THE CONTRIBUTION OF TECHNOLOGIES TO MEET EDUCATION AND HEALTH CARE NEEDS IN ISOLATED REGIONS

Dr. Raul Katz
Adjunct Professor, Columbia Business School
Director of Business Strategy Research, Columbia Institute for Tele-Information
Visiting Professor, Universidad de San Andrés

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Executive Summary

Information and communication technologies have been undergoing a dramatic diffusion process in Latin America in the last fifteen years. For example, at the end of 2010 wireless telephony has reached an average penetration of 99%, while Internet usage is shared by 36% of the population. On the other hand, while broadband has been growing extremely fast, its penetration has reached only 7% of the population, while 10% of all wireless telephones are prepared to provide mobile broadband access.

Despite this impressive growth, there are regions in Latin America that have not benefited from this process. For example, while wireless telephony networks cover on average 87% of the population (although in some countries coverage reaches 100%), the 3G networks, which are capable of supporting mobile Internet access cover approximately 61% of the population. On the other hand, fixed broadband, while having a higher coverage rate, exhibits high acquisition costs in terms of the need of purchasing a computer and paying a monthly subscription.

In this context, of persistent digital divide, the application of information and communication Technologies in the education and health care sector have continued to evolve, thus becoming an essential input in both sectors. For example, without undermining the fundamental role of teachers, technologies represent a complementary resource to support of student knowledge acquisition, raise the skill level of teachers and, ultimately, reduce student attrition.

There are several technology platforms that can contribute in terms of the benefits pointed above:

- Video programs distributed through broadband: there is considerable research supporting the educational value of distance learning through television as a complementary resource to the classroom. With the introduction of broadband and the use of computers, the development of "learning objects", which constitute small video segments that can be easily integrated with mathematics, history and geography curricula, have become commonplace. These programs have also started to be modified in order to be able to be distributed through smartphone screen formats;
- Interactive whiteboards: despite being a new technology, these tools can play a very positive role with regards to the use of methods promoting student engagement, that can be easily adapted to different learning styles ;
- Portable terminals, such as personal computers, tablets and smartphones can address limitations in terms of access to content, promoting student independence in those educational settings that have a small number of teachers (such as schools with a single teacher in remote areas). However, this effect can be fulfilled if content is adapted to the different screen formats, which in some cases, can be fairly small;
- Virtual learning platforms: these technologies comprise traditional audiovisual tools, such as videoconferencing, or more o advanced based on the Internet, with

a capability of operating in real time with an upstream channel. These types of tools can very useful in teaching semantics and conceptual mapping (such as story lines, and roadmaps to structure the writing of essays), geometry and hard sciences.

In addition, information and communication Technologies contributes in an important way to the health care service quality when delivered to remote areas. These technologies are needed to tackle the economic challenges derived from delivering quality services, particularly in the handling the relationship with patients, the provision of clinical care and administration. In general terms, three priority areas can be identified where technologies can contribute to increasing the efficiency of health care delivery, In the first place, the administration of health care information can be significantly improved on the basis of hospital information systems, digital archives of clinical histories and treatments and digital libraries containing diagnostic images and records.

Secondly, patient-doctor/nurse communication can be conducted in a more efficient manner by means of installing on-line registration, telemedicine (in areas such as tele-psychiatry, tele-cardiology, tele-radiology and tele-surgery), remote monitoring, and the creation of community and social networks linking patients and health care professionals. The application of these technologies in the processes of both primary and specialized care has a positive impact not only on the quality of delivery but also on its flexibility and adaptation to patient needs.

Thirdly, the communication among health care professionals through the deployment of social networks, distance learning programs and video-conferencing leads to an improvement in skill level and the delivery of up-to-date information. In this way, health care professionals residing in remote areas can continue their training and updating by means of eLearning platforms.

The contribution of these applications is far reaching. On a social dimension, research has identified an improvement in the quality of health care delivery, a decrease in time required for delivery of services, an increase in service quality, coupled with higher efficiency in the information exchange among professionals and the benefit of their continuing education. From an economic standpoint, the contribution of information and communication technologies to the health care sector results in better management of material and human resources, a reduction of care delivery and patient transportation costs, and the consequent reduction in information handling costs.

On the basis of the conclusions stated above, both regarding the persistent geographic digital divide and the value that technology embodies for the delivery of education and health care in remote areas, the formulation of public policies aimed at extending these services to remote and isolated areas. In the first place, in parallel with the enactment of national broadband plans, it is critical for governments to define service coverage targets for educational institutions and health care centers located in isolated and rural areas. Some Latin American countries have already determined that, regardless of the gradual deployment of infrastructure which would eventually reach uncovered areas, it is

important that a 100% of educational and health care centers be served by broadband within the next two years. The urgency in the provisioning of quality of health care and education service delivery is critical. Furthermore, given the type of applications and usage intensity, these establishments require broadband service levels that are more sophisticated than those delivered to residential customers. Coverage targets need to establish speed of access ranging between 6 Mbps and 20 Mbps for educational institutions and 20 Mbps and 100 Mbps for health care units. The range of service speeds is driven by the volume of students and patients served in each remote area.

Based on these objectives, a work plan based on five action items has been defined:

- Accelerate the deployment of basic communications infrastructure, especially in fixed broadband and mobile services, by means of building a collaboration between the public and private sectors; while acknowledging that the private sector is primarily responsible to invest in network deployment, in this case, the public sector has a role to fulfill by supplying additional funding to address remote areas network coverage and creating the appropriate regulatory framework which could potentially stimulate investment in those regions;
- Development of holistic policies aimed at promoting usage of Technologies in the health care and education sectors; while we remain realistic about the difficulties that can be encountered in the development of coordinated polices which embody a consensus between government and civil society, it is necessary to develop multi-year plans and state policies that establish technology-based targets and implementation plans for the health care and education sectors;
- Development of training programs aimed at professionals: throughout this document, we have demonstrated the need to create the intangible capital that allows the referred sectors to assimilate all the potential that technology has to create positive effects in health care and education. These training plans have to be all-encompassing addressing needs of teaches and health care professionals, while enhancing the skill and technological awareness of policy makers in the ministries of education and health;
- Monitoring of technological impact: it is difficult to conceive the development and implementation of technology policies without the capability of monitoring their impact on the basis of carefully defined metrics; it is, therefore, urgent, the technology deployment in this sector is supported by information systems that capture the measurement of adoption and impact in both sectors;
- The role of provincial and municipal governments: it is important to acknowledge the central role that can be played by state governors and mayors as well as their respective administrations in the development of public policies in the domain of education and health care technology. Local governments have resources and are positioned closer than central governments to the population in isolated areas. As a result, local governments have a better understanding of the population needs and have higher awareness of the need to adopt technology in both sectors. Their efforts should not be perceived as contrary but contrary to that of central governments. As a result, national agendas should define the role local governments should assume in this regard.

With the coordinated involvement of authorities responsible for the development and implementation of policies, including ministries of communication, science and technology, education and health care, these objectives and work plan represent an unavoidable task for which all governments in the region have to commit.

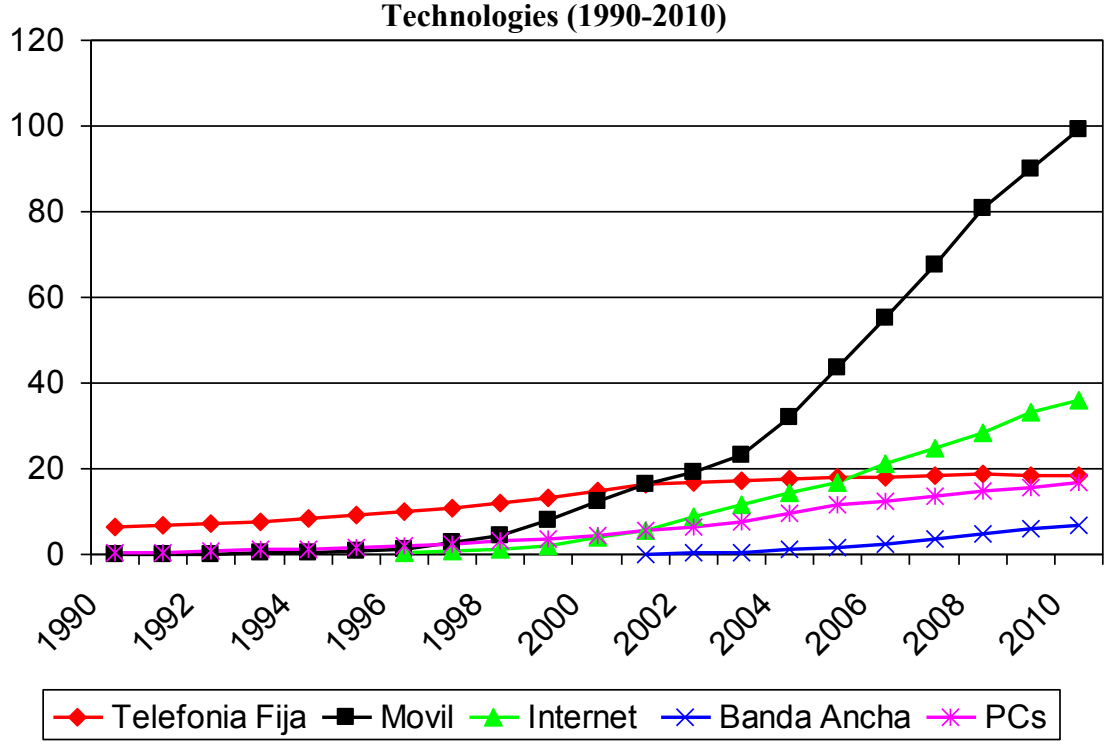
1. Introduction

The purpose of the following technical document is to assess, in the first place, the state of the situation regarding deployment of technology both in general and in isolated areas in Latin America. Based on this assessment, it presents the empirical evidence regarding the contribution of technology, in particular, information and communication, in education and health care for the population in isolated areas. Building on this assessment, the document formulates a set of policy recommendations aimed at maximizing the contribution of technology to the referred sectors. The analysis focuses on the Latin American region and, consequently, is directed at stimulating the dialogue among policy-makers in order to develop a consensus around the development of a strategy aimed at improving the performance of both sectors and benefiting the populations of isolated areas.

2. The development of technologies in Latin America

In the last two decades, information and communication Technologies have undergone a dramatic diffusion in Latin America (see figure 1).

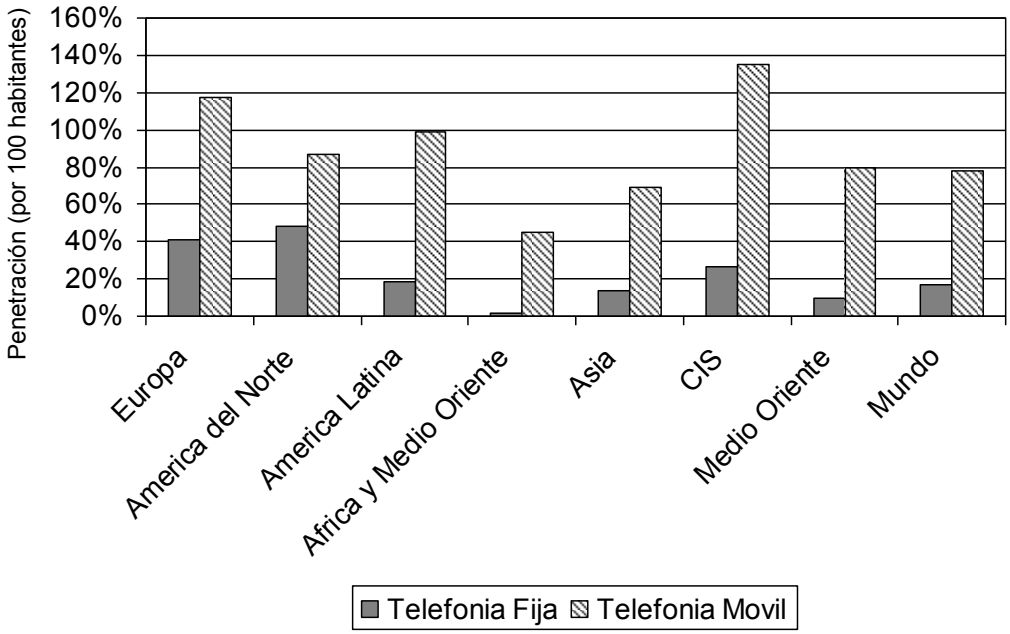
Figure 1. Latin America: Adoption of Information and Communication Technologies (1990-2010)



Source: International telecommunications Union; regulatory authorities

For example, the absolute number of fixed access lines has increased by 79 million[1], resulting in a growth of average penetration from 6.30% in 1990 to 18.44% in 2010. In addition, wireless telephony, which was introduced in the continent in 1989, has reached an average penetration of 99% in 2010. In some countries, penetration has exceeded 100%[2] which means that in certain socio-demographic segments it is common to own more than one wireless subscription[3]. In the rest of the region, wireless telephony has also developed according to an extremely high growth rate. For example, at the beginning of 2011, mobile telephony had reached a penetration of 97.80% in Colombia and 84.60% in Brazil[4]. In comparative terms, Latin America and the Caribbean are positioned at medium level of development of fixed telephony and at an equivalent stage of penetration with regards to mobile telephony with mature countries (see figure 2).

Figure 3. Telecommunications technology comparative adoption (2010)



Sources: ITU; UN; analysis by the author

The accelerated telecommunication technology diffusion process is the combined result of two factors: privatization and market liberalization, especially in the mobile sector. Starting in 1990, year of the beginning of telecommunications privatization in Latin America, and running through 2007, wireless telephony operators have invested US$ 224 billion in infrastructure deployment and maintenance[5]. As a result of the fixed telephony investment programs, teledensity increased significantly in all countries in the region. For example, in Argentina, the number of lines per 100 population jumped from 10% in 1990

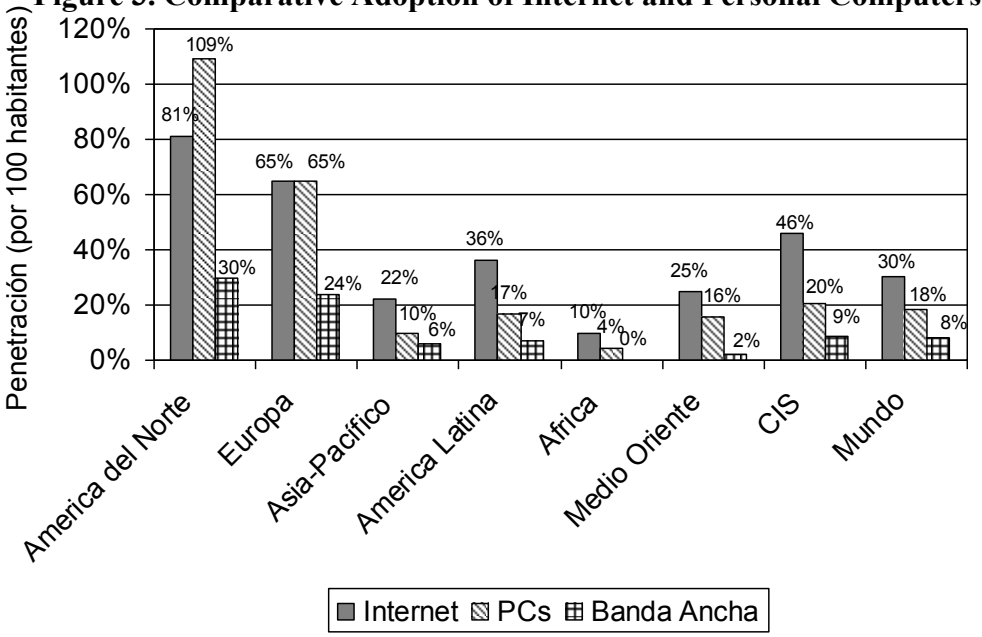
[1] En 1990, Latin America and the Caribbean had 27 million access. In 2010, that number reached 106 million (Source: ITU).
[2] For example, in 2011, Argentine wireless penetration reached 133.10%, while in Uruguay this number reached 131.70%, in Chile 116% and Brazil 117.40%.
[3] This does not mean that technology has reached full adoption, although it implies we are reaching levels close to universal service (see below).
[4] Source: Wireless Intelligence
[5] World Bank. *Private Participation in Infrastructure Database*.

(year of the privatization of ENTEL) to 22%, ten years later, while in Mexico, density grew from 6% in 1990, year of the privatization of Telmex to 12% 10 years later.

In parallel, all the countries in the region exhibit a liberalized wireless telecommunications industry, comprising three or more competitors. The combination of the competition effect, regulatory initiatives (such as the method of "calling party pays") and product strategies such as prepaid resulted in an accelerated diffusion of wireless. Technology adoption has reached also to the base of socio-demographic pyramid. Recent studies indicate that wireless is increasingly being adopted by the C3, D1, D2 and E segments, reaching 61% in Argentina, 42% in Brazil, 63% in Colombia, y 37% in Peru (Galperin et., 2007).

Simultaneously, Internet usage and personal computer adoption has also entered in a period of accelerated diffusion, although the incubation stage has been a bit longer than in wireless. Internet usage, which begun in 1995, has reached 36% of the population in the region. Internet access is conducted through public terminals (located in telecenters, cybercafés or computers located in the educational institutions or the workplace) or private computers. Computer adoption has reached 17% of the Latin American population and is entering a period of acceleration of diffusion. In relative terms, the adoption of computers and Internet usage in Latin America is at a medium level of development, while broadband access is still embryonic, at least in some countries. Average broadband penetration in Latin America is 7% of the population, while in mature countries, penetration ranges between 24% and 30% (see figure 3).

Figure 3. Comparative Adoption of Internet and Personal Computers (2010)



Sources: ITU; UN; analysis by the author

3. The level of development of communication and information technologies in isolated regions of Latin America

Beyond the explosive deployment of technology, it should be stated that the geographic divide in the region continues to be a permanent fixture. National and provincial capitals, as well as second tier urban centers exhibit a high level of development of networks, while third tier cities and rural areas continue not being fully served by telecommunications networks.

In the first place, telecommunications network coverage, while high, continues to exhibit areas with limited service. In the case of Latin American wireless networks, coverage is relatively high (see figure 4).

Figure 4. Latin America: Wireless Network Coverage (2010)

País	Cobertura
Argentina	99,00 %
Bolivia	45,99 %
Brazil	96,58 %
Chile	100,00 %
Colombia	94,00 %
Costa Rica	87,00 %
Ecuador	84,00 %
El Salvador	95,00 %
Guatemala	76,00 %
Honduras	89,93 %
México	93,00 %
Nicaragua	100,00 %
Panama	85,20 %
Peru	95,60 %
Dominican Rep.	51,10 %
Uruguay	100,00 %
Venezuela	90,00 %

Source: Internacional Telecommunications Union

However, a comparative analysis of wireless voice networks and fixed and mobile broadband networks in five Latin American countries indicates more gaps, particularly in mobile broadband (see figure 5).

Figure 5. Latin America: Cobertura de la población de redes de telefonía móvil, banda ancha fija y banda ancha móvil (2010)

		Argentina	Brazil	Colombia	México	Perú
Wireless Telecommunications	2G	99%	97%	94%	93%	95%
	3G	75%	75%	52%	39%****	65%**
Broadband	ADSL	90%	94%	63%*	92%***	59%**
	Cable	60%	35%	28%*	18,1%	…

Methodology for calculation:
**Estimated on the basis of the number of inhabitants in the department with at least a broadband connection, March 2010*
*** Calculated on the basis of the number of inhabitants in districts where there is a t least a customer with an ADSL connection (14%), in the case of fixed broadband and with a 3G connection (348 districts covered with a 3G network of the total 1833 districts)for mobile telecommunications. December 2010.*
**** Broadband coverage through ADSL is collected from Telmex 2008 Annual report*
***** Mexico 3G penetration for Mexico is calculated by using the population of cities where 3G service is being offered. January 2010.*
Sources; Operators; Teleco; ITU; ANATEL; CRT; Ministry of Transport and Communications of Peru; analysis by the author

As shown in figure 5, wireless telecommunications coverage, particularly in terms of voice service (prevalent in 2G networks), is highly Developer. More than 90% of the population of the five countries being analyzed in figure 5 has access to voice communications. On the other hand, 3G coverage, which is more suited for mobile broadband because of its transmission capacity and throughput, exhibits an average penetration of 50% the population, most of it resident in urban areas. Finally, in the case of fixed broadband, coverage is high in Argentina, Brazil and Peru and lower in Colombia and Peru.

Consistent with the high level of wireless network deployment, the adoption of mobile telephony voice service is extremely high in the region (see figure 6).

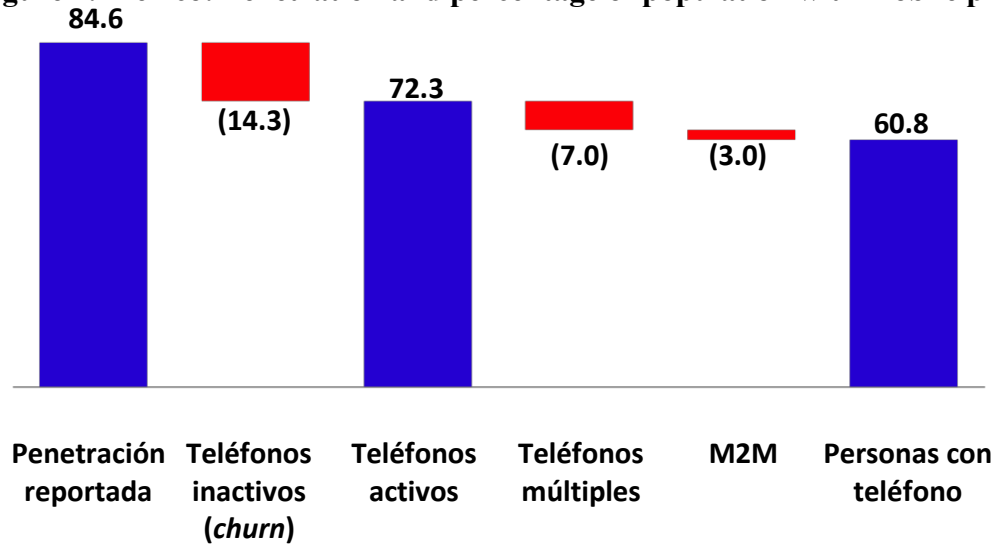
Figure 6. Latin America: Penetration of telecommunication technology (percentage of population)

	Mobile subscriptions	Percent of subscriptions with 3G technology
Argentina	133,10 %	1,47 %
Bolivia	72,30 %	2,47 %
Brazil	117,40 %	11,49 %
Chile	116,00 %	7,23 %
Colombia	97,80 %	7,46 %
Costa Rica	65,14 %	11,74 %
Ecuador	102,18 %	11,25 %
El Salvador	124,34 %	4,37 %
Guatemala	125,57 %	5,65 %
Honduras	125,06 %	5,59 %
Mexico	84,60 %	12,91 %
Nicaragua	65,14 %	6,74 %
Panama	184,72 %	3,68 %
Paraguay	91,64 %	5,74 %
Peru	85,80 %	12,62 %
Dominican. Republic	89,58 %	15,55 %
Uruguay	131,71 %	5,00 %
Venezuela	96,20 %	41,61 %

Sources: Wireless Intelligence; International telecommunication Union

According to figure 6, the adoption of mobile telephony ranges between 184% in panama and 72.3% in Bolivia. As mentioned above, while adoption exceeds 100%, this does not mean that mobile has reached universal levels of adoption. The adoption profile indicates that in countries like Brazil and Argentina a portion of the population owns more than one subscription, or that a portion of subscriptions is being used for telemetry interconnection in "machine to machine" service. For example, an analysis of mobile penetration numbers indicates that the approximate real penetration is close to 25 percentage points less than what is reported in the statistics. Flores-Roux (2011) reports that in Mexico, for example, less than 70% of the population has access to a mobile phone (see figure 7).

Figure 7. Mexico: Penetration and percentage of population with mobile phone



Source: Flores-Roux (2011)

Nevertheless, the analysis of statistics contained in figures 5 and 6 with reference to mobile telephony leads to the following conclusions:

- Argentina: a gap amounting to just 1% of the population is unserved by mobile telecommunications; the aggregate rate of adoption confirms the high level of network coverage
- Brazil: similar to the case in Argentina, there is a gap in unserved population of 3%, while the rest of the Brazilian market has reached high penetration levels
- Colombia: the fact that both network coverage and adoption rates are equivalent (94%) indicates the market is developing following a vector similar to that of Brazil and Argentina, while it has a gap of 6% of the population
- Mexico: in this case, we observe a supply gap (7% of population unserved by mobile telephony) and a demand gap (of the 93% of covered population, 12% do not purchase service)
- Peru: in this case, the situation is similar to that of Colombia,: high level of penetration in covered zones, but a supply gap of 5%

As a result, it can be concluded that in the case of mobile voice telephony the fundamental gap to be solved pertains to the supply side: how can the networks cover the isolated areas? The additional coverage will ensure that an important portion of the population purchases the service. This number has been estimated as a function of the uncovered population and penetration of mobile in the lower two deciles of the socio-demographic pyramid (see figure 8).

Figure 8. Additional subscriptions gained as a result of reaching total population coverage

Country	Population uncovered by mobile networks (2010)	Additional Subscriptions
Argentina	408.600	372.000
Brazil	5.887.000	1.943.000
Colombia	2.797.000	2.238.000
Mexico	7.602.000	1.824.000
Peru	1.480.000	592.000
Total		**6.969.000**

Sources: Euromonitor; analysis by the author

Extrapolating this result to the whole of Latin America, we estimate that by extending coverage to the total population, 20.1 million people will be adopting mobile telephony (that is 4.8% of the total population) (Katz y Flores-Roux, 2011).

With regards to the Internet, computers and broadband, penetration levels are considerably lower (see figure 9).

Figure 9. Latin America: Adoption of Personal Computers, Internet Usage and Broadband (Percent of the population)

	Internet	Computers	Broadband
Argentina	36,00 %	40,00 %	9,56 %
Bolivia	20,00 %	17,03 %	0,97 %
Brazil	40,65 %	34,86 %	7,23 %
Chile	45,00 %	46,80 %	10,45 %
Colombia	36,50 %	26,10 %	5,66 %
Costa Rica	36,50 %	41,30 %	6,19 %
Ecuador	24,00 %	27,00 %	1,36 %
El Salvador	15,00 %	14,19 %	2,83 %
Guatemala	10,50 %	15,81 %	1,80 %
Honduras	11,09 %	12,91 %	1,00 %
Mexico	31,00 %	29,80 %	9,98 %
Nicaragua	10,00 %	8,16 %	0,82 %
Panama	42,75 %	19,83 %	7,84 %
Paraguay	23,60 %	16,30 %	0,61 %
Peru	34,30 %	22,70 %	3,13 %
Dominican Republic	39,53 %	16,42 %	3,64 %
Uruguay	43,35 %	52,79 %	11,37 %
Venezuela	35,63 %	17,27 %	5,37 %

Sources: Euromonitor; Internacional Telecommunications Union

As the statistics in figure 9 indicate, the adoption of the three technologies follows a fairly similar pattern across countries:

- The Internet is generally more widely adopted because a user does not need to have any infrastructure of his own (computer or broadband monthly subscription). Individuals can access the Internet at a cybercafé, a telecenter, place of study or at work;
- On the other hand, adoption of personal computers is higher than broadband usage because there is a group of consumers that, while having a PC do not necessarily purchase a broadband subscription, using the platform for processing information, or they access the Internet through dial-up services;
- Finally, broadband penetration is the lowest of the three technologies because its adoption implies payment of a monthly subscription for fixed service; on the other hand, mobile broadband, while growing fast, does not exhibit yet high penetration rates.

In the case of broadband, coverage is also high. However, the difference between coverage and adoption is extremely high. For example, in Argentina while ADSL or cable modem technology can be deployed to approximately 90% of households, broadband penetration is only 9.56%. Therefore, while the supply gap amounts to 10%, the demand gap is 80.4%. By conducting a similar analysis for other countries in Latin America, the statistics in figure 10 are displayed.

Figure 10. Latin America: Broadband Supply and Demand gap (2010)

País	Supply Gap	Demand Gap(*)
Argentina	10%	80,4%
Brazil	6%	86,8%
Colombia	37%	57,34%
Mexico	8%	82,02%
Peru	41%	55,87%

Note: (*) Calculated as the difference between the percent of covered population and service adoption
Source: ITU; Euromonitor; analysis by the author

As shown in figure 10, in those countries where the supply gap is small (Argentina, Brazil and Mexico), the demand gap is significant. In countries with more limited coverage (Colombia, Peru), there appears to be an equilibrium between supply and demand.

4. The social digital divide in Latin America

The limited adoption of broadband for accessing the Internet in Latin America is due partly to network coverage but, more importantly, to a demand gap that can be explained in affordability, educational and generational terms. Each of these factors will be reviewed in turn.

In general terms, A, B and C1 households in the region have almost a 100% fixed broadband and PC adoption, while households at lower socio-demographic segments, Internet usage drops under 40%. At the same time that the affordability variable is found to play a decisive role in driving adoption, other factors appear to be at play: this can be

identified around the difference between Internet users and household broadband adopters. The fact that Internet usage is always higher than broadband adoption, as is reviewed above, could be explained by several factors. For example, limited service coverage could force Internet users that could afford purchasing a subscription of broadband service to access the service at work or place of study; this could happen with high income households, although its occurrence is fairly rare. On the other hand, the difference between Internet usage and broadband service purchasing in the lower social segments could be linked to limited affordability.

As expected, the difference between Internet usage and broadband adoption tends to diminish at the lower levels of the socio-demographic pyramid. This is the clear influence of the economic variable (or limited affordability) driving levels of adoption. However, another variable appears to be playing a role as well. At lower educational attainment level (which is related to the household income), one observes lesser interest in accessing the Internet and, consequently to adopt broadband. Therefore, the combination of the economic and educational effects emphasizes the difference in Internet and broadband adoption.

In the first place, higher educational attainment level is directly related to Internet penetration and adoption of personal computers in the household. Households exhibiting lower educational level of their members show a significantly lower level of adoption of the technology. In fact, the relationship between educational level and Internet usage is driven by a bi-directional causal link. The educational attainment level determines adoption of the technology simply because subjects have been exposed to the Internet and computing at their school or university. In other words, the higher the level of education, the higher adoption of computers and broadband. In addition, the technology provides a way of continuing the access to educational content and information. Finally, the evidence indicates that independently of income, educational appears to be a key driver of technology adoption.

Finally, beyond the geographic duality discussed above, the digital divide has also a generational aspect. This situation is directly linked to the division between digital natives and digital immigrants. This is why in Latin America, more than 80% of traffic of Internet access through a computer at home takes place within people between 15 and 24 years old, while this volume declines substantially after 55 years old.

These observations trigger a number of potential public policy initiatives to stimulate broadband and technology adoption. Obviously, for those segments that can afford the service but are not properly served through networks, the key objective is to deploy the right stimuli through public and private participation to extend the networks to the unserved territories. For those segments that experience economic barriers to adoption, the initiatives could comprise subsidies or differentiated tariffs that stimulate purchasing. This is the case of Chile, a country that developed a telecommunications Subsidy Plan in 2008, or Finland where, as part of its policy aimed at stimulating adoption was focused

on the provision of subsidies, not only to consumers but also to small and medium businesses[6].

In conclusion, there still are isolated regions in Latin America where the coverage of networks and the adoption of technology is limited. In this context, it is important to explore what would the social impact be if, by means of enhancing the access to technology, governments could provide more efficient delivery of health care and education services. In the next section, we will present empirical evidence of the potential these technologies have to improve delivery of high quality education and health care to isolated regions.

5. The contribution of technologies to education in remote zones

The introduction of technology in education changes the scale in the delivery of the educational product, both in terms of resource availability as well as regarding the training of teachers and professors. In addition, by its nature, technology has the potential to break the distance barrier, becoming a fundamental tool to meet the needs of population in remote areas. The use of technology in education can generate a significant contribution in five areas:

- Learning support to students in quantitative subjects such as geometry, basic algebra and hard sciences;
- Teaching support in regions where achievement tests yield results that are lower than the national average, whereby they might be linked to socio-economic, ethnic, or gender gap;
- Contribution to address shortfalls in adolescent students that exhibit reading and comprehension difficulties;
- Resource support for teachers;
- Finally, technology also appears to have a potential, indirectly through some of the effects mentioned above, or directly, to reduce student attrition, particularly in areas where rates approach 30%.

Having said that, the return on the technology investment in education in remote areas depends on three factors: the contents delivered through technology have to be adapted to the technology format, the processes and principles guiding the teaching experience have to be redesigned in order to incorporate the technology input, and finally, teachers and professors have to be trained on the utilization of technology. These three requirements are of paramount importance in order to ensure that the technology investment in remote areas yields the expected results.

In the first condition, research indicates that educational contents need to be adapted to the new teaching formats, rather than being merely copied and digitized. Under the second requirement, the teaching process has to be transformed in order to render the use

[6] *Finland: Broadband Access Made Legal Right In Landmark Law*

of technology within a new context of enhanced learning that blends the classroom experience with the technology support. Finally, teachers and professors need to be trained so they can not only familiarize themselves with the technology but also learn how to use it effectively in the classroom.

In light of these conditions, technology plays a very important role in the transformation of the educational institution located in remote areas. In the first place, the technology platform becomes a learning tool inserted within a learning experience that is student-focused. Secondly, technology becomes a vehicle for delivering resources and teacher support. Third, technology becomes an enabler to facilitate the transition of students in an information society.

The technology platforms that can contribute in terms of the benefits mentioned above are the following ones:

There are several technology platforms that can contribute in terms of the benefits pointed above:

- Video programs distributed through broadband: there is considerable research supporting the educational value of distance learning through television as a complementary resource to the classroom. With the introduction of broadband and the use of computers, the development of "learning objects", which constitute small video segments that can be easily integrated with mathematics, history and geography curricula, have become commonplace. These programs have also started to be modified in order to be able to be distributed through smartphone screen formats;
- Calculators also contribute to the quality of teaching in geometry and mathematics;
- Interactive whiteboards: despite being a new technology, these tools can play a very positive role with regards to the use of methods promoting student engagement, that can be easily adapted to different learning styles ;
- Portable terminals, such as personal computers, tablets and smartphones can address limitations in terms of access to content, promoting student independence in those educational settings that have a small number of teachers (such as schools with a single teacher in remote areas). However, this effect can be fulfilled if content is adapted to the different screen formats, which in some cases, can be fairly small;
- Virtual learning platforms: these technologies comprise traditional audiovisual tools, such as videoconferencing, or more o advanced based on the Internet, with a capability of operating in real time with an upstream channel. These types of tools can very useful in teaching semantics and conceptual mapping (such as story lines, and roadmaps to structure the writing of essays), geometry and hard sciences.

The contribution of technology in education remote areas covers numerous applications domains from distance learning to the utilization of portable terminals and computer-

based tools. In the case of distance learning, research shows that students in remote areas whose primary vehicle of instruction is the technology platform tend to perform at an equivalent level that those students learning in traditional classrooms (Hudson; 2006). The studies of Witherspoon et al. (1993) show that, despite the distance and physical separation from the teacher, the students undergoing a distance learning program tend to be more motivated to learn, and are more mature. On the other hand, the design of educational material tends to be more systematic and oriented toward making the learning process mroe efficient. Finally, Hudson indicates that distance learning programs combined with tutoring delivered via satellite tend to reduce school (Hudson, 1990).

Another important effect of technology in education is the impact of the Internet. While the extent of its contribution is highly dependent on the quality of equipment and the telecommunications access, when those factors controlled in study settings, the Internet can compensate for variables such as low training of teachers or lack of educational material (Puma et al., 2002). A particular case of application of technology to education in remote areas is the use of social networks. For example, Aprendaris.cl is a web portal Developer in Chile with the purpose of creating collaborative social networks in support of learning and knowledge search focused on educational institutions. The project, developed by the Universidad Tecnica Federico Santa Maria in 2008, was funded by the Chilean government at a cost of US $130.000.

The portal provides several technology tools that help build online learning communities, comprised of teachers and students. At the end of 2008, the system counted 1,600 users, of which 960 were teachers and 640 students. Aprendaris.cl is a third generation web-based application based on two principles: promote user participation in the flow of information by jeans of offering user-friendly tools and use of semantic tools, capable of understanding context of searches and automatically generating the content that is most suited to the user.

The benefit of technology in education can materialize when its introduction is coupled by teacher training with the purpose of breaking down adoption barriers (in other words break the dialectic between "digital students" and "analogue teachers"). In a similar fashion, technology training has to be extended beyond teachers into the mid-level functionaries of ministries of education, where barriers to the introduction of technology tools often reside. Ultimately, one of the most important challenges in this domain is transforming the culture and resistance to technology in educational institutions and ministries of education.

6. The contribution of technology to health care in remote areas

In addition, information and communication Technologies contributes in an important way to the health care service quality when delivered to remote areas. These technologies are needed to tackle the economic challenges derived from delivering quality services, particularly in the handling the relationship with patients, the provision of clinical care and administration. In general terms, three priority areas can be identified where technologies can contribute to increasing the efficiency of health care delivery, In the first

place, the administration of health care information can be significantly improved on the basis of hospital information systems, digital archives of clinical histories and treatments and digital libraries containing diagnostic images and records.

Secondly, patient-doctor/nurse communication can be conducted in a more efficient manner by means of installing on-line registration, telemedicine (in areas such as tele-psychiatry, tele-cardiology, tele-radiology and tele-surgery), remote monitoring, and the creation of community and social networks linking patients and health care professionals. The application of these technologies in the processes of both primary and specialized care has a positive impact not only on the quality of delivery but also on its flexibility and adaptation to patient needs.

Thirdly, the communication among health care professionals through the deployment of social networks, distance learning programs and video-conferencing leads to an improvement in skill level and the delivery of up-to-date information. In this way, health care professionals residing in remote areas can continue their training and updating by means of eLearning platforms.

The contribution of these applications is far reaching. On a social dimension, research has identified an improvement in the quality of health care delivery, a decrease in time required for delivery of services, an increase in service quality, coupled with higher efficiency in the information exchange among professionals and the benefit of their continuing education. From an economic standpoint, the contribution of information and communication technologies to the health care sector results in better management of material and human resources, a reduction of care delivery and patient transportation costs, and the consequent reduction in information handling costs.

7. Políticas públicas para la el desarrollo de la aplicación de tecnologías en la educación y la salud en zonas remotas

The purpose of this document has been to present in brief fashion the enormous importance that technologies can have in the delivery of education and health care services to remote areas. Our point of departure has been that the combination of privatization and liberalization in the telecommunications industry in Latin America has opened a technological revolution, with the net result of a gradual closing of the digital divide when it comes to voice communications. This does not deny that inequality still persists, particularly in rural areas. However, the investment achieved in the last twenty years has greatly contributed to narrowing that gap. However, without undermining the benefits, information and communication technologies still need to resolve the broadband gap, where Latin America lags significantly the rest of industrialized world.

The contribution of technologies to the delivery of education and health care services is dependent upon the massive deployment of telecommunications, particularly broadband and Internet in the region. For this to happen, it is necessary to create the institutional synergies to allow the emergence of a vision where the needs of the education and health care sectors can be met through an accelerated rhythm of innovation and technology

deployment. Beyond the creation of this vision, that has to be shared by the public and private sectors, governments need the engage in the construction of an agenda for the future. Coordinated holistic planning bringing together all the relevant areas of the public sector becomes a preeminent requirement.

On the basis of the conclusions stated above, both regarding the persistent geographic digital divide and the value that technology embodies for the delivery of education and health care in remote areas, the formulation of public policies aimed at extending these services to remote and isolated areas. In the first place, in parallel with the enactment of national broadband plans, it is critical for governments to define service coverage targets for educational institutions and health care centers located in isolated and rural areas. Some Latin American countries have already determined that, regardless of the gradual deployment of infrastructure which would eventually reach uncovered areas, it is important that a 100% of educational and health care centers be served by broadband within the next two years. The urgency in the provisioning of quality of health care and education service delivery is critical. Furthermore, given the type of applications and usage intensity, these establishments require broadband service levels that are more sophisticated than those delivered to residential customers. Coverage targets need to establish speed of access ranging between 6 Mbps and 20 Mbps for educational institutions and 20 Mbps and 100 Mbps for health care units. The range of service speeds is driven by the volume of students and patients served in each remote area.

Based on these objectives, a work plan based on five action items has been defined:

- Accelerate the deployment of basic communications infrastructure, especially in fixed broadband and mobile services, by means of building a collaboration between the public and private sectors; while acknowledging that the private sector is primarily responsible to invest in network deployment, in this case, the public sector has a role to fulfill by supplying additional funding to address remote areas network coverage and creating the appropriate regulatory framework which could potentially stimulate investment in those regions;
- Development of holistic policies aimed at promoting usage of Technologies in the health care and education sectors; while we remain realistic about the difficulties that can be encountered in the development of coordinated polices which embody a consensus between government and civil society, it is necessary to develop multi-year plans and state policies that establish technology-based targets and implementation plans for the health care and education sectors;
- Development of training programs aimed at professionals: throughout this document, we have demonstrated the need to create the intangible capital that allows the referred sectors to assimilate all the potential that technology has to create positive effects in health care and education. These training plans have to be all-encompassing addressing needs of teaches and health care professionals, while enhancing the skill and technological awareness of policy makers in the ministries of education and health;
- Monitoring of technological impact: it is difficult to conceive the development and implementation of technology policies without the capability of monitoring

their impact on the basis of carefully defined metrics; it is, therefore, urgent, the technology deployment in this sector is supported by information systems that capture the measurement of adoption and impact in both sectors;

- The role of provincial and municipal governments: it is important to acknowledge the central role that can be played by state governors and mayors as well as their respective administrations in the development of public policies in the domain of education and health care technology. Local governments have resources and are positioned closer than central governments to the population in isolated areas. As a result, local governments have a better understanding of the population needs and have higher awareness of the need to adopt technology in both sectors. Their efforts should not be perceived as contrary but contrary to that of central governments. As a result, national agendas should define the role local governments should assume in this regard.

With the coordinated involvement of authorities responsible for the development and implementation of policies, including ministries of communication, science and technology, education and health care, these objectives and work plan represent an unavoidable task for which all governments in the region have to commit.

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