new focus stems from the so-called ***21st century skills*** based on the evidence that job markets no longer value the technical skills per se, but rather the higher order cognitive skills within the context of deployment of ICTs.

For the educational sector, this represents the challenge of skilling people not only in the traditional skill sets (reading, writing and math), but to also be capable of solving non-routine problems and handle complex information often presented in digital environments (Levy & Murnane, 2007). Therefore, today there is a growing consensus that students ought to develop higher order skills necessary to solve problems in managing information and communication, such as search, evaluate, synthesize, analyse and present the information in a new format within the digital environment; as well as having the ability to use technical skills to share and collaborate with others. These skills are the foundational skill sets that must be developed in students to drive self-learning over the course of their lives; with the ability to participate, incorporate new knowledge and innovate productive and social processes in which they will be part of (OECD, 2009; Fraillon et al, 2014).

Given the above, a number of different countries and international agencies have begun to define conceptual milestones, and in some cases, have built and applied instruments that measure students' performance[52]. For instance, countries like England and Australia have developed curricular guidance and evaluations for this type of skills in schools. Moreover, under the guidance from the IEA (International Association for the Evaluation of the Educational Assessment), an international initiative is taking place – the International Computer and Information Literacy

52 Visit the Partnership for 21st Century Skills in the United States (www.21stcenturyskills.org) and ATSC Project by Intel, Microsoft and Cisco (http://www.atc21s.org/).

Study (ICILS) – in which twenty-one participating countries have undertaken one assessment of this nature in 2013. The slow appearance of evaluations of this type of skills is probably due to a number of reasons, but among these the complexity and cost of implementation are without a doubt extremely important, given that the performance in these skills must be measured in simulated digital environment using computer programs specifically developed for this purpose[53].

In our region, despite a number of countries demonstrating interest in this type of measurement, to date only Chile has produced a structure and an assessment. It was applied in 2011 and 2013 as part of its National Education Quality Evaluation System (SIMCE – ***Sistema de Medición de la Calidad de la Educación***). For Enlaces, placing special attention in the evaluation of this type of skill is a natural outcome of it historically prioritizing the competencies required for development in the society of knowledge, which include technological skills such as cognitive dexterity that enable management of information, interaction with others and ethical behaviour in an increasingly digital world. Aware that the evaluation and certification of this type of competency can facilitate the development and employability of students, in the middle of the last decade, Enlaces began to promote training in the basic use of ITCs based in the Computer Driving License model; and by the end of that decade, began to develop a broader conceptual framework to include the more complex cognitive dexterities. This new conceptual framework was drafted with support from the Learners of the New Millennium project of the OECD (OECD/CERI). The definitions resulting from this work were used by the OECD/CERI to study and discuss the importance of developing these competencies during school-based education (OECD, 2009). Whereas, in Chile, these were deployed as the basis to establish a measurement tool and a pilot study that would enable measuring these competencies in Chilean students, which was applied in late 2009 (Claro et al, 2012).

Within this context, in 2010, the Ministry of Education took an additional step by committing to undertake a nationwide assessment to evaluate these competencies in students in the tenth grade, which was finally performed in 2011 and again in 2013. Currently, Enlaces is redesigning the instrument for a

53 In recent years, international efforts have been made to assess skills related to the digital world, skills that require computer-assisted tools. For instance, the Electronic Reading Assessment test (ERA test) by PISA in 2009 evaluated online reading skills in students across 19 countries, including Colombia and Chile in Latin America (OECD, 2011); and the Assessment & Teaching of 21st Century Skills initiative (ATC21S), where Costa Rica is a taking part, is developing methods to assess competencies connected with communication, collaboration, problem solving, citizenship, and digital fluency (ATC21S, 2012).

third deployment in 2017. The measurement received the name of SIMCE TIC, alluding to the fact that it is part of the SIMCE regularly applied by the Ministry of Education in Chilean schools, and given its focus is in connection with digital technologies. The difference from most of the evaluations performed as part of SIMCE is that this assessment is not full census (applied to all schools and students); but rather sample based (applied to a representative sample of school and students); and is also not applied every year. For this reason, the information generated by SIMCE TIC is focused on establishing a baseline and to provide feedback for decisions in national policies and not, as is the case of the other instruments in SIMCE, to inform teachers and parents about the performance of their schools.

SIMCE TIC: evaluation and outcomes

SIMCE TIC evaluated the capability of students in solving school problems and tasks in the digital context in the three environments:

a) within the scope of the ***management of digital information***, where the skills in accessing, understanding, utilizing and generating information through technological media are evaluated;
b) within the scope of ***coordination and communication*** with others using digital media, where the skills in transmitting information to other people applying ICT are evaluated;
c) within the ***social and ethical scope of information technologies***, within which the capability of recognizing the consequences of using the Internet and making a responsible use of ICTs is evaluated.

Table 1 shows the skills matrix used in SIMCE ICT:

Table 1 – ICT Skills Matrix

Dimension	Sub-dimension	Skills
Information: Skill in accessing information, understanding, using and generating new information in technological media.	*Information as source:* Skill in obtaining information, managing, organizing and understanding it.	• Define the information needed • Search for information • Select information • Evaluate information • Digitally organize the information
	Information as product: Skill in generating new information within a technological environment based on elements available on the web, in connection with the higher cognitive capacity of synthesizing, drafting and creating new information.	• Integrate information • Understand information • Analyse information • Represent information • Generate new information
Communication: Skill in passing information using technological media, i.e., in addition to accessing the information, it is expected that people will be capable of communicating, transmitting this information, within a technological environment.	*Communication:* Points specifically to the skill of transmitting information effectively in virtual context in order to interact within them and passing information adequately in each context.	• Can transmit information to other people
Ethical and social impacts: Evaluate the skill in analysing situations of interaction within the virtual context, recognizing the consequences that the use of technology can have in personal lives and/or others, and making decisions for actions in this technological world as a function of the ethical and social consequences of both personal and third-party impacts.	*Social impact:* Evaluate the recognition of impact or consequences in people's lives, both positive and negative, of the use of the Internet as well as other technological tools, both as individuals as well as impact on social groups. Takes into account the capacity to reflect on said impacts.	• Make responsible use of ICT

Source: National Results SIMCE TIC, Ministry of Education of Chile.

SIMCE TIC is applied using a software that simulates a virtual environment in a computer, containing simplified versions of text applications, spreadsheets, presentations, email and Internet. Students must use these tools to solve problems and tasks they receive via chat. Each task is part of a larger project which must be undertaken with three virtual friends in the chat room, within a transverse role curricular environment, such as ecology.

The majority of the test, containing a total of 32 items and an approximate duration of 120 minutes, is answered by selecting an option from a set of alternatives shown in the software, for which students must have previously performed some action with using the tools in the virtual environment. Some items have as a result a digital product that will later be manually evaluated with a correction line.

The tool is applied to a nationally representative sample (around 10 thousand students in the 10th grade distributed across approximately 500 teaching institutions across the country). Since the test is loaded on a memory stick and educational institutions have computers, the application runs on a set of portable computers taken by the person responsible for applying the test, in order to ensure the reliability required by the process. The total number of facilities is covered in a period of several weeks. It is worth highlighting that, in parallel, student social-economic status questionnaires are deployed to collect data in order to have information enabling analysis of context and conditions that could affect the achievement reached in the measurement (Jara et al., 2015).

In order to facilitate the interpretation of the SIMCE TIC results, Enlaces established the three levels of achievement – beginner, intermediate and advanced – describing the knowledge and skills expected to be displayed by students taking the test. In order to do this, a standard-setting (baseline) procedure is carried out by experts that analyse the results based on the empiric difficulty of the items in the test by applying statistical RASH analysis. Table 2 describes these levels of achievement:

Table 2 – Description of Levels of Achievement in SIMCE TIC

Beginner (89-245 points)	Intermediate (246-335 points)	Advanced (336-393 points)
Students can: • make basic use of the ICT functionalities; • interpret simple information; • identify evident Internet risks and threats. These students have not consolidated the intermediate level performance, given that, on occasion, they are successful in some of the skills described at this level but with lower frequency or inconsistently.	Students can: • make basic functional use of the simpler digital tools; • search, select and integrate information from different sources and generate a product corresponding to the task set; • effectively express and transmit clear and relevant messages by choosing the most appropriate means for the addressee and the specific context; • are aware of the procedures of care and security in the use of computers and information, recognize situations of evident personal risk and identify illegal activities in the digital environment.	Students can: • make advanced use of the more complex ICT tools, allowing them to solve problems with flexibility and efficiency; • search, evaluate and select, restructure and integrate information from different sources and develop and print out their own ideas into a product that solves a problem within a specific context; • identify procedures in care and security in the use of computers and information, recognizing potential personal risk situations and understanding the consequences and social impacts of participating in illegal activities in the digital environment.

Source: Levels of Achievement in SIMCE TIC, Ministry of Education of Chile.

So, given the scores achieved, students can be classified into these levels. General results of the applications used are shown in Charts 1 and 2:

Chart 1 – Percentage of 10th grade students based on the level of achievement in SIMCE TIC: 2011 and 2013

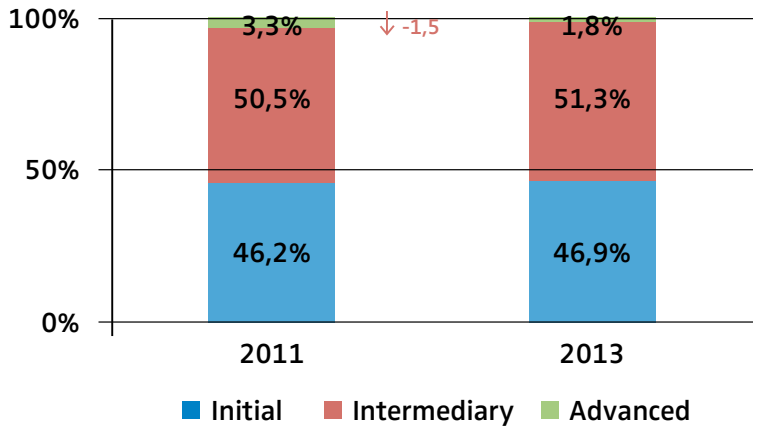
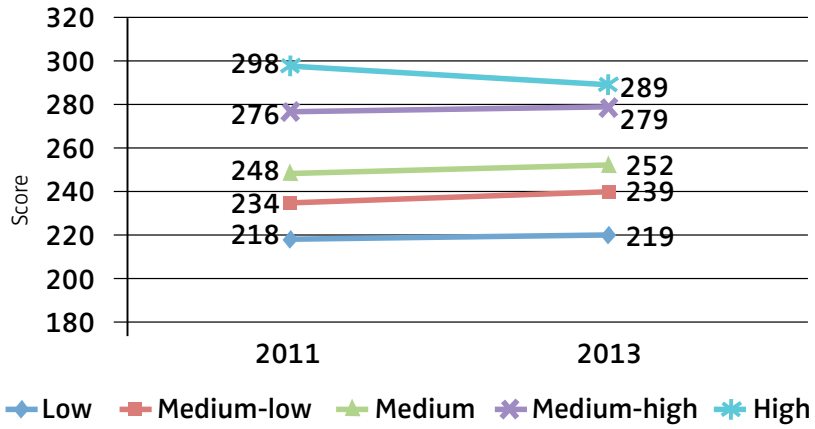


Chart 2 – SIMCE TIC results according to social-economic status (GSE): 2011 and 2013



Source: National Results SIMCE TIC, Ministry of Education of Chile

The results of these digital skills assessments reveal the limitations of efforts undertaken in this area: on one hand, about half of students do not reach the minimum level expected in the skills and very few reach advanced levels; on

the other hand, the social distribution of these skills remains closely linked to the socio-economic status of the students' families. As expected, the type of tests with tasks of higher demand for higher cognitive skills are also the most difficult for students, while the more achievable ones are those that only address technology skills.

The results achieved in these measurements are eloquent in four aspects: first, they reflect the limitations carried by Enlaces in developing these skills in students; second, they confirm the novelty and difficulty that these skills represent for the Chilean school system; third, they reveal that access and use of ICTs is not enough to develop digital skills and suggest that a curriculum framework and pedagogical work specifically driven to their development is necessary; and fourth, they highlight the impact that differences in Internet access in the home might have in the uneven development of digital skills of students.

Consequently, the main challenges Enlaces is facing in this area are: at a general system level, coordinating with other educational and social policies to ensure the minimum access and use conditions; at the teacher training level, ensuring teachers training in these skills and coaching in the early delivery years; at a curriculum level, specifying in plans and programs how these skills are integrated with subject matter contents; and at a pedagogical practices level, illustrating with concrete resources and activities how these skills develop and open space for innovation in this area.

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Reflections and perspectives

The more teachers make progress on harnessing new technologies, the more they are prepared for critical assessment of their potential for everyday's work, thus succeeding more to change their practices on school projects. In the analysis and data assessment experts carry out in this publication, there is no doubt that providing quality training that sparks the interest of the faculty is a key point for the advancement of projects that include ICTs in school environments.

The educators' involvement level in new projects greatly influences the success of the endeavour. Similarly, the authors of this article agree that no one can expect trainers to get excited about using technologies while they have scarce or lack infrastructure to learn and teach, face endless difficulties to access Internet, or are destitute of support to constant challenging questions students ask when the pedagogical proposal welcomes their greater participation and includes new tools. Are there teachers who deal with all adversities and still perform an exceptional job? Yes, these teachers do exist.

Nevertheless, the following article deems it indispensable to pay careful attention to teachers' training, for the scenario that fosters the most change is one involving a reasonable framework to adopt methodologies and practices, and that above all else, values different educational realities.

Training teachers is not about offering a course in a school hoping they will learn and discover overnight how all of that is related to the school context they form a part of. Working on specifications rather making generalizations is a key point. Thus, everything mentioned before must be taken into consideration should ICTs be implemented in rural schools as well. It is necessary to talk about different realities, whether it be related to training or the model designed for the assessment.

A few years ago, assessments for use of ICTs in education were scarce. Now, these assessments exist and their results tell stories and suggest successful practices; in other words, what went right can and must be spread.

Reflections on ICT integration into educational settings

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Introduction

This article deals with a brief analysis of two crucial aspects of ICT policies in education: the management of ICT policies and their importance in building digital citizenship and its impact on educational practices.

The first aspect includes government-related issues, digital citizenship, and resource management, as well as infrastructure and connectivity. The second aspect has to do with issues related to training of teachers and principals.

The considerations herein specified correlate primarily with the Comparative Review Study of mobile learning initiatives conducted in 2015 in Colombia, Costa Rica, Peru and Uruguay, with support from the Division for Policies and Lifelong Education Systems in UNESCO's Education Sector.

At the heart of this analysis is the belief that public policies need to be directed towards educational priorities in every country, based on a convergent and integrated vision in order to achieve the objectives of inclusion and educational quality in a sustainable manner.

Furthermore, these public policies are framed in the perspective of the right to education with the aim of having an effect on both the democratization of knowledge and the improvement of education systems.

Management

The experience accumulated in the region shows that the size of government and management is a key factor for the development of ICT policies. In other words, the creation of a scenario addressing political, technical and organizational matters is necessary, guaranteeing sustainability over time as well as the participation of many players and institutions. Only in this way is it possible to think of the viability of these policies. This viability consists of two mutually complementary features.

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On one hand, there is the political support to implement ICT integration policies and design an implementation model including both political-educational priorities and the characteristics of national contexts. On the other hand, there is an institutional management model in which the State plays a major role in different processes – planning, implementation and evaluation- and to provide financial, human and material resources required to carry out those policies. A relevant question is the necessary review of regulatory frameworks in relation with the use of ICTs in classrooms, i.e.; banning of cell phones in schools in several countries.

Another question to take into account is the early establishment of monitoring and assessment systems of ICT policies and related programs, particularly the pedagogical uses of ICTs. In this way, we can have reliable, valid, and relevant information to make decisions on improving actions for the future.

With a common view to ensure the access to technology as a right of all people, prioritizing equity and social inclusion objectives, case studies show that the configuration of dynamics differentiated in relation with their management models and the role played by the government to guarantee the viability of policies.

For example, the ***Ceibal Plan*** implemented in Uruguay in 2007, emerged from a strong leadership that combined government management with a priority in education, thus gaining the political and budgetary support required. Furthermore, management had the professional and operational capacities needed to accomplish the proposed plan within the framework of an institutional design with political and strategic decisions at a government level. Also, the operation management led to a parastatal specialized institution, the Ceibal Centre, with less participation of the Ministry of Education.

For its part, ***Computadores para Educar*** (Computers for Education-CPE) is the initiative created in Colombia in the year 2000 under the articulated guidance of the Ministry of Education (MEN) and the Ministry of Information and Communication Technologies (MINTIC). This initiative has been consolidated as a central program of the national ICT policy around which other pre-existing initiatives have been converging. Several factors prove to be decisive in explaining the sustained viability of the program; from the institutional point of view, an articulated and coherent inter-ministerial administration, to a management planned according to clearly defined strategic lines translated into quantitative goals, to the monitoring and evaluation of their processes and results, and the

development of an important operation capacity based on stable professional teams that maintain a smooth relationship with educational establishments and decentralized offices.

In Costa Rica, the project ***Learning with Mobile Technology in Multigrade Schools*** (ATEM)[56] is an initiative started in 2012, to intensively use mobile technologies with a one-to-one equipment model in one-teacher rural schools and a two-to-one model in those of Direction one. A key factor that has contributed to the implementation and consolidation of this initiative is that it falls within a national policy that has been making use of technologies in the education field for three decades – the National Program of Educational Informatics (PRONIE MEP-FOD)[57] – sustained on a vision of the educational pre-eminence over technology. The long history and continuity of the PRONIE MEP-FOD and its legitimacy within the educational community provided a stable framework that allowed to take advantage of the accumulated experience.

A different direction in terms of viability is posed by the ITC policy in Peru, where the main financing institution of the program, the OLPC Foundation[58], conditioned the initial decisions. The project developed in a framework of institutional weakness characterized by different planning problems and certain difficulties to put up a monitoring and evaluation system. Furthermore, there was a lack of funds to acquire devices and poor infrastructure and connectivity in most educational centres. After the change of the administration in 2011, a period of reflection and critical review of the policy began as well as reorientation of the policy towards the use of the existing devices with pedagogical purposes, based on the sharing of experiences developed at a regional level that have been positively assessed.

From the social dimension, the importance of digital citizenship for countries is evident. The ICT policies mentioned in this study show the leading role played by families when turning to the installation of ICTs in education. Through their involvement in the distribution and use of devices, they benefit with policies aimed to meet their social rights as they become key allies to engage in transformations in educational institutions. Experiences have suggested two questions worthy of consideration in this regard: the necessity to adjust mechanisms of trust among educational institutions and families with respect to the maintenance of devices; and the importance of strengthening their skills in the handling technical devices

56 ATEM for its acronym in Spanish: ***Aprendizaje con Tecnologías Móviles en Escuelas Multigrado***.
57 PRONIE MEP-FOD for its acronym in Spanish: ***Programa Nacional e Informática Educativa del Ministerio de Educación Pública – Fundación Omar Dengo***.
58 OLPC for its acronym in English: ***One Laptop per Child.***

as well as of allowing them to use these devices in tasks and necessities inherent to the family and community life. Thus, the appropriation of ICTs by families activates and recreates the exercise of new forms of citizenship.

The question of technological infrastructure and connectivity shows the persistence of common problems despite valuable efforts and considerable progress achieved in the region. In this sense, three issues to work on are mentioned below:

First, the suitability of ***technological equipment*** of institutions according to the model adopted. This is a subject that on the one hand refers to the launching of the "technological floor," or in other words, engineering and logistics to install and integrate electric networks, local area networks (LAN), installation and wireless network equipment (Wi-Fi) necessary to provide operation for different software. It is a question of low visibility but of great importance while its adequate implementation means a possible condition to develop a serious proposal for digital inclusion and pedagogical use of ICTs at schools. Furthermore, the management of technological equipment refers to bidding and purchasing processes that, in general, involve long periods of time by the States and a significant administrative effort. In this connection, ICT policies analysed show a trend to create purchase and scale economies that, in the long run, aim to ensure the acquisition of up-to-date equipment.

The second unsolved problem in most countries has to do with ***connectivity***, which limits the pedagogical use of mobile technologies. The main factors involved in this item include, among others: stable access to electric energy, which is not always available; connection speed, including the "upload" speed, which many times is not considered; and the availability of advanced technological floors. It is important to note that, in order to provide connectivity at schools, the coordination of different players is fundamental both within an interstate context (among ministries and different jurisdictions) and in coordination with the civil society and telecommunication companies.

The experiences of some countries show alternative intermediate solutions such as the use of intranet. However, national policies with significant progress on the subject, particularly those adopted by Uruguay where 99% of centres have Internet connection, account for the fundamental value of Internet access in educational practices to develop pedagogical experiences that foster collaborative work, and the suitability of practices to guide teaching concerning different

learning models and students' needs. This means harnessing technologies while alternating synchronous and asynchronous tools and the combination of both, thus allowing for de-structuring of classical times, spaces and groups of the traditional school.

The third problem area has to do with ***recycling of electronic devices and e-waste policies***. In this regard, it is essential to analyse the negative impact on the environment caused by high volumes of technological waste. While a trend towards the inclusion of policies and frameworks that provide management of technological waste is evident in the region, including recycling, as a key piece of digital inclusion policies, there is still a long way to go.

The comprehensive e-waste management experience adopted by Colombia turns this country into a regional and worldwide reference. Thus, Computers for Education has three equipment reconditioning centres in Bogotá, Cali and Medellin, responsible for repairing or reconditioning computers; and a National Centre for Electronic Waste Reutilization (CENARE)[59], located in Bogotá, for e-waste management. Uruguay, in turn, has decided to carry out a responsible management of waste generated under the Ceibal Plan, mapping a recycling policy that adequately treats waste generated by devices no longer in use. In the same vein, Costa Rica has implemented a plan to recover obsolete equipment and the subsequent evaluation of their final purpose: backup, relocating, and recycling.

In summary

In the different modalities of management and governance adopted, the region's experience indicates that one of the major challenges currently and in the future is the articulation between education policies and ICT policies in a complex scenario characterized by the multiple decision-making levels and actors involved. Hence, the construction of institutions is a condition for the viability of policies.

To this end, perceiving the State as an irreplaceable actor in the administration of ICT policies in education is pivotal. This role means defining a medium and long-term planning agenda that goes beyond fostering initiatives to achieve State policies. This includes considering modality, scope, total policy funding and coverage of actions, and definition of an ICT integration model to be implemented. Furthermore, the adhesion of involved actors is necessary, especially those benefiting from ICT policies (teachers, students, educational community) and the sectors engaged (universities,

59 CENARE for its acronym in Spanish: ***Centro Nacional de Aprovechamiento de Residuos Electrónicos.***

companies, unions, etc.). Lastly, it is important to review regulatory frameworks necessary to undertake actions.

In order to overcome problems associated with lack of connectivity and/or poor access, which constitute one of the major conditioning factors to integrate ICTs in classrooms, we must work on comprehensive budget planning of ICT policies, assessment on the relevance and viability of the different ICT integration models; precise and organized planning of the technical support strategies; and attention to the design of policies for e-waste recycling.

With the consideration of these elements are the ***following recommendations***:

a) Develop from the State inter-sectoral dynamics that are responsive and flexible, supported by transparent, proactive and productive management mechanisms for the development of ICT policies oriented towards the achievement of national educational goals.

b) Consider progressiveness as an implementation modality.

c) Focus on the social adhesion to ICT policies, particularly of families, with a view to building new forms of citizenship.

d) Discuss and review regulatory frameworks associated with the uses of ICT for educational purposes, particularly the regulations ruling the use of devices at schools.

e) Establish follow-up and assessment systems of all aspects connected with the implementation of ICT policies that guarantee reliable evidence-based data and information that is useful to make decisions involving better use of ICTs in teaching.

f) Make progressive investments to achieve full, high-speed connectivity per user, meeting the needs of Internet access from all the school sectors and other public spaces (squares, public libraries and clubs) with the purpose of ensuring an equitable pedagogical use of devices by means of interaction, download and production on the Internet.

g) Consider all the necessary technical dimensions to install technological floors at institutions and plan technical support strategies in advance.

h) Work intersectorally on the design of e-waste recycling policies.

Pedagogical practices

Due to the scope of transformations proposed by the digital culture, one of the most challenging issues for the ICT policies in education is the introduction of changes in pedagogical practices. From this perspective, it is reckoned that digital culture may be an opportunity to achieve deep changes towards better learning and meet pending commitments in education. Four problem areas may be mentioned in this sense:

First, the required ***teacher training***. There is a consensus that reaffirms that this is the "hard core" in the constitution of ICT policies in education, a fact that may be confirmed in evidence gathered in analysed countries.

Costa Rica, for example, aims at a change of approach: from a prescriptive offer to one based more on free choice and responsibility of teachers. The virtual modality is offered as a possible alternative to the challenge of universalization of ICT policies. For its part, Colombia bets on the teacher training component as a pathway to improve the students' learning results by reviewing the training offer. Changes aim to combine virtual and face-to-face modalities by means of diploma programs addressed to an array of groups and focused on the supervised production and learning based on problems.

Uruguayan strategies present a mixed model by combining different lines of action designed in an integrated and convergent manner towards the idea of change in teachers' pedagogical practices. The training offered converges through different modalities, face-to-face and field support sessions for trainers and development of comprehensive projects in new collaborative environments. In the case of Peru, a model under review, the national policy proposes the relocation of the centrality of teachers in this change taking into account their needs. In this connection, the national portal positions as a reference both the provision of resources and the construction of environments for exchange and online training

The initiatives assessed help appreciate the development of training models centred on educational institutions and on the belief of innovative and creative capacity of teachers. In practice there are different models of public-private cooperation highlighting the diversity of strategies that include the participation of technology companies that offer their proposal.

The evidence recorded allows identifying an important limitation: teachers' working conditions, above all, those related to the lack of available time. This

issue presents a serious limitation over training processes and the possibility to produce and experience innovations at a pedagogical level.

The second problem area is related to the integration of ICTs into the ***pre-service teacher training***. Some problems show the need for a revision in the light of new issues that emerge during the digital inclusion at schools including: impact on the organization structure of education institutions, teachers' working positions and conditions; distribution of devices to education centres and/or students within the level; structure and curriculum design of the training offer; strengthening of trainers of future teachers, among others.

The approach on this topic is present in many forms in the region. The research we refer to indicates, for instance, that in the view of Peruvian ICT policies, this question is the backbone of the future agenda. It has also mobilized the development of certain valuable initiatives, for example in the case of Uruguay, through the decision that students in their last year of the pre-service teacher training program work with families and the community. In 2012, laptops were handed over to students when starting their third year of training (a decision based on the high dropout rate during the first two years) and laptops and LabTeD kits were delivered in information science labs at teacher training institutions.

The last problematic area has to do with the centrality of ***management teams*** encouraging the institutional change. Their role is key in organization management of the technological equipment and administration of available resources; work carried out on motivational readiness of players towards change; the dynamization and orientation of innovative educational practices; construction of a collaborative culture among teachers, through informal and distributed leadership processes; use of ICTs in the administrative and communication management systems; including of families and the educational community in the processes of transformation of school culture.

ICT integration policies included in this study consider the problem in their agenda with a focus on several critical issues identified during the implementation process and planning actions towards their resolution. Based on this perspective, different strategies have been adopted.

The case of Costa Rica case offers elements for analysis. This is about actions that tend to overcome one of the problems identified as hindering the change within the institutions: the weak collaborative culture that simplifies and promotes more collective and sustainable innovation processes. In educational centres, principals assume a central role with respect to team management, which entails,

for instance: improve security conditions for safekeeping purposes; coordinate with teachers the shared use in case of having a two-to-one implementation; coordinate and promote the transfer and use of mobile equipment at home, or in case of changes, at a management or teacher level from one year to the following one or even within the same year, and to handle the application so the Omar Dengo Foundation provides support for the training for the new staff and/or the new students.

Computadores para Educar (Computers for Education), in Colombia, has designed the "ICT use training strategy for teachers with an impact on students (ETIC@)," an initiative focused on offering four diploma programs, including one course specifically addressed to school authorities with a focus on school management, institutional education projects and education community.

The ***Ceibal Plan*** in Uruguay, in turn, has identified the centrality of school authorities in the sustainability action processes of facilitator teachers and supporting teachers of Ceibal (MAC). Thus, the commitment and training of school authorities is seen as a key element to accompany the pedagogical support process with a view to a qualitative advantage of the use of devices beyond the priority attention on the part of MAC.

Even after this progress, the question has not yet been included in the backbone of political agendas in order to comprehensively support the particular complexity entailed by the conduction of change at an institutional level by means of the leadership of management teams.

In summary

In the search of strategies to produce changes in educational practices, the ICT policies assessed strengthen the initial and lifelong training of teachers and principals, thus perceiving they play a leading role in connection with change. The new forms of training promote collaboration and networking practices to build pedagogical knowledge among teachers. Additionally, pre-service training and management teams are two aspects highly considered. Last but not least, necessary budgetary investment is required to move forward in these aspects.

Taking this into account, the ***recommendations*** for teacher and principal training include:

a) Reinforcing the role of the State in leading the teacher training policy by fostering synergies with private sector initiatives in the framework of the general goals and guidelines of the educational policies.

b) Emphasizing the implementation and in-depth study of new training formats.

c) Developing specific training and coaching strategies for the management teams of educational institutions.

d) Guaranteeing the distribution and maintenance of technological and connectivity infrastructure for the teacher training institutions.

e) Assessing actions taken in connection with teachers and management training to have the necessary changes to produce the necessary tools in a timely manner.

Cooperation
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Telefonica Vivo Foundation and UNESCO Office in Brazil came together in 2015 for the Evaluation Panel: Education and Digital Technologies. This meeting discussed the reality and challenges facing the methodologies of existing evaluation initiatives which use new digital technologies in education. A new evaluation paradigm must be built to generate outcomes and information on the same level of complexity of technology-related educational projects. This publication presents ideas about the context, the methodologies and the evaluation outcomes of technology-related projects and programmes for education in Latin America. Technology is seen as an important tool for achieving a comprehensive approach to school and for the training of a new generation of young social leading actors.

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