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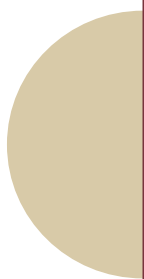
Comparative Review of National Mobile Learning Initiatives in Latin America

**The cases of Costa Rica, Colombia, Peru
and Uruguay. Comparative Report**

EXECUTIVE SUMMARY/ABRIDGED VERSION



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Introduction

During the last decade, Latin America has turned into one of the most proactive regions in the world regarding integration of ICT, based on the articulation between this and the purposes associated with the social inclusion and democratization of education systems. In this sense, mobile learning has been increasingly strengthening during the last years and has been particularly relevant especially in contexts where the challenge to guarantee such purposes is even more important.

Hence, within the framework of the UNESCO Project *Comparative review of national initiatives on mobile learning*, IIEP-UNESCO Buenos Aires has coordinated, together with the Division for Policies and Lifelong Learning Systems in UNESCO's Education sector, the elaboration of a comparative study on a cluster of mobile learning initiatives developed in Latin American countries: *Computadores para Educar (Computers for Education)* (Colombia); *Learning with Mobile Technology in Multigrade Schools* (Costa Rica); *ICT Policy* (Peru); y *Plan Ceibal* (Uruguay).

The main purpose of this study was to delve into the analysis of public policies focused on the integration of ICT into the education system as a valid strategy to face some of the most urgent educational needs in the region and the world. Within this framework and based on the perspective of education as a right, improving equity and education quality in the countries of the region undergoing problems associated with education inequality, is considered a priority.

Based on the above, the study is presented as a tool for those responsible for policies and other actors involved in their design and implementation, as it provides elements of analysis and recommendations to develop mobile learning policies and programs, both in the 1-1 modality and other alternatives.

The information and analysis of the results obtained have been organized in a collection of five titles: four of them describe national initiatives (Costa Rica, Colombia, Peru and Uruguay) and the fifth title, a summary of which is contained in this document, develops a comparative study on the surveyed experiences.

Our special thanks to David Atchoarena, Director of the Division for Policies and Lifelong Learning Systems in UNESCO's Education sector, and to Francesc Pedró, who has designed and promoted the production on mobile learning at a regional and global level, for trusting IIEP-UNESCO Buenos Aires regional office to carry out this study. A special mention to the Ministries and agencies responsible for ICT policy in the participating countries: *Computadores para Educar (Computers for Education)* in Colombia, *Learning with Mobile Technology in Multigrade Schools Project* of Fundación Omar Dengo in Costa Rica, *ICT Policy* of the Peruvian Ministry of Education and *Plan Ceibal* in Uruguay, as well as to government officials, teachers and other actors who generously shared their experiences and initiatives at the schools visited in order to accomplish this research. We also thank to the Advisory Board of this study: Francesc Pedró (UNESCO), Raúl Katz (University of Columbia), Manuel Area Moreira (University of La Laguna), Guillermo Sunkel (CEPAL) and Margarita Poggi (IIEP-UNESCO Buenos Aires), who offered a valuable contribution to the report through their critical perspective and participation at different stages to achieve this paper.

1. Comparative study of mobile learning: starting points

During the last decades, the debate on the integration of ICT policies in the education system has been productive and significant. No doubt, the hectic pace of technological advances has strengthened this debate in search of alternatives to improve the learning process in a scenario shaped by the new social, political, economic and cultural coordinates in the global context.

Within this framework, the mobile learning issue is particularly significant in contexts with a major challenge to guarantee the right to access a quality education in conditions of justice and equity. Thus, mobile learning appears as an alternative not only to rethink the comprehensive integration of ICT in education systems, but also, and particularly, to promote its implementation in specific contexts such as remote or inaccessible rural areas dominated by populations in situation of poverty and social exclusion.

Taking account of the characteristics of mobile learning allows for measuring its contribution to increase and enhance education opportunities. Two principal features characterize this learning modality.

First, while mobile learning entails the use of mobile technology, either alone or in combination with any other type of information and communication technology, the most important feature is portability. Indeed, ease of transport allows mobile devices to perform different tasks, particularly those related to communication and learning. Second, portability as a characteristic of mobile learning is associated with another key element: ubiquity. Thus, the use of mobile devices unfolds the notion of ubiquitous learning as an open process that may be developed anywhere.

The potentiality implied in these attributes has set the grounds for the expectations on the renewal of traditional educational models in line with the new requirements of the global world. Mobile learning offers different advantages that result in valid arguments to canalize the decisions for change within the framework of ICT policies in the educational area.

Thus, a mobile learning sets up an environment open to the invention of new educational practices, and predicts new contributions, especially when taking into account the technological advances that may enhance this new educational model in the coming decades. However, the expectations generated by the contribution of mobile learning are not exempted from the importance to evaluate how viable and appropriate it is from the education viewpoint, as well as the need to interact with the contributions of other models previously installed in the region. In this sense, it should be considered, however obvious it may seem, that technological advances are not supposed to introduce significant changes in educational practices. Hence, a parallel and articulated progress between technology and education is a key issue to achieve synergic processes.

This is essential to design and implement public policies of ICT integration since it renews the importance of the role of the State to address educational policies. In this sense, it is necessary to pay

attention to the importance of ICT when defining an agenda including educational issues and challenges, as to which contributions provided by the development of technologies are evaluated and made use of and as to which contributions are devised to guide its course of action.

From this perspective, paying special attention to the learning lessons drawn from the accumulated experience in the region on integration of ICT policies, the study of the initiatives in the countries included in this paper was oriented by a series of key questions. Far from an emphasis on evaluative evidence, these questions were intended to identify the elements of analysis that contribute to strengthen these policies and are concurrently significant for planning and implementing ICT policies in education in other contexts.

These questions were:

- Which are the principal points that define the viability of ICT policies in education? Which are the onset decisions and minimum conditions required to formulate these policies?
- Which are the institutional mechanisms that strengthen the role of the State to conduct ICT policies as public policies from a rights-driven approach?
- How will the contribution of ICT policies shape national education policies?
- Which are the basic institutional conditions to achieve a genuine integration of ICT?
- Which prove to be the most viable and appropriate equipment and connectivity strategies for the different contexts?
- Which are the favourable strategies to position teachers as the key actors of the educational change as of the appropriation of ICT?
- How to take advantage of the contribution of ICT pedagogical potential to improve the learning quality? Which is the contribution of digital contents and how could they be maximized? How to design good pedagogical and institutional practices and introduce them on a large scale?
- How to encourage pre-service teacher training and professional development policies that incorporate ICT?
- How to include families and the educational community towards change and the joint development of a digital citizenship?

The case study was the methodology used to analyse national initiatives because it allows approaching the fundamental characteristics of the national programmes considered. It also takes into account their objectives, rationale, ideologies guiding them, as well as the processes used to shape and develop them, taking into account the particular context in which they were implemented. Based on this, a multidimensional approach was encouraged for each initiative articulated on four dimensions –*government and management; infrastructure, access and connectivity; digital contents; use and appropriation*–, which allow for grasping and analysing the set of decisions and factors that have a bearing on the design and implementation of ICT policies aimed at integrating them in the education sector. The analysis allows appreciating the development degree attained by the countries in each component and identifying the aspects showing the major challenges currently faced by the region.

2. ICT policies in education in Colombia, Costa Rica, Peru and Uruguay

One-to-one model has progressively turned into the main focus of most ICT educational policies in Latin America, both at a national, provincial and/or municipal level, by means of several implementation processes in their scale and target groups. Attentive to the inequality issue as one of the major challenges in the region, educational policies in force have found in this model the appropriate channel to guarantee the reduction of the access digital gap, a *sine qua non* condition to install long term educational changes processes. The one-to-one model has thus proved to be a starting point with an unquestionable social value, largely recognized by different sectors, though the question is still on hold as to both the scalability and sustainability and the impact of this modality in the introduction of ICT into the institutional dynamics and teaching and learning processes.

To a certain extent, this trend has relegated the exploration of alternative mobile learning models not necessarily focused on furnishing each student or teacher with a device, which, though desirable, it is not always possible due to the expensive sustainability. In this same direction, it is necessary to point out that this pedagogical model does not necessarily oblige the adoption of computers as a sole possible device and that the asset entailed in this model does not only depend on the use of a certain device, but rather on the pedagogical variations that encourage the alternative use of digital devices, of other technologies and through various activities and strategies.

The array of current mobile learning initiatives, coexisting with other ICT integration modalities developed in the region during the last decades, lays out a path of challenges to follow within a broader framework of a change in the cultural and educational paradigm. There is a consensus to assert that a pedagogical model that integrates technologies must look beyond the successive adoption and a particular device -which means an incremental approach- to frame the issue as *device ecology*.

However, the truth is that beyond the consensus, the countries of the region follow different channels in their ICT policies by implementing various models with possible combinations among them. These are decisions oriented by the broadest guidelines of the education policy in each country, which are affected by the peculiar social, political, economic and cultural scenario in each context. The countries included in this study are a proof of this.

In the case of Colombia, two issues are identified among the main challenges of the public education in the country. On the one hand, 55% of children attending rural schools drop out before concluding their studies. Rural education represents 80% of the educational offer, with many isolated schools and some of them lacking electric energy. A high rate of rural illiteracy is observed (average urban rate was 5,4% and rural 18,6%). On the other hand, the quality of education is a great concern. According to the OECD, the result from the PISA's test for Colombia in 2006 in Mathematics is below the ones obtained by 61 countries and similar to the countries that obtained the three lowest results.

In this setting, *Computers for Education (CPE)* has practically reached almost all of 43.000 public Colombian schools by means of a programme integrating various components such as infrastructure, teacher training, monitoring and evaluation, and environmental management. Even after the achievements reached during the 15 years of implementation, the programme presents some challenges in the short and medium terms. Approaching these challenges does not only depend on the institutional strength and the management and operation capacity, since some of them are part of the structure of the education system, for example, the high level of rurality. These challenges include, among others: improve internet connectivity, help improve learning results, accompany the transformation of teacher practices, particularly contributing to reduce the pedagogical isolation in their area.

In its turn, although Costa Rica has one of the highest literacy rates in the world and ranked second among Latin American countries in the 2009 PISA test, and shows significant progress in reducing inequality, it maintains the challenge to develop a bilingual intercultural education considering the diversity characterizing the country's population.

In this scenario, the project called Learning with Mobile Technology in Multigrade Schools (ATEM) kicked the integration of the one-to-one model in multigrade one teacher rural or Dirección 1 (one principal) schools in Costa Rica in 2012 as part of an equity strategy. In these three years in operation, the project reached 776 multigrade rural schools scattered all along the country, while envisaging to attain 100% of these centres by 2017, on the occasion of the 30 years of the National Programme of Educational Informatics (PRONIE MEP-FOD). A few cases in the region may demonstrate such continuity and sustainability level in a specific policy, in this case a policy referring to the use of technologies in education, projecting ATEM as a universal intervention for multigrade rural centres in Costa Rica in a few years. In this search, the pending challenges focus in achieving quality connectivity at schools as well as strengthening the processes to use and appropriate technologies on the part of educational stakeholders.

The case of Peru presents a steady progress overview in terms of education after a historic delay in the region. Thus, literacy rates have been improving, gender gap was reduced and there is an increase in the completion of primary and secondary cycles. Apart from this improvement, the country faces other challenges, especially with respect to access inequality that is still affecting the most vulnerable social groups, since poor academic performance, repetition and dropout concentrate in the poorest students, especially women and indigenous people, and illiteracy is still a pending issue attaining 6,2% of the population.

Within this framework, the history of ICT integration policies developed in the country proves the implementation of several initiatives among which the adoption of the programme *One Laptop Per Child (OLPC)* was the most important one, though affected by different problems which resulted in a revision process started in 2012 in an overall restructuring framework of the Ministry of Education (MINEDU). The main objectives presented for the ICT integration policy focus on giving the priority to the less advantaged sectors so as to contribute with social equity processes based on the digital inclusion, considering at the same time the cultural diversity and specificity and the rurality of a big part of the target population. Also, increasing efforts to coordinate

initiatives and policies by creating areas and spaces for institutional articulation; developing connectivity and the access to educational centres. Finally, consolidating a new approach on ICT and education to strengthen the impact of the initiatives on the subject and take advantage of the change of ICT approach to promote pedagogical innovation processes and equity.

The case of Uruguay presents a long-lasting public education system that shows good education indicators such as the average school years and literacy rates of the population. Also, Uruguay has participated in the main international studies that measure academic results of the education system, which allows the country to position in the international context and confirm its good performance in the region.

Following the ideas of the international initiative OLPC, Uruguay was the first country in the world to commit itself and implement a plan to distribute personal computers to every student and teacher in the public education system, with the strategic purpose of improving educational quality in an equity framework. Notwithstanding the considerable progress attained since the beginning of the plan in 2007, Ceibal faces obstacles and challenges: the most important one is to promote an increased and more relevant use of technology to have a broader and profound impact on the education of children, especially those in secondary education.

National initiatives outlined in the wider context of the characteristics of each country, set up an overview that both in their diversity and in their common approach, identify a set of difficult areas and pending challenges for the future as regards ICT integration policies in the region.

3. Difficult areas and pending challenges for the future

The Institutional Structure of ICT Policies in Education

The experience gathered by ICT policies in the region allows concluding that the institutional structure is a key factor for development. To address the dimension of government and policy management based on these grounds entails **assuring a series of necessary conditions and their continuity to accomplish the proposed objectives, i.e., their viability**. This means a complex scenario wherein it is necessary to articulate political, technical and organizational matters by means of the participation of multiple actors and institutions. The viability of policies is made up of two complementary features. First, a combination between the political support to implement ICT integration policies and the capacity to design an implementation model that takes into account both political-educational priorities and the characteristics of national contexts. Second, the existence of an institutional management model with a strong role of the State to conduct the different processes –planning, implementation and evaluation- and to provide financial, human and material resources required to carry out those policies as well as to coordinate at a central level the different sectors and agencies involved –public and private- within the framework of the political and administrative organization of the education system in each country.

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 the configuration of dynamics differentiated by the viability of their policies, which resulted in the conditioning element to pursue their objectives.

For example, the *Plan Ceibal* implemented in Uruguay in 2007 emerged from a strong leadership that combined a government management with a priority in education, thus gaining the political and budgetary support required. A management that 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 accompanied this. Also, the operation management was referred to a parastatal specialized institution, the Ceibal Centre, with less participation of the Ministry of Education. Furthermore, the adoption of the one-to-one model was adapted from the very beginning to the Uruguayan context, particularly as to the consideration, contrary to the principles of constructionism, of the centrality of teacher management and the importance of their involvement and the design of teacher training actions. Taking into account the intersectoral articulation, it must be considered, among other decisions, that the revision of strategies has always been nurtured by ongoing monitoring activities and by the support of several external assessment studies which entailed the decision of a close interaction with the academic field to accomplish them. With a view to the strengthening of the viability of its national policy, *Plan Ceibal* envisages, as a challenge for the future, the possibility to take a better advantage of the ANEP, and in general of the school system stakeholders, technological development and education innovations promoted by the Ceibal Centre.

Computers for Education (CPE) is the initiative created in Colombia in the year 2000 under the articulated guidance between the Ministry of Education (MEN) and the Ministry of Information and Communication Technologies (MINTIC). This initiative has been consolidated as a central programme of the ICT national policy around which other pre-existing initiatives have been converging. Several factors prove to be decisive to explain the current profile of the programme in a sustained viability framework. From the institutional viewpoint, an articulated and coherent interministerial administration, a management planned according to clearly defined strategic lines, translated into quantitative goals, 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, have contributed to achieve an important territorial coverage and accomplish the anticipated goals. It could be affirmed that all of these factors together have also contributed to legitimate their action and sustainability over time. Today, facing the simultaneous change of administration at MEN and the executive management of CPE, an important challenge is to consolidate the achievements attained as far as the coordination is concerned and to always count on an administration able to maintain an efficient management that meet the demands of national policies.

In the case of Costa Rica, the Project *Learning with Mobile Technology in Multigrade Schools* (ATEM) is an initiative started in 2012, to intensively use mobile technologies with a one-to-one equipment model in one teacher rural centres and a two-to-one model in those of Dirección 1. A key factor that has contributed to the implementation and consolidation of this initiative is that it falls within –and depends on– a national policy that has been making use of technologies in the education field since three decades ago already –the National Programme of Educational Informatics (PRONIE MEP-FOD)– sustained on a vision of the educational role with a pre-eminence over technology. The long history and continuity of the PRONIE MEP-FOD provided a stable framework that allowed taking a scaling suitable advantage of the accumulated experience, beyond the changes of administrations and the legitimacy of its actions facing the education community, as a result of an alliance between the Ministry of Education and a non-profitable private entity. During the four years of existence, a gradual pace characterized the ATEM Project implementation as far as its coverage is concerned, as a progressive appropriation of the proposal, anticipated in the model and reflected in the progress monitoring results and in the assessment of its results. Currently facing the challenge to universalize the coverage of the project with respect to the total of multigrade rural schools, new infrastructure challenges are posed together with the sustainability of accompanying actions oriented towards a greater alignment of the mobile learning initiative with educational policies.

A different direction as to the viability is posed by the Peruvian case, where the main funding body of the Programme, the OLPC Foundation, conditioned the initial profile of decisions. Upon undergoing through several stages and objectives, 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. Likewise, an institutionally centralized management in one of the departments in the Ministry of Education, the lack of budgetary availability to cover the number of devices that should be acquired and a poor infrastructure and connectivity in most

educational centres, implied the need to modify the project implementation modality. After the change of the administration in 2011, a period of reflection and critical review of the policy started. The principal measures adopted in this last period entailed the abandonment of the generalization of the one-to-one model, the decision to stop making central, large scale purchases (trying to complement the lack of equipment with contributions from other stakeholders such as provincial and district governments, companies, NGO) as well as the emphasis on teacher training and the creation and availability of education digital contents. Without setting aside the efforts to improve connectivity and Internet access, it is possible to confirm that this last period is characterized by a reorientation of the policy towards the use of the existing devices with a pedagogical purpose based on the sharing of experiences developed at a regional level that have been positively assessed.

In the various forms of management and government adopted, the experience of the region shows that one of the current and future major challenges 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 institutionality construction process is a condition for the viability of policies.

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Technological Infrastructure and Connectivity

Though it is not enough, the size of the infrastructure and the provision of equipment, access and connectivity of schools are essential conditions to integrate ICT in education. The evidence gathered in this study shows three problem areas as an example of the challenges pending in the region.

The first problem area refers to the **technological equipment** of institutions according to the model adopted, which in the case of the device ecology model as a strong growth trend in the region, entails the need for a careful planning.

This is about a subject that on the one hand refers to the launching of what is known as “technological floor”, i.e., the engineering and logistics to install and integrate electric networks, local area networks (LAN), assembly and equipment of wireless networks (*Wi-Fi*) necessary to provide operation for different software. It is a question of low visibility but of great importance while its adequate concrete implementation is a possible condition to develop a serious proposal for the digital inclusion and pedagogical use of ICT at schools.

The experience of the countries considered is an example of different approach modalities with respect to this subject. In the case of Costa Rica, the provision of technologies at schools is given

within a context as a result of a prior analysis, especially to ensure the so-called basic infrastructure. Thus, before the on-site equipping, the role has been assumed to analyse the situation for each school by sending a specialized team of engineers and electronics technicians who would establish the design and determine the requirements as to the necessary electrical materials to ensure that everything fits and is ready to deliver and distribute the equipment. In the case of Colombia, local networks (*intranets*) attempt at solving the access to education contents by installing server equipment that host the contents allowing for their publication and distribution. This is particularly important because tablets have a low storage capacity. In this way, the local network opens up the possibilities at a software level.

Furthermore, the technological equipment management refers to the bidding and purchase process that, in general, may involve long periods on the part of the States and a considerable effort of administration load. In this sense, ICT policies analysed show a trend to create purchases and scale economies that, in the long run, aim at ensuring the acquisition of up-to-date equipment. For example, the ICT policy in Colombia has decided on biddings and purchases every four years assigned to three different suppliers to reduce risks. Also, during the technology acquisition periods, regional bodies -municipalities and local governments- work together with the national government to purchase at a low price, which resulted in a positive and valuable experience because of the possibility to save for future equipment reinvestment. In *Plan Ceibal* in Uruguay the purchasing system establishes international biddings every two years including a special clause on technological improvement that allows for an additional purchase included in the same contract in the year following the bidding, provided the new purchase contains technical advances and/or better prices with respect to the original purchase the year before.

Finally, technological equipment management refers both to the delivery and distribution mechanisms and to those related to the maintenance and upgrading of equipment. The modalities and procedures in this case are a key issue in building confidence, ownership and participation in ICT integration by educational actors. Therefore, an active involvement of families in this process, as shown by the Colombian experience, is a key feature. Or, as in the case of Costa Rica for the implementation of efficient mechanisms to repair and upgrade the equipment.

The second problem area refers to the size of technological infrastructure and the yet unsolved question of **connectivity** in most countries of the region, which limits the pedagogical use of mobile technologies. With intermediate solution alternatives, such as the use of intranet, the experience of national policies with significant progress on the subject, accounts for the fundamental value of Internet access in educational practices to develop pedagogical experiences that encourage collaborative work in pursuit of polisynchrony, i.e., to alternate with tools that may be both synchronic and asynchronic and a combination of both, thus allowing for deconstructing classical times, spaces and groups of the traditional school.

The set of factors involved in the definitions on the connectivity issue include, among others: first of all, a stable access to electric energy, which is not always available due to the high concentration of population in rural areas; the connection speed, including the upload speed which many times is not considered; the availability of advanced "technological floors"; the anticipation of technical solutions to emerging connectivity problems in institutions.

Based on all this, both the overview to address the problem and the goals achieved in the different countries are different. Thus, in Costa Rica a high percentage of educational centres have a certain type of connectivity, although due to its characteristics (on average they have 2,5 megabits with a 3G and ADSL technology) it is considered insufficient for the expectations of an optimized pedagogical model because it results in a slow Web surfing. In Colombia, since 2014, the connection of 75% of educational centres has been achieved, hopefully completing 90% during 2015. There are still 2.500 institutions not yet connected. These schools have unstable electric energy and still lack Internet access which is difficult to gain due to the high rurality conditions of the Colombian education system. In Peru, in 2015, 15% of educational centres would be connected and the remaining 85% corresponds to schools with low student populations, which in general are located in rural contexts. At the connection quality level, many centres are still connected through the dial-up telephone system, which results in a very slow Internet access speed per user. Consequently, the lack of Internet access is a key issue for a project including the characteristics of the one-to-one model in mobile technology.

In its turn, *Plan Ceibal* in Uruguay is the initiative presenting the best development and the higher connectivity demand coverage. Currently, 99% of the centres have Internet connection and most of those located in urban areas have optical fibre, a less portion has ADSL. In the case of rural centres, there is an array of solutions depending on their location and enrolment. *Plan Ceibal* has installed and maintains a network and server infrastructure in education centres throughout the country. For this reason, during the first implementation stage it was necessary to provide educational centres with an electrical system. The services of ANTEL are hired to provide them with Internet connection. Apart from the educational centres, *Plan Ceibal* has installed free Internet access points in parks, public libraries and clubs, so as to allow access to children from most vulnerable sectors that lack this resource at home. Something worth mentioning is the fact that a high percentage of centres with optical fibre have videoconference equipment, which is generally installed in a multipurpose room. Optical fibre allows to reach with 30M (download)/10M (upload), and an estimated speed average of 100Kbps per student, in case everybody use the Internet at the same time. This is enough to have a reasonable use experience with online education resources. The information surveyed shows that although the Internet is better today than what it used to be, there are still intermittent flaws that discourage the use of the net in the classroom.

It is important to point out that in ICT policies analysed it is observed that, to provide schools with connectivity, the coordination of different actors is essential both within the State –for example, among the ministries- as in the articulation with the civil society and telecommunication companies.

The third problem area in connection with the technological infrastructure refers to the **recycling of electronic devices and electronic waste policies**. Although the benefits of an extensive use and application of ICT and technology programmes are already known, it is essential to analyse the impact of the technological waste volume growth and the negative consequences on the environment.

In the cases under analysis there is a trend to move forward in the inclusion of policies and frameworks that consider technological waste management as a key factor in the digital inclusion policies that allow for not only the use, application and/or commercialization of new technologies but also, in the end, their waste and recycling. In this sense it is to be considered the comprehensive electronic waste management experience adopted by Colombia, which makes its ICT policy to be a referral for the region and the world. Thus, *Computers for Education* has three equipment reconditioning centres in Bogotá, Cali and Medellín, responsible for computer management by repairing and/or reconditioning them, and a National Centre for Electronic Waste (CENARE), located in Bogotá, for electronic waste management. Uruguay, in turn, has decided to carry out a responsible waste management generated by the *Plan Ceibal*, by designing a recycling policy that allows them to adequately treat the waste generated by those devices no longer in use as well as a device recovery plan which has included the repair and functional computer check-up. In the same sense, Costa Rica has implemented a mechanism to recover obsolete equipment and further evaluation of its final purpose: keep it as backup, relocating equipment, or for recycling purposes.

The question of technological infrastructure and connectivity is a key issue in ICT policy agendas in the region, gathering valuable efforts that resulted in the achievement of considerable progress. However, the persistence of characterised problem areas confirms the importance to follow-up the processes and the possibility to readjust expected plans as well as the adoption of flexible strategies according to the characteristics of the different implementation contexts and the adopted technological models.

Even considering the efforts and achievements attained, the persistence of problem areas related to infrastructure and connectivity confirms the importance to follow-up the processes and the possibility to readjust expected plans as well as the adoption of flexible strategies according to the characteristics of the different implementation contexts and the adopted technological models.

New Forms Of Education Knowledge Production And Dissemination: Digital Contents

The development of education digital contents is at the core of ICT policies in education, while the availability of new formats and resources promotes the access to a digital culture. The approach to the subject focuses on two problem areas to be considered by public policies.

First, the attention paid by the State to **define and ensure a common horizon on the access to knowledge** which is something students are expected to achieve in each country under justice and equity conditions. The transformations occurred in the knowledge production process enhanced by the development of ICT make it difficult for the articulation with a new conceptualization of educational contents and the rules emerging from the curricular regulations.

As a starting point, all ICT policies in the countries under study recognize in the curriculum in force in their countries, a key benchmark to formulate their actions, which include the production of digital contents as well as the development of strategies that promote their use at education institutions. However, their actions also include the exploration and definition of strategies aimed at implementing new appropriations of new types and modalities of knowledge that strengthen the educational value of the curriculum.

Examples of this are Costa Rica and the setting of performance standards for students learning with digital technologies; the inclusion of *Plan Ceibal* in the Learning Global Network for the development of deep structural learning, i.e., capacities that prepare students to solve problems, develop their creativity, collaboration, critical thinking, among others; or the production of Digital Learning Units in Colombia, i.e., curriculum materials organized based on learning competences and standards at a national level, which, in turn, have a close relationship with the standardized evaluation of the Saber tests which seeks to improve student learning results as a priority political goal.

The second problem area refers to **the forms of production and dissemination of digital contents**, an area considered by UNESCO to be included in the creative industries field, while being a strategic move for the development of countries and their economies. Two central issues are discussed in the agenda.

On the one hand, the potentiality of the possible alliances between the public and private sectors to develop this issue, considering the role of the State in the necessary organization of the whole process. The editing industry and the companies related to the education market have been developing during the last years a prolific and valuable production -textbooks in digital format, digital contents, adaptive platforms, videogames, simulation models, networks and/or repositories of educational resources, software, among others - which, although with some nuances, offer high quality proposals and technological use of resources. However, the State is responsible for regulating the process with a view to ensure the quality of resources and their articulation with broader curricular, pedagogical and learning decisions.

ICT policies in the countries included in this study offer various alternatives to think about the subject. On the one hand, the *Plan Ceibal* in Uruguay has adopted a strategy that, based on the demands detected and the decisions made throughout its implementation process, turns to the private sector to obtain resources that may support the objectives set out in the ICT policy. Within this framework there is the negotiation with the editorial market and the acquisition of copyright to use textbooks and literature to be included in Ceibal's Digital Library (<http://bibliotecadigital.ceibal.edu.uy/>) and in the tablets distributed among students of the first year at the primary level. In the same sense, the case of adaptive platforms CREA2 and PAM may be mentioned, acquired from foreign companies prior to a selection process based on the needs detected by the *Plan Ceibal* and which undergo an adjustment procedure taking into account their adequacy to the teachers, the students and the Uruguayan education system. And also the Ceibal project in English, a model to teach a foreign language combining distance and face-to-face sessions acquired from the British Council as a strategy to approach the lack of teachers at the primary level and which also suffered modifications all along its implementation process.

Colombia, in its turn, has adopted another pathway to decide on this issue. In this case, and based on a cost-benefit analysis, the country has decided not to purchase digital contents. The relationship of dependency with publishing companies and the lack of added value on the printed book were the arguments that strengthened the decision, which anyway envisages the possibility to receive donations from publishing companies and software companies together with the bidding of digital contents for the National Reading Plan. The centrality of the national ICT policy relies on the production of educational contents by means of the “Korea Project”, a strategy resulting from a cooperation agreement between Colombia and the South Korean Republic. Consequently, five CIER (Regional Education Innovation Centres) have been created managed by accredited universities that operate as units for the research and production of education contents and as teacher training units for the pedagogical use of ICT. They have professional specialists on the subject and topnotch technology to support an important production capacity of quality education contents, which, as envisaged, will allow meeting almost all the demand of contents in public education.

On the other hand, a second point of attention associated to the forms of production and dissemination of digital contents is the review and cataloguing of valuable existing contents for his access and distribution.

In this sense, the initiatives that have been developing during the last years in the line of open educational resources (OER), contribute not only to improve the access to these information sources, but also its organization for a better orientation. The *Plan Ceibal* is an example in this sense, which nowadays has 1835 Open Educational Resources available, combining those acquired, updated and created.

Also to be highlighted is the creation of spaces where digital contents are concentrated and catalogued, among which are the education portals. As in other countries of the region, ICT policies on education in the countries included in this study have granted a significant role to national education portals due to their potential to distribute digital education contents as well as to encourage the collaborative work among teachers with a view to introduce innovation into the teaching profession. In their development it is possible to identify first, and on a common basis, the decision of governments to grant a central role to portals as public, free spaces, open to the education community guaranteed by the State. The valuable decision does not prevent the implementation of their strategies and actions from being complex, while ICT policy management entails the institutional articulation of different bodies.

Such is the example of Uruguay, with the existence of two education portals: the portal of *Plan Ceibal* (www.ceibal.edu.uy) and the educational portal of ANEP (www.uruguayeduca.edu.uy), which are different in the offer of resources and supports. Similar analysis is applicable to the case of Costa Rica, as of the existence of the educational portal called Educ@tico (<http://www.mep.go.cr/educatico>) of the Ministry of Education and the Omar Dengo Foundation portal (<http://www.fod.ac.cr>), which contains the UPE campus –the door to knowledge– (www.upe.ac.cr/) developed for teacher training purposes.

The cases of Peru and Colombia, in their turn, are examples that account for another management modality. In the first case, PerúEduca proposes an integrated model centered in the Ministry of Education who, trying to position the portal as a reference for the education community, is currently proposing to prioritize the implementation of teacher training courses as well as the production of digital contents. In the same sense, Colombia Aprende (www.colombiaprende.edu.co) (Colombia Learns) has turned into the key reference portal, which all along its history has resulted in one of the backbones of the ICT policy management carried out with *Computers for Education*. As the principal source of distribution of contents and dissemination of initiatives, and provider of a wide range of services to teachers and students, the main current challenge is to increase its potential thanks to an adequate articulation with the work carried out by CIER promoted by the Ministry of Education itself.

Digital contents are one of the concepts that express the potential entailed by digital technologies to update educational practices towards a cultural change. The agenda is prolific and, as demonstrated by the accumulated experience, it opens valuable opportunity pathways. Topics such as the free access to quality contents, author copyrights, the production of digital contents and alliances between the public and private sectors, the protection of user rights, the design of tailor-made learning pathways, the design of education contents articulated with curriculum regulations and evaluation are being defined or redefined by governments in the realization of their ICT policies on the production and distribution of digital contents.

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Changes in Educational Practices

Due to the scope of transformations proposed by the digital culture, perhaps one of the most challenging issues for ICT policies in education is the introduction of changes in educational practices. Four problem areas may be mentioned in this sense.

The first one refers to the **implementation of professional support and development strategies for teachers**. As central key actors, this is in general a topic recognized by ICT integration policies of the region, confirmed by the countries considered in this study, which include them in their agendas and in the development of their actions.

Demonstrating the obsolescence of traditional training formats and based on the potential offered by ICT in the training processes, different intervention models have been adopted, generally oriented by the balance of previous experiences, the adjustment on future priorities and the scalability and scope projection of their actions.

Costa Rica aims at a change of approach: from a prescriptive offer to another one based rather on the free option and responsibility of teachers. The virtual modality is offered as a possible alternative in lieu of the, until today, predominant face-to-face training, a compulsory decision facing the challenge of the universalization of the ICT policy. In its turn, Colombia bets on the teacher training component as a pathway to improve the learning results of students by reviewing the training offer. Modifications aim at combining virtual and face-to-face modalities by means of diploma programmes addressed to an array of target groups and focused on the supervised production and learning based on proposed problems. Uruguayan strategies present a mixed model by combining different lines of action elaborated in a comprehensive manner and directed towards the idea of change in teacher pedagogical practices. In this sense the training offer converges through different modalities, face-to-face and field support sessions for teachers and the development of comprehensive projects in new collaborative environments. In the case of Peru, in a model under review, the national practice proposes the relocation of the teacher centrality in this change taking into account their needs. In this sense, the national portal proposes as a referral both for the provision of resources and for the construction of online exchange and training environments.

Additionally, initiatives developed at a regional level provide strong elements to rethink teacher training and support models centred in education institutions and in the role of teachers as innovators. In their heterogeneity, these models tend towards centralization in the conduction of change, though strategies presented for development have different participation levels of other institutions or actors, both from the public and private sectors. Furthermore, these models recognize some important common elements to be considered in the design of ICT policies in education. First, the attention to diversity of knowledge, to teacher ability and attitudes in relation to ICT integration in the teaching practice. Second, the importance of support or training dynamics centred in the construction of collaborative working environments, wherein teachers may develop a leading and active role, open to experimentation and exchange among colleagues. Third, the relevance of different intervention strategies according to the various objectives, context and scales proposed in the support and lifelong teacher training. It is worth highlighting the limitations that teacher working conditions, especially those referred to the lack of available time, impose on the training process and on the possibility to produce and experience innovations at a pedagogical level.

The second problem area posed by the change in education practices refers to **pre-service teacher training**. This contains a set of different types of decisions that have a close relationship with ICT integration models adopted in the different contexts: their impact on the organization structure, teacher working positions and conditions, the distribution of devices to the centres and/or students within the level, the structure and curriculum design of the training offer, the strengthening of trainers of future teachers, among others.

Even recognizing their importance, and in line with the trend at a regional level, ICT policies of the countries under study are still unable to give this topic the same priority as other lines of action undertaken. Probably, the implementation of ICT policies through the distribution of devices

focused on basic school levels had a bearing on the priority development of strategies oriented towards the strengthening of the professional development of in service teachers by means of different actions.

However, the approach on this topic has not been missing. To the contrary, and as demonstrated by the Peruvian case, it is at the heart of the future agenda. It has also mobilized the development of certain valuable initiatives in the case of Uruguay, for example through the decision that students attending the last year of the pre-service teacher training programme develop their work with families and the community, as part of their training practice activities. Likewise, as of 2012, laptops were delivered to students at the institutes 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 institutes.

It must be said that the discussion agenda around the pre-service teacher training poses in the region a joint question of training localization in the pedagogical use of ICT in the curriculum structure of the pre-service teacher training, i.e., as a specific curriculum environment or as a cross-disciplinary subject which adds to the ones assigned to the pre-service training level.

A third problem area related to the change in educational practices refers to the importance of **institutional management team leadership**. This is a key role in relation to different aspects: the organization management of the technological equipment at institutions and the administration of the available resources, the work carried out on the motivational ability of actors towards change, the assistance and orientation of innovative educational practices, the construction of a collaborative culture among teachers through informal leadership processes and distributed leadership, the use of ICT in the administrative and communication management systems of institutions, the inclusion of families and the education community in school culture transformation processes. These are the aspects specific to the supervision task of management teams, their leading role being even more important facing the challenge to integrate ICT into the educational institutions.

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

The case of Costa Rica offers elements for analysis. In educational centres, principals assumes a central role with respect to team management, which entails, for example: 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 the 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, handle the application so that the Omar Dengo Foundation provides support for the training for the new staff and/or the new students. These are actions tending to overcome one of the problems identified to be an obstacle for changes within the institutions: the weak collaborative culture that simplifies and promotes more collective and sustainable innovation processes.

Computers for Education, in Colombia, has designed the “ICT use training strategy for teachers with an impact on students (ETIC@)” focused on an offer of four diploma programmes. Included in these programmes there is one specifically addressed to school authorities with a focus on school management, institutional education projects and education community.

Plan Ceibal 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 considered a key element to accompany the pedagogical support process for teachers with a view to a qualitative 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 with a view to comprehensively support the particular complexity entailed by the conduction of change at an institutional level by means of the leadership of management teams.

Finally, the third problematic area focuses on the **appropriation of ICT by families and the community** assuming their central role in the mobilization towards change.

ICT policies considered in this study demonstrate the central role assumed by families in the mobilization towards change. By including them in the distribution and use of devices, they benefit from public policies aimed at the respect for their social rights and at the same time they are the key partners to accompany the transformations within the educational institutions. The experiences have been demonstrating two questions worthy of consideration in this sense: the need to adjust trusting mechanisms among institutions and families as to the careful handling of devices; and concurrently, the importance of strengthening their abilities in the technical handling of devices as well as opening up the possibilities to use them for tasks and needs inherent to the family and community life. Thus, the appropriation of ICT on the part of families stimulates and recreates the exercise of new forms of citizenship.

The history of ICT policies in education at a regional level is an evidence of the growing interest to emphasise the educational dimension of the transformation processes. The generalized evidence that the availability of technological equipment does not produce *per se* an improvement in the school culture, has focused the attention on pedagogical processes without neglecting, of course, the technological dimension as an excluding condition. Hence, the attention to educational practices and the specificity of the dynamics of the actors to take part in the transformation process is a key issue.

Due to the scope of the transformations proposed for the digital culture, perhaps one of the most challenging issues for ICT policies in education is the introduction of transformation movements in educational practices. Hence the growing attention of ICT policies of the region to the educational dimension, to the specificity of knowledge and to the expectations and demands of education actors, particularly teachers.

4. Conclusions and Recommendations

The evidence gathered in this study and its analysis according to the different dimensions, allows to conclude on a series of premises and a set of recommendations that offer a guidance both to the review of ICT policies until now developed in the region and the planning of new initiatives in other contexts.

1. The Viability of ICT Policies Relies on the Continuity, the Intersectorality and the Scalability in the Articulation with the Educational Priorities of the Country.

Ensuring the viability of ICT policies calls for a contextualized view oriented towards the articulation with the educational policies of each country. To this end, there are some key elements such as:

- The irreplaceable role of the State in the administration of ICT policies in education stimulating an intersectoral process;
- A medium and long term planning agenda including modality, scope and coverage of actions;
- The definition of an ICT integration model to be implemented;
- The adhesion of involved actors, particularly those benefiting from ICT policies;
- The attention to regulatory frameworks necessary to implement the actions.

Considering these elements, follow these recommendations:

1. To develop from the State intersectoral 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.
2. To consider progressiveness as an implementation modality and the ecology of devices to define a model of mobile learning.
3. To focus on the social adhesion to ICT policies, particularly of families, with a view to building new forms of citizenship.
4. To discuss and review regulatory frameworks associated to the uses of ICT with pedagogical purposes, particularly the regulations ruling the use of devices at schools.

2. Connectivity is a Pending Challenge as it Strengthens the Pedagogical use of digital Technologies.

Problems associated with the lack of connectivity and/or with a poor access are, among others,

one of the principal conditioning factors identified by education actors, particularly teachers, to integrate ICT in the classroom. Facing this pending challenge means considering, among other elements:

- The comprehensive budgetary planning of ICT policies;
- The assessment on the relevance and viability of the different ICT integration models;
- The precise and organized planning of the technical support strategies;
- The necessary attention to the design of policies for the recycling of electronic waste.

Hence, the principal recommendations related to technological structure are:

5. To make progressive investments to achieve a full, high speed connectivity per user meeting the needs of Internet access from all the school sectors and other public spaces (parks, public libraries and clubs) with the purpose of ensuring an equitable pedagogical use of devices by means of the interaction, download and production on the Internet.
6. To evaluate the relevance and viability to implement different ICT integration models anticipating the provision and maintenance costs at a medium and long terms.
7. To consider all the necessary technical dimensions to install "technological floors" at institutions and to plan technical support strategies in advance.
8. To work intersectorally on the design of policies and the recycling of electronic waste.

3. Democratization of Knowledge Shapes a New and Favourable Scenario for the Production, Dissemination and Consumption of Digital Contents

In the growing commitment of ICT policies to focus on the education dimension rather than on the technological emphasis, mobile learning models place digital education contents at the heart of the agenda considering both their forms of production and their pedagogical use, which necessarily leads to reflect on the transformation of teaching and learning experiences. Hence, the following must be considered:

- The responsibility of the State on the decisions related to the matter;
- The balance between the contents defined by the recommended curriculum and the new horizon of skills, abilities and knowledge strengthened by digital technologies;
- The quality of digital contents, particularly their potential to develop new forms of learning;
- The attention to accessibility and to the pedagogical appropriation of digital contents of the different actors, especially teachers.

Recommendations of this subject focus on:

9. To conduct and regulate from the State the production and evaluation processes of digital contents to validate their quality and adherence to the curriculum guidelines of the country taking into account the coordination of institutional mechanisms and including the articulation with the private sector.
10. To highlight the potential of national and regional education portals, especially to promote the use and exploitation of digital contents by means of training, networks and teacher communities.
11. To articulate the production of digital contents with short, medium and long term horizons established for the development of infrastructure and connectivity.
12. To attend to the production of significant digital education contents in national, regional and local languages as well as for special education.
13. To promote the inclusion of teaching of programming in the basic and compulsory curriculum of schools.
14. To continue developing new forms of education both face-to-face and on the net and on a multicontextual setting, thanks to adaptive technological environments.
15. To promote the creation, distribution, selection and use of contents open to teachers, in line with UNESCO recommendations on Open Education Resources (OER).

4. The Challenge of Teacher and Principal Training is to Attain, on the one Hand, Better Educational Practices And, on the Other, the Pedagogical Appropriation of ICT

In the search for strategies to produce changes in educational practices based on the technological availability, ICT policies strengthen the bet on the pre-service and lifelong learning training of teachers and principals. In this sense, the following is considered:

- The centrality of teachers and principals as the principal actors of the transformation process.
- The budgetary investment in attention to quality in training and in institutional and pedagogical support.
- The focus on the motivation and autonomy to appropriate the necessary knowledge.
- The promotion of collaboration and networking practices for the building of pedagogical knowledge among teachers.

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

16. Reinforcing the role of the State in leading the teacher training policy by fostering synergies

with the private market initiatives in the framework of the general goals and guidelines of the educational policies.

17. Emphasizing the implementation and in-depth study of new formats to assist teachers inside the institutions and for the pre-service teacher training by assessing the relevance of these formats in context.
18. Developing specific training and coaching strategies for the management teams of the schools.
19. Establishing monitoring and assessment policies for the pedagogical uses of ICT in the pre-service teacher training and during their professional development so that they may have valid data and information to make decisions on the use of ICT in teaching.
20. Guarantee the distribution and maintenance of technological and connectivity infrastructure for the teacher training institutions.



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