Latin America and the Caribbean: Education and Technology at the Crossroads

A Discussion Paper

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This is a draft document circulated for discussion only. Comments and suggestions are welcome and will be considered in preparing the final version.

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Foreword

This is the first regional report by the World Bank on the role of technology in education. The report responds to growing interest in the role of technology in education by the Bank's client countries, the donor community, and the private sector.

Rapidly evolving technologies are being applied worldwide to address seemingly intractable education problems, especially those related to access and quality, but also as innovations to anticipate future trends in the way educational services at all levels could be delivered. The demand for such applications is clear-cut. *Within school walls*, teachers and students now access information and knowledge through Internet connections. The electronic exchange of ideas about teaching and learning has generated new ways to enhance the curricula and to stimulate professional development. *Outside the classroom*, students and teachers more frequently interact through new combinations of distance-education formats. In addition, connections to cultural and scientific institutions, and the growth in connectivity using various telecommunications modes in the home and elsewhere, has led to expectations that information and knowledge sharing and learning seemingly have no barriers.

To capitalize on the potential of available technology, countries now need to develop their own educational strategies to make technology integral to their education vision and strategic planning for the year 2000 and beyond. In the current dynamic environment, educational decisions taken during the next few years undoubtedly will have long-lasting consequences for the educational and productive future of all LAC societies. Countries will need to prepare a facilitating environment to encourage both public and private sectors to contribute fully to education in this regard.

Building the required infrastructure to accommodate new education technologies looms on the horizon. Current capacity varies considerably in the LAC region. Investment strategies must reflect the fiscal reality of each country; however, as noted in the report, educational technology appears within reach of all countries of the region if it is carefully selected and deployed at suitable educational levels and where cost-effectiveness can be achieved.

An important consideration not to be overlooked is the potential inequities that could be perpetuated when planning technology investments. All segments of the learner populations should be considered, but special attention should be given to technology access by the poor in both rural and urban areas. Above all, the incorporation of technologies must be organized to maintain open societies that encourage the free flow of information.

Acknowledgments

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Executive Summary

Progress and Continuing Challenges

The countries of Latin America and the Caribbean have made important strides in increasing primary and secondary school enrollments. Despite such progress, countries of the region confront major challenges in the development of education in the years ahead. Indices of education quality, such at the Third International Mathematics and Science Study (TIMSS), reveal that Latin America countries lag behind many other nations in student achievement on these measures.

The context for educational development has been changing as a consequence of economic globalization, shifts planned or underway towards service and information economies, and the persistence of poverty and inequality. Many of the challenges facing education result from telecommunications and information generation covering all aspects of economic and social life. LAC countries have been using technology for many years to deliver educational services, mostly in the form of radio and broadcast television. Both have been effective in addressing specific education challenges, especially reaching students in rural areas. The problems that are addressed and the achievements are significant. There are, however, significant differences in the application and cost of technologies now available for education, and thus in the way they are being--or could be--now and in the next century. The combination of small and powerful multimedia computers with the expanding reach of telecommunications technologies in the region are starting to provide new technological capacity that could address many chronic education challenges.

The complexity and cost of these technologies should not deter innovative experimentation that must precede large-scale use in educational settings. With careful planning, and given the continuous decrease in costs, these technologies may offer the most important opportunity for improving education available in many decades. Moreover, technologies at all educational levels can be applied even under current budget constraints if strategically developed and carefully planned.

National Strategies for Education and Technology

Most LAC countries lack a comprehensive strategy for incorporating technology into their educational systems--even though several are now making significant investments. A few major projects in some countries in the region provide evidence of how best to proceed. In addition some smaller, generally free-standing projects, not coordinated into an overall educational planning framework can be found in most countries. More evaluation is needed of these early investments efforts, especially their cost and the application of lessons in other efforts in the same or other LAC countries.*

* For example, see María Inés Alvarez, Francisca Roman, María Cecilia Dobles, Jeanina Umaña, Magaly Zúñiga, Jackeline Garcia, Barbara Means, Michael Potashnik, Laura Rawlings. 1998. Computers in Schools: A Qualitative Study of Chile and Costa Rica, *Education and Technology Series, Special Issue.* Washington DC, The World Bank.

Ideally, investment in technology will become an integral part of a country's overall strategy for education improvement. World experience suggests that it is prudent to coordinate technology planning and investments with key education goals rather than to consider them as merely discrete applications. One of the greatest opportunities is that technology may eventually provide higher quality education to substantially more of the population.

The World Bank Priorities

The World Bank strategy will be to support countries in defining priorities and plans for the most effective use of technology in education and training systems; experimenting with new technologies and pilot projects; disseminating knowledge and information about good practice in the use of technology; and in developing procedures of continuous innovative applications based on empirical evidence, as education tools, methods, and materials will continue to change; in building capacity to design and manage projects using technology; and an expansion of lending and technical assistance to LAC countries for distance learning and technology in education projects.

Chapter I

Expanding Educational Opportunities and the Technology Challenges

Educational Achievements

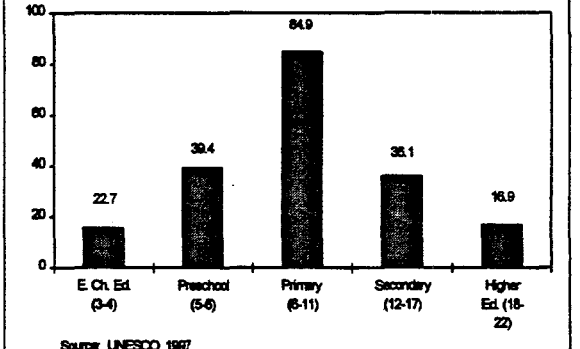
Latin American and Caribbean countries in the past 30 years have expanded educational opportunities, improved quality, enhanced management of educational systems, and involved the private and the third sector (non-governmental organizations). The decade of the 1990s has been one of growing commitment to the social purposes of education and preoccupation with issues of quality and access.

Primary education now is nearly universal and adult literacy rates increased over 20 years (1970-90) from 76 percent to 86 percent. In 1970 only four of ten school-age children in Chile had access to secondary school; today, eight of ten have that opportunity. Several countries, including Colombia, Ecuador, Mexico, Trinidad and Tobago, and Nicaragua, doubled their *secondary* school enrollment rates since 1970. Although disparities exist across and within countries, the net enrollment rates for the region as a whole reached 84.9 percent for children primary school age (6-11), 36.1 percent for children of secondary school age (12-17) and 16.9 percent for youth of higher education age (18-22) in 1991 as shown in Table 1. Gender differences in school access have tended to disappear in all educational levels.

Preschool net enrollment rates in the LAC region steadily increased as well-- from 3.4 percent in 1960 to nearly 23 percent in 1996. This area is rapidly expanding in coverage and program diversity. In several countries poor children are beginning to benefit from pre-schooling--although there are still significant inequalities between rich and poor and urban and rural children.

Over 26 percent of the school-age population is enrolled in *higher* education institutions, comprised of traditional and non-traditional universities, technical institutes, and professional schools. The national systems of science and technology include a few research universities, specialized NGOs but limited scientific and academic communities.

Table 1:
1990-1996 Latin America and the Caribbean Net Enrollment Rates by School-age Group (%)



Source: UNESCO, 1997.

Recent Reform Agendas

Recent educational reforms are aimed at improving learning outcomes, developing new curricula and teaching materials, upgrading teacher competencies, providing opportunities for community involvement, and improving school management. The region has identified education as a political and economic priority, as reflected in the Presidential Hemispheric Summits (1994 and 1996), the *Nariño* Accord (1994), and the meetings of the Head of States of the Iberoamerican Nations (1991-96). Public investment in education increased steadily in most nations of the region, except during the economic crisis of the

The Red Integrada de Participación Ciudadana in Bogota is a new project which combines educational reform goals with broader social goals. The *Red* (network) is meant to create a more tolerant, active, and civic-minded population. This is to be done using the newest telecommunications technologies to bridge the gap between the public citizens and municipal government and by encouraging increased communication among Bogota's diverse population and their organizations. The Red would function at three levels. Schools would be provided with computers and a local area network (LAN) connected to local school administrations and the municipal Secretary of Education. At the second level, the project will set up *Veinte Puntos de Información Ciudadana* (twenty points of public information.), where citizens can access a variety of information sources, including their neighborhood development plans or copies of new laws. At the third level, the *Puntos de Tramite Administrativo* (Points for Administrative Processing) will permit citizens to meet routine municipal administrative requirements or obtain information about more complicated procedures.

1980s.

The extraordinary expansion of educational systems has provided Latin America and the Caribbean with a diverse representation of private and public institutions, expertise, and some successful educational innovations and alternatives. Several innovations were developed by NGOs and private research centers, many of which involve the use of technology for distance education.

Current Issues

Persistent *inequality* in the region, *low quality* of educational supply and outcomes, and *lack of relevant educational experience to current country realities* present immediate challenges to all Latin American and Caribbean countries. Inequities include: unequal access to education, and inequalities in school readiness, school attendance, educational environment, and learning outcomes. The most effective education appears concentrated among the wealthy and upper-middle classes. The population most limited in educational opportunity are indigenous girls and women; for example, the average school attainment for Guatemalan indigenous females is less than one year. Educational inequalities clearly perpetuate income and social inequity. Increasing the quality of basic education for the poor, providing early childhood education, and expanding access to upper-secondary and higher education have become a part of a new strategic vision for reducing inequality within LAC societies, and dealing with disparities between LAC and other regions at similar stages of economic development.

Educational experts in the region are concerned with unsatisfactory educational outcomes. Evidence from national tests and international comparisons--such as the TIMSS (Third International Mathematics and Science Study), and a study conducted by the International Association for the Evaluation of Educational Achievement and UNESCO--suggests that most students, especially those in public schools, fail to meet minimum objectives of national curricula standards, with Latin American and Caribbean students performing below their peers in other regions. Weak educational outcomes point to poor quality of inputs, including: insufficient learning time, a school environment that interferes with learning, low teacher expectations coupled with inadequate preparation, and curricula irrelevant to students' lives and the changing work requirements.

In a highly demanding, increasingly global work environment, tertiary institutions also face critical challenges. Recent expansion has been slow compared to other societies. Academics and the private sector are questioning the relevance of the traditional university curriculum (as well as courses of study) in preparing students for emerging labor force needs or for preparing scientists and engineers that will be required for national economic growth and development. And the scientific and technological productivity of universities is generally low. Finally, the higher education community has been slow to adopt new technologies, to integrate into the international research community, and to develop new educational finance schemes using more business-like approaches to university program and budget management encountered in many other regions of the world.

Many LAC countries are decentralizing their education systems. There is a substantial need to enhance

the quality and efficiency of management in this sector, including the development of an expanded leadership and strategies to support decentralized and responsive school management.

As computers and telecommunications infrastructure become available in schools, technology can be used to improve communication between ministries and local educators, to more efficiently handle and communicate data in a timely fashion, and to access support resources and professional communities. *As school management systems become increasingly decentralized, management information systems will become essential to promote efficient and effective school administration.*

Administrators generally require considerable training and support to decentralize their systems successfully and to gain the necessary skills to use new technologies. Many more leaders will need to be become adept information-handlers and decision-makers over a broader range of issues. Technologies are a very promising contributor to develop technology-based leadership through Internet applications that augment conventional leadership training both in content and interactivity. Like teachers, administrators need to invigorate professional community dialog, which can be developed and perpetuate leadership skills gained using technology mentioned through online environments.

Pressures for Change

The 1990s brought about rapid changes in Latin American development. The region now confronts new challenges because the context for providing education, and approaches taken are quite different than in the past. These challenges to the patterns of education development can be delineated as follows:

Economic globalization is creating a new series of economic relationships in which knowledge and information management skills become major assets for conducting business and commerce. To compete effectively in the new global economy, government and private sector officials are increasingly aware that they must reorient their education systems to prepare children for participation in the information age through acquisition of skills needed for managing significantly more knowledge and information, for continuous learning and upgrading of skills, and for understanding more complex procedures and interpretations of ever-increasing information in knowledge databases.

Economic development and technological change are transforming economies from agricultural and industrial to service and information economies. These transformations have far-reaching consequences for labor markets, which harbinger new forms of education, training, and certification. Governments are increasingly aware that an educated workforce familiar with technology will be a prerequisite to promoting investments in information and high-technology industries. There is an urgent need to facilitate transitions from school to the labor force by preparing students to function in workplaces that rapidly are being transformed by information technologies. There is also need to increase opportunities for and effectiveness of higher education in its partnership with business and industry and the private sector.

Poverty and inequality continue unabated in much of the region; indeed, income inequality is worse today in many countries than in the 1980s. Notwithstanding higher economic growth rates in the 1990s, economic globalization and technological change increase the gap between urban and rural areas and the well-educated and less-educated in both rural and urban areas. Rising inequality poses a threat to the social order and political stability. Education, with the help of technology, can either intensify these differences or help to overcome them. The challenge facing governments is to use technology appropriately to close gaps in educational opportunity and to provide skill-training and life-long learning opportunities for all citizens.

Gains in democratic governance, as well as its reflection in civil society are being consolidated in many countries after years of dictatorship and civil strife. To consolidate democratic forms of governance, governments need to promote participatory decision-making to reinforce democratic values; much of the population of the region--including young people--do not yet have the habit of civic participation or of seeking relevant information on which to base informed opinion about social issues and priorities. Sustaining democracy requires addressing social issues, such as the skewed income distribution found in most LAC societies favoring upper-income groups. Telecommunications and information networks within schools and the community at large (libraries, community centers and banks) can foster de-

mocracy. The challenge facing the region is to use telecommunications and technology to promote an educated and informed citizenry, instill democra values, and foster an understanding of how to participate actively in the productive life of their respective communities in the twenty-first century. *Red Integrada de Participación Ciudadana* appears to be one promising example.

The role of the state in economic and social affairs is being redefined in many countries. To reduce state subsidies and achieve greater efficiency, governments have been privatizing a wide range of public enterprises. This process will continue into the next century and should produce highly beneficial results. States are now creating the appropriate policy for this environment while leaving management of services to the private sector. The telecommunications sector is often the first to be privatized and open to competition in line with agreements reached with the World Trade Organization (WTO). Changes in the role of the state also occur from modernizing its functions through the adoption of new and improved management systems, technology, and decentralization. The state still lacks efficiency and credibility in many countries because of mismanagement and corruption. Such corruption undermines the social and moral fiber of societies and exacts a high toll on the poor. Technology and modernization efforts can help bring the needed transparency to State administration but will require a different set of skills than are being produced by many educational systems in LAC.

The preparation of teachers and the profession of teaching will need to change to address chronic problems of education in the region, as well as to help the education system meet the challenges of the information age. Today teachers in Latin America often have little education themselves, in basics skills and the areas their students will need to master in the future. Considerable experience from around the world confirms that technology cannot replace teachers; and quality of education improves when the technologies are effectively combined with skilled teachers. One key strategy for technology investment, especially given limited resources, is to focus the uses of available technology on the professional development of teachers. The profession typically has been isolated, with relatively little development beyond initial training (which can be quite minimal), and almost no access to new ideas or materials. To improve the quality of education in the long term, the problem of better preparation, improvement in the conditions of teaching and the profession, and long-term professional support of teachers must be addressed.

Guiding the Change Process

Several factors have been identified to date from international experience--including that of several LAC countries--that foreshadow the direction of change and the elements that should be reflected in applications and implementation of educational technology by government planners and educators alike:

Investments in and implementation of technologies for education are most successful when coordinated with a country's key education challenges. Technology planning and deployment should not take place in isolation from core deliberations about education improvement overall. Such separation will only delay the effective deployment of these critical resources.

Organized experimentation with new technologies in small or pilot programs is critical to helping countries assess the best designs for their circumstances. Ongoing projects should be carefully studied with evidence-gathering techniques and analyses to guide decisions that must be made. Systematic programs to gain experience with and understand of the processes required to incorporate technologies should be part of overall plans and efforts. Procedures for gaining systematic understanding of what is successful need to accompany such efforts.

In light of the enormously expanded content available through the Internet and the world wide web, *careful attention should be paid to the balance between acquisition of content material and software that has been created elsewhere,* with incentives to develop country or region-specific content.

As telecommunications infrastructure is created, there should be coordination between private sector support and educational needs; education should be a primary and not secondary beneficiary. Because educational equity is so critical to a country's future, and is unlikely to be addressed by simple market mechanisms, investigation of unintended inequities and planning for remedies is needed from the outset.

Effective deployment of technologies requires co-

ordinated policies and implementation strategies to address several key factors simultaneously, including: investment in hardware and infrastructure, professional preparation and ongoing development of educators, creation of reliable technical support systems, curriculum, and materials development/deployment.

The investment of a substantial part of the technology budget in sustained professional development is critical. In addition, early investment in the institutions that prepare teachers to use technologies well can result in considerable savings in the long term. These institutions can also be redesigned to provide effective support to schools in their region as technologies are deployed. Distance learning technologies can be a cost-effective initial investment to improve the knowledge and practice of teachers.

The use of information and telecommunications technologies to expand and enhance distance learning options in secondary and higher education is one of the most promising arenas for immediate deployment. Effective design needs to consider issues of infrastructure and content, but also of the social dynamics of on-line courses, faculty development, certification and financing challenges.*

In LAC some countries have begun to incorporate elements of these guidelines at the national level while others are experimenting with applications in a variety of contexts.

Education Technology Strategies Used in LAC

There are several strategies that countries in the LAC region have employed to incorporate technology into education. Some countries have used more than one approach. Examples of these strategies are:

(1) Developing a *national or regional* plan for country-wide deployment of technologies (e.g., Barbados, Costa Rica, Chile)

(2) Implementing *experimental projects* using technologies to gain experience and knowledge for eventual country-wide deployment (e.g., Chile, Jamaica, Mexico, Paraguay).

(3) Undertaking a variety of *small-scale projects* that use technologies to meet regional or local objectives or as demonstration projects. These projects tend to be independent of each other and often ad hoc in nature. (e.g., Argentina, Brazil, Colombia).

(4) Using technology to address educational *equity issues* (e.g., Costa Rica, Chile, Jamaica, Mexico).

(5) Using broadcast technologies--radio, television, and more recently computer access networking--to develop and deliver improved educational content and pedagogy, especially to learners in *remote areas* (e.g., Bolivia, Dominican Republic, Honduras, Venezuela, Brazil, Mexico)

(6) Focusing technology investment on preparing secondary school students or school leaders for technology-based jobs. (e.g., Costa Rica, Uruguay, Brazil)

(7) Creating new kinds of schools built around technologies as their *core education delivery system*, such as *Telesecundaria* (e.g.. Mexico) and distance-learning-based higher education (e.g., University of the West Indies).

The following chapter highlights the development of educational technology applications in a number of countries in LAC as a prelude to discussing investment choices (chapter III), telecommunications aspects (chapter IV), the development of national strategies that incorporate the guidelines outlined above (chapter V), and World Bank's current and future support.

* See also Luis Osin, 1998. *Computers in Education in Developing Countries: Why and How*, Education and Technology Series, Vol 3, No. 1. The World Bank.

Chapter II

Technology Use in LAC Education Systems

Background

In general, technologies have been used in LAC to address two overall goals: to improve access to basic, secondary and higher education throughout the populations; and to improve the quality of education throughout the system. Technology use in education in LAC varies widely. Most countries have considerable experience with educational television and radio dating back to at least the 1960s or 1970s. Radio, television, video, and more recently computers and networking meet educational objectives through a variety of means. The collective experiences of the region with these technologies are an important knowledge resource as countries plan future programs and investments

Most countries have initiated projects using the newer technologies. Only a few, however, have *substantial* experience with computers and connectivity in the education sector. While there are many innovative education projects and applications of technology underway in LAC, most countries are only beginning to develop a strategic vision for introducing the information technologies as part of systematic investment programs.

Improving primary and secondary education quality

Technologies applied in primary and secondary education are frequently used to improve quality of instruction by supporting teachers and caregivers. In this regard, technologies have been used to support *primary* and *secondary* students' education in three complementary ways: *expanded educational materials; interactivity; and enhanced pedagogy*. Initiatives usually feature one or more of these elements in their design. The interactivity and engaged-pedagogy approaches typify more recent projects.

Expanded Educational Materials

Technologies can be used to transmit enriched material through broadcast media (radio and television), as well as more flexible distribution channels (cassettes, internet, and web) that allows teachers to customize its use.

Latin America has a history of experimentation and success in radio education. Many countries in the region use correspondence and radio education to improve basic skills and life-adaptation skills of rural and urban poor--using technology to reach the population segments that have most difficulty accessing education services. Governments and the Catholic Church comprise the main sponsors of these programs, which have grown impressively in Colombia, Mexico, Argentina, Brazil, Guatemala, and Costa Rica. Correspondence and radio education continue to be popular; radio, in particular, has been used extensively in classrooms in Nicaragua, the Dominican Republic, and Venezuela.

Broadcast television also has been used to extend educational opportunities, especially to adults and children in remote rural areas; however, television is now being deployed primarily to improve teacher education (e.g., Brazil's *Salto para o Futuro* (see subsection on "Professional Development of Teachers" below).

Radio and television also are being used to provide education in new curricular areas or to approach tra-

Jugando en el PIDI (Projecto Integral de Desarrollo Infantil), in Bolivia, uses the unique qualities of radio to create active learning environments in small, home-based child-care centers (called *pidis*) throughout the country. The *pidis* took care of children's physical well being while their parents worked but provided little mental stimulation. Most *pidis* were run by women who often had no more than two years of schooling. As a small pilot project, *Jugando en el PIDI* began broadcasting a program about a *PIDI*. At 20-minute intervals, the radio characters, children, and caregivers play games, do learning activities, and sing songs. One of the characters, *Tia* Clara, also explains to the caregivers why certain activities are important for the young children and how children grow and develop. *Jugando en el PIDI* not only provides stimulating age-appropriate activity but functions as professional development for the caregivers so they can continue to support the children's development. Another essential element of *Jugando en el PIDI* is that it is *radio* not TV, which means the children can be up and active while listening to the program, but watching caregivers and other children, instead of focused on a TV screen.

ditional subjects in new and dramatic ways. Many countries in LAC are using radio effectively for teaching core subjects, among them Venezuela, the Dominican Republic and Honduras.

There are other interesting teaching applications. Ecuador, for example, is experimenting with a radio program on conflict resolution that uses storytelling as a pedagogical tool. Students and teachers are asked to suggest ways to resolve the conflict between characters. Costa Rica is using radio for teaching English language. For early childhood education the older technologies of TV and radio are still the most important media to create active learning environments for young children. Radio projects like Bolivia's *Jugando en el PIDI* (see above) have rapidly improved the quality of daycare. A radio is relatively easy to introduce into preschool. TV programming for young children has the substantial drawback of being quite costly; moreover, to be effective with young viewers, TV programs must have a very polished look, since it must compete with commercial programming.

Radio and television programs are now available on cassette. This gives teachers more freedom over when media materials are used. Many projects create worksheets, posters, stories, and curricular activities to accompany these programs. The teacher can also decide how much material to use; and, since the supplementary material is optional, the programs can still be used independently. For these reasons, programming is often suitable for learners outside the formal educational system.

Both old and new technologies play vital roles in providing improved curricula by either *raising the quality* of available educational materials or by *offering new content areas*. Some countries have developed educational television stations that distribute programming on science, art, history, language, and other core areas. The growing distribution of VCR's has provided more flexibility, since teachers can stop the video to discuss a specific point or to conduct an experiment.

Multimedia also is a useful way to create and distribute a wide range of materials. Of particular interest are multimedia applications for cultural, artistic ethnographic, and historic material. Early in the development of multimedia, Mexico produced a program using the vast collections of the *Museo Nacional de Antropologia*. The Spanish-language web site *Arte*

The *Arte Latino* Web site (http://www.arte-latino.com/) in the Dominican Republic is a Spanish-language reference site with brief informative entries on Latin American music, art, literature and poetry. The site contains biographies of famous composers, painters, and writers, including images or texts of their work. *Arte Latino* also provides information on important genres in the history of Latin American Art. *Página de Lengua Española* (http://www.latintop.com/espannol/) is a web-based resource on grammar and the use of the language designed for native speakers. It contains dictionaries, grammatical guides, courses, tutorials, and links to other sites that also help students learn about their language.

Latino is another example of this type.

The Internet also has substantially enriched curricula by connecting students and teachers to on-line libraries, art collections, comprehensive databases, legal documents, newspapers, or historical archives. LAC countries now use networking to create and distribute local materials.

Libraries now provide access on-line to resources previously unavailable to most users. The Library of Congress in the US has digitized vast amounts of its photography and primary collections and made them available over the Internet. The *Bibliotheque National* in France has made numerous works of French literature available over the Internet as well. In fact, literary classics in most major languages are now available over the Internet for free downloading. In Latin America, some countries are beginning to follow suit. *Escola Futura*, in Sao Paolo, Brazil, has created a virtual library, and Argentina is planning a Digital Library that will contain digitized material accessible by intranet within the library, through a wider network of 24 *Centros de Documentatción*, and over the Internet. A section of the library is specifically for schools, with the project goal to create a network of 700 secondary school libraries connected to the digital library.

Interactivity: Students, teachers, caregivers

Technologies are used not only to transmit education content but also to provide interactivity between learners, educators, and caregivers using technology-based materials. A prime example is interactive radio instruction (IRI), which evolved into an educational tool for teachers because of its flexibility in adapting to different levels of education and training plus accommodating available resources.

Early radio programming was intended to compensate for inadequate teacher training by limiting the teacher's involvement and controlling her participation. Traditional pedagogical strategies like lectures and repetition were commonplace. Today's programs encourage interaction among students, teachers, and the community at large. They often use dramatization of real-life situations to connect students to larger issues covering a variety of content areas. Radio projects also now use a two-audience approach that provides in-service training to teachers that contributes to their professional development. In fact, programs like Costa Rica's *Econautas* provides learning experiences and educational content in unique ways that no other technology can deliver.

In many countries, children living in remote rural areas lack access to the full range of coursework offered their peers in more populated areas, particularly in developing countries, where basic infrastructure services are rare. Mexico's *Telesecundaria* program uses satellite broadcasts, teachers, and textbooks to reach over 700,000 seventh, eighth, and ninth graders all over Mexico. The target population is students in rural areas with population densities too low to support a traditional high school. Launched in the 1960s, *Telesecundaria* now covers 11,300 schools, each with at least three rooms, three teachers, and an average of 20 students. Students watch a 15-minute TV program, followed by a 35-minute discussion facilitated by the three teachers. The program has worked so well that the Mexican government is planning to expand it to cover the entire six years of sec-

Econautas: Misión Naturaleza is a Costa Rican radio (as well as cassette) education program about the environment geared to fourth graders. One of the goals of the *Econauts* program is to support teachers in the introduction of a new subject, environmentalism. As a new content area, Costa Rica's teachers had little training in the topic and few materials; the radio program was designed to fill this gap. But the project staff also decided it was important to promote student participation. The program consists of 28 chapters of a complex story. Each chapter presents an environmental problem for the students to solve, and the overall story helps to maintain student interest and to introduce discussion of environmental ethics. The program is designed to support classroom discussion, student collaboration and problem-solving by inviting students to debate issues and solutions, send in advice to the characters, or dramatize scenes from the story. Teachers also can do other activities around specific environmental themes. As presented, the program does not offer single-answer solutions. The innovative pedagogy behind the *Econauts* program was initially difficult for teachers who had no experience with student-centered learning. Although project staff had produced support materials and model activities for the program, they also provided systemic professional development to help teachers change their classroom practice.

Telesecundaria is a junior secondary-school program structured around satellite broadcasts and special classrooms or learning centers, where one specially-trained teacher works with a group of students in all standard high school curricula. Much of the success of *Telesecundaria* lies in the sophisticated design of an entire educational system built around television support materials, and a few well-trained personnel, providing both well-designed education media and effective support for teachers to provide learning interactions around these core resources. Only 20 students are needed to create a *Telesecundaria*. One teacher works with the same group of students for the entire year. The school day is divided into 50-minute periods and each period covers a different subject. *Telesecundaria* broadcasts three 17-minute content pieces (each piece aimed at a separate grade) that the teacher and students work on for the rest of the period. The content support provided over television allows the same teacher to cover each subject with the depth required in secondary school.

ondary school.

Correspondence schools, universities, and educational broadcasting companies from the United States, Canada, Latin America, and elsewhere currently offer distance learning courses encompassing technical, professional, and general interest subjects that permit interactivity by learners. To date, most interactivity takes the form of correspondence with faculty or tutors. Increasingly, interactivity through the Internet is being explored. Distance education providers include the Virtual University of the Monterrey Institute of Technology and many others (see Table 3). Also, externally-provided distance learning from universities and private companies has grown dramatically in recent years propelled by the Internet and the increasing demand for higher education and professional development in LAC countries.

Engaged Pedagogy

Technology projects can promote student-centered learning through enriched curricula and exploit network and Internet capabilities to expand student engagement in learning, i.e., engaged pedagogy. Many technologies can support educational activities when the educational goal is to transform the learning environment into a more dynamic learning situation. Projects like Costa Rica's Computers in Education

Conexiones in Antioquia, Colombia, employs the newer teaching strategies by placing more responsibility on students to become actively engaged in learning through experimentation and problem-solving. Antioquian children use technology to learn about the environment and to think like scientists by conducting their own research for *Conexiones*' biodiversity project. *Conexiones* started in 1993 as a research project at the University in Antióquia. It was based on the use of informatics as a learning tool for primary and secondary schools (ages 8 to 14).

Initially *Enlaces* in Chile served as the model; however, the staff soon realized they had to adapt Chile's approach to the Colombian context, and to take full advantage of Colombia's unique natural environment. Typically technologies need to be shaped by local educational goals, needs, and characteristics. Changes required by Conexiones' adaptation of Chile's Enlaces model were:

(i) The teacher-training component was modified for Colombian national curriculum requirements.

(ii) Collaborative projects were redesigned so that children worked only with students within Colombia and not internationally.

(iii) Colombia's unique bio-diversity was used for educational purposes by incorporating local environmental and ecological projects into the curiculum.

(iv) Networking strategies differed from Enlaces, in that the Chilean project provided the hardware; in Colombia each school had to acquire its own hardware, with most schools having only one or two machines

(v) Conexiones and Enlaces differ in the metaphorical representation of the project. Instead of the Plaza, like Enlaces, the central metaphor for Conexiones is La Pachamama, a Quechua word that means Mother Earth. Pachamama is a planet accessible through the Internet

Program, supported by the Ministry of Education and the Omar Dengo Foundation, has since 1988, been at the forefront in using computers to stimulate creativity, cognitive skills and collaborative work using *Logowriter* programming software. The program reaches yearly 30 percent of the total elementary school population and is present in all regions of the country. *Logo* is also being used in Brazil, Chile and other LAC countries. Other project objectives have been to rekindle teachers' interests in teaching and to provide students with new learning environments and opportunities.

Software and multimedia also offer curriculum enrichment in an engaged-learning format. Such software enables students to edit each other's reports and to apply their knowledge of grammar, reading comprehension, analytical skills, and diplomacy as they correct and discuss each paper. Also, students seem to work harder on the first draft, as they realize it will be judged by a classmate. Basic productivity tools (e.g., word processing, database, spreadsheet, and graphics packages) have proven effective in secondary school computerization programs in Puebla, Mexico. These types of productivity tools also equip students with an apprehension of the basic skills needed in many future work environments.

Computer simulations can be valuable tools as well. The Aztlan program, for example, which is produced in Brazil, offers a decision-making simulation model that teaches students to weigh alternatives. The program was developed at SENAC-SP and simulates the governing of a province. Students make decisions about planting, harvesting, food distribution, and land acquisition in changing contexts, such as burgeoning population growth, war, drought, and rebellion. Teams of students debate each move, make preliminary calculations, and consider possible short- and long-term consequences. Their choices are entered into the program, which then simulates the passage of time, informing the students of progress made based on their decisions. The software promotes collaborative learning and provides activities for integrating content from history, politics, and sociology.

The availability of software in Spanish has been problematic. Software titles have increased as have web sites. A comprehensive annotated listing of software, web sites and other educational materials available in Spanish has been compiled by the *Centro de Recursos Educativos* at the *Universidad de la Frontera in Temuco*, established with support from the World Bank. The listing is available at: www.enlaces.ufro.cl/Recursos. The market for educational software generally has not been large enough to support a viable education materials industry in most countries. Thus, many education projects use combinations of software produced elsewhere (e.g., application environments that can be produced much more efficiently on a transnational basis), and some locally- created content material (e.g., the *Aztlan program*). The Web, however, offers a new opportunity to make local content material digitally available for relatively low cost. (A selected list of educational web sites in Latin America is provided in Annex IV)

The Internet and networking technologies can have a profound impact on enhancing the quality of education in Latin America. In addition to providing basic access to enriched materials for teachers and students, the Internet and electronic mail can enhance learning by interconnecting students across their country, students in other countries, and to scientists worldwide. Or, the Internet can be used to connect students in collaborative, cross-national activities, such as science or writing projects, and cultural exchanges.

The *Enlaces* project originally was a sub-component of Chile's Primary Education Improvement Project (MECE), begun in 1991; however, in 1994, it became a part of Chile's secondary education reform project as well. This learning network links the primary and secondary schools that comprised a pilot project in Santiago and the southern region of *Araucania*. Its success caused it to grow much faster than originally envisaged. The target of 100 schools by 1997 was surpassed as early as 1995, with 180 schools wired. The project was well received within Chile's educational community. *Enlaces* project staff

In Argentina, *Nueva Alejandria* is an independent Internet site that offers teachers curriculum support and on-line activities for many subjects. Some programs link-up with schools in Argentina to encourage students from different regions, backgrounds, and neighborhoods to interact. *Nueva Alejandria* also helps schools link-up with schools in other countries. On-line and classroom activities about peace, conflict resolution, and tolerance are provided. On-line activities can be performed individually or by the entire class. Teachers' guides and activities are provided that require no on-line component. *Nuvea Alejandria* can be found at http://www.nalejandria.com/index.htm

comment that what is most noteworthy is the teachers' *impatience* for change, not their resistance to it (see Potashnik, 1996a)

In the LAC region, four countries- Brazil, Chile, Paraguay, and Peru are currently participating in the World Links for Development (WorLD), an initiative of the World Bank's Economic Development Institute (EDI) aimed at creating on-line learning communities of teachers and students in *secondary* schools. WorLD has developed a training manual and CD-Rom for the training of teachers in the use of the Internet, including the preparation of web pages for their schools. For examples of these web pages see: web sites for each country can be found at the following URLs:

Brazil: http://www.enlaces.org.br,
Chile: http://www.enlaces.cl/~wlink/
Paraguay: http://www.senl.edu.mx/paraguay, and
Peru: http://www.minedu.gob.pe/Segundo.htm

The WorLD Program is expected to yield lessons on Internet use and foster integrative applications of technologies in the classroom.

The interactivity provided by the Internet and the web opens the possibility of changing traditional pedagogical models, which is now being contemplated in many education systems. The Internet also represents a powerful tool for improving access to and raising the quality of educational resources, unconstrained by geographical distance.

Computer-Assisted Instruction

Several LAC countries--such as Jamaica, Mexico, and Grenada--have been experimenting with the use of Computer-assisted Instruction (CAI) and Integrated Learning Systems (ILS) to tutor students in basic literacy and numeracy skills. In CAI the computer provides text and multiple-choice questions or problems to students, gives an immediate response to the answers given, summarizes students' performance, and generates exercises for worksheets and tests. In ILS, computers are networked and equipped with software that provides a set of sequential lessons, as prescribed by the built-in management system, which tracks individual student progress. These systems have been used widely in the United States, Israel, and other countries, mainly to provide remedial language and mathematics instruction.*

Upper Secondary Education: School-to-Work Transition

Preparing secondary students for and readily connecting them to future workplaces is a major issue in developing countries. School-to-work concerns are often related to preoccupations about competitiveness that extend throughout the Caribbean and Latin American region. They are intrinsically related to the perceived need to improve the quality of education at all levels. Achieving and sustaining competitiveness requires more than just equipping a subset of students with marketable skills. Students will need both conceptual ability as well as a deeper understanding and familiarity with theoretical and applied science and technology.

The Costa Rican Ministry of Education (MOE) introduced productivity software--such as word-processing, spreadsheets, and administrative skills--into secondary schools. There were two long-term goals: to provide students with the means to write and calculate more proficiently; and to introduce some simple computer applications into the network of small, family-run businesses--from mechanic shops to corner stores to farms--which comprise most of the economic activity of the country. The idea is that students can begin to improve the efficiency of their families' business activities with the use of something as simple as a spreadsheet to track sales or stock.

English language facility is considered an asset in the global marketplace Colombia is now experimenting with the use of computers to provide English language instruction to students enrolled in the *bachillerato tecnico* stream to prepare them for the new labor market requirements.

The use of computerization is focused on high schools in some countries. For example, the some believe that it is better to introduce informatics during adolescence since these skills are learned more rapidly than by small children, and the and the transition from school to work is closer. An additional rationale is that since software changes so rapidly, if students learn applications near the end of secondary school, they will be more likely to reflect the actual work environment they will enter. Software applications for younger children often have no direct correspondence to the workplace but instead used as a stimulus to learning.

* For a positive assessment of the Israeli experience with CAI see Osin, 1998.

Two LAC countries—Brazil and Costa Rica—believe the information industry is at the heart of their economic future. Brazil is committed to develop its own high technology industry. Thus, programs are being designed to disseminate computers into schools across the country so that computational technology becomes an integral aspect of learning at all educational levels. The private sector is also playing an important role. Intel has made substantial investment in Costa Rica, which is a reflection of this country's concern to develop its young workforce appropriately in the form of developing the capacity for growth of high technology industries.

In addition, as telecommunications infrastructure becomes more widespread in the region, Internet-based connections will begin to support needs for specific job-related knowledge through on-line connections and apprenticeships. Distance learning technologies are being used (and supported) by the private sector to provide worker training. For example, in Mexico, *Telesecundaria* is moving into the workplace to help workers who dropped out of school to complete their education.

Mexico is also confronting a need to modify vocational technical training to meet competitive standards for full participation in NAFTA. To meet this challenge, Mexico is developing competency standards in conjunction with the private sector as a framework for assessing and licensing in technical fields. Three vocational school networks will develop pilot curricula incorporating new standards, which then would be applied to all technical fields. The new vocational programs are intended to train students for work not only in emerging technology fields but more traditional ones as well.

Brazil, with its *Telecurso 2000*, a televised distance education program, is filling a variety of training needs. Its original function was to help the nearly 40 million illiterate/semi-literate adults who are already in the workforce and would have difficulty modernizing their own skills and adapting themselves to the demands of a new economy because of their inadequate early schooling. The courses, developed by the Roberto Marinho Foundation, are not replacement courses for standard secondary school material, but specifically focused on workplace skills for a semi-literate audience.

The pedagogy behind *Telecurso 2000* rests on four foundations: (1) Instruction in Context--students take courses at their workplace; (2) *Contextualization* of Instruction--all material is related to students' real-life situations; (3) Basic Tools--each lesson is about key tools and abilities; (4) Citizen Awareness--the instructional content promotes civic consciousness. *Telecurso 2000* is distributed over broadcast TV and currently carried on *Rede Globo, Rede Brazil, Rede Vida*, and *TV Futura*.

Higher, Continuing, and Professional Education

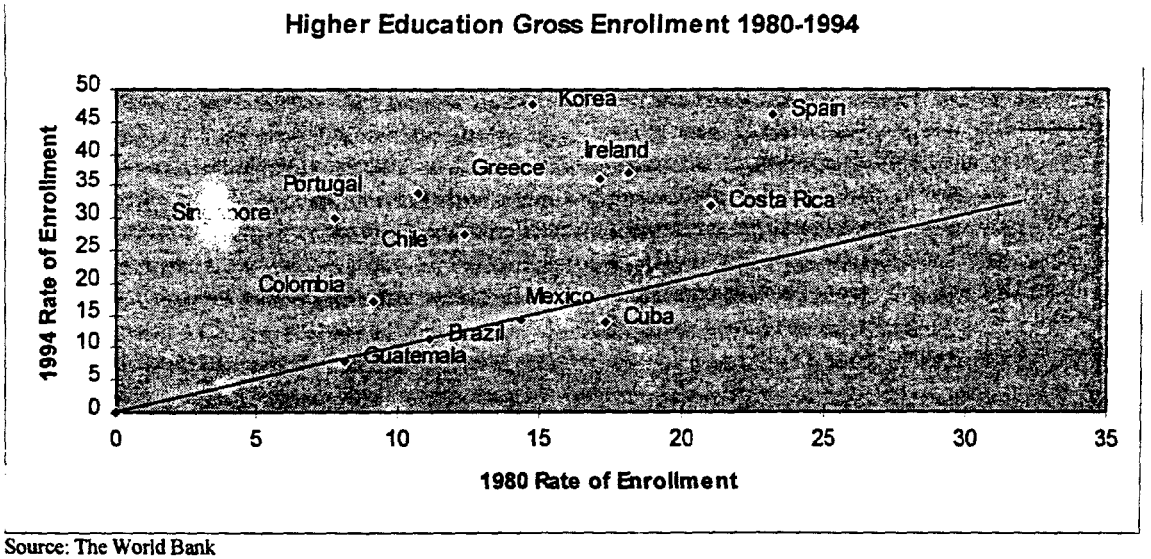
Access. Higher education institutions in LAC face challenges similar to other countries: transformations to a global economy, an emerging information age, and shifts towards life-long learning. In developing countries these challenges are manifold: more demand for access, calls from the public and private sector to improve the quality and relevance of higher education, and the search by higher education administrators for better financial management practices and new definitions of productivity in the wake of rising costs and reduced public financing.

Response to the growing demand for access by more diverse student populations has led to: (a) new forms of higher education, often directed to meet labor market requirements; (b) many new private universities; and (c) growth and expansion of distance education programs using telecommunications and emerging information technologies.

Until recently, telecommunications and information technologies played only a minor role in traditional higher education institutions and their continuing education programs. This profile is changing rapidly as the potential of technologies to promote access, quality, and productivity on a broad scale comes into sharper focus. Such contributions include increasing access to higher education through new strategies and institutional forms, invigorating quality and access to learning resources, and reducing costs for the delivery of higher education services. Planning and financing investments in infrastructure, faculty development, and certification are central to realizing the potential of new technologies in higher education institutions in LAC.

Meeting demand. Latin American and Caribbean countries increased higher education enrollments significantly during the past quarter century; however,

Table 2: Higher Education Gross Enrollment, 1980-1994



Source: The World Bank

this expansion was slower than in other regions. For example, in 1980 Mexico and Korea had similar higher education enrollment rates (14.3 percent and 14.7 percent, respectively); but 14 years later Korea tripled its higher education enrollment (47.7 percent), while Mexico's rates stagnated (see table 2). Similarly, Cuba, Greece, and Ireland had comparable enrollment rates in 1980; however, over the same period (1990-94), Cuba's rate declined by 3.4 percent by 1994, while Greece and Ireland increased their enrollment rates by 19 percent.

The pressure for higher and continuing education in many Latin American countries continued to increase during the 1990s reflecting demographic trends; the growth of primary and secondary enrollments; and new and greater employment and income opportunities for skilled professionals and technically competent workers. Current demand for higher education now also reflects strong interest of the adult population, whose learning needs and interests cannot be met by traditional academic programs of higher education institutions. New higher education institutions have evolved in LAC to meet the demand by non-traditional learners, as elsewhere in the world; however, they are not yet captured by available data. Preliminary indications suggest that the demand for innovative forms of higher education is outpacing that for traditional "on-campus" offerings.

If LAC countries are going to meet the challenge of increasing access to higher education, as well as accommodating the demands of non-traditional learners for technology-related education, policies should be adopted and programs developed that would encourage more efficiency and productivity, accompanied by strategic investments to enable higher education institutions to reach the expanding learner base. One of the most promising and economical means to achieve this is through distance education.

Varieties of Distance Education Programs. Distance education formats in higher education began to appear in the LAC region in the 1940s and 1950s--although considerable evolution has occurred in program types and use of instructional technology. In the mid-1970s a number of countries in the region established distance education programs, generally of two main types: open and dual-mode. *Open universities*--modeled after the successful British Open University and other European variants--have been dedicated exclusively to delivering university-level, post-

The University of the West Indies (UWI) Distance Education Centre (DEC) works with faculties of UWI located on three campuses--in Barbados, Jamaica, and Trinidad & Tobago--to develop and deliver programs by distance to service the learning community throughout the Caribbean. DEC uses a variety of distance teaching methodologies: self-study print materials supported by audio and video cassettes, face-to-face tutorial sessions, interactive audio-graphic teleconferences, and computer assisted learning packages, e-mail, and world-wide-web.

The TeleLearning Network of Centers of Excellence (TL•NCE), founded in 1995, is a national collaboration among Canadian researchers and organizations involved in the development and application of advanced education technologies. The aim of the network is to bring together leaders who share a vision and interest in giving Canada a competitive edge in the development of new learning technologies. The principal goal is to develop telelearning as an environment that will provide students with access to learning experiences not available or achievable in conventional classrooms. To achieve this goal, the TL•NCE brings together computer-supported environments, artificial intelligence, high-performance networks, multimedia, and collaborative tools to form coherent systems. They are used to support advanced pedagogies such as knowledge building and collaborative learning. These developments are expected to extend access and bring quality education to all citizens, regardless of their location, age or status. TL*NCE brings together over 130 researchers from 30 Canadian universities who are presently involved in 56 research projects across seven themes.

graduate, and continuing education courses at a distance. They were pioneered in Costa Rica, Colombia, Venezuela, and Chile, which have adopted a model of distance education based on multimedia instruction--combining print, tutorials, audio and video recordings, and other media. *Dual-mode institutions* combine traditional and distance courses and are more frequently encountered in the region in the context of courses in applied fields, such as basic education, preschool education, business administration, public administration, and agriculture.

Currently, there are no official statistics available on distance education programs. Unofficial estimates of these programs for LAC countries that show significant coverage of students and program areas are listed in the table below. Data in Table 3 show that enrollments in these types of programs total about 750,000 students. If programs under development in Chile and other countries were added, the total would be well over one million. It is not possible to capture fully the rapid enrollment growth in new distance education institutions--such as the Virtual University of the *Instituto Tecnologico de Estudios Superiores de Monterrey* (ITESM)--because of the tendency of such programs to expand on their own, coupled with the absence of systematic data-gathering.

Teaching and Learning On-line. In nearly all LAC countries, higher education institutions are experimenting with alternative teaching and learning paradigms, which have implications for technology use. Many involve experimenting with the Internet and adopting new forms of distance learning. In some institutions, like *Instituto Technologico de Monterrey* Virtual University, student satisfaction with on-line courses is higher than in traditional classrooms (interestingly, grade-point averages and other measures of student achievement are the same or better), and there is generally more interaction between students and instructors. A number of on-line teaching-and-

Table 3: Distance Education Programs in Latin America

Country	*Number of Institutions*	*Student Population*	*Programs Using ICT*	*Educational Programs*
Mexico	51	200,000	4	Undergraduate, Graduate, Vocational, Continuing, Secondary, Basic
Costa Rica	2	15,000	1	Undergraduate, Graduate, Continuing
Colombia	37	150,000		Undergraduate, Graduate Vocational, Military, Secondary, Basic
Venezuela	5	100,000	3	Undergraduate, Graduate Vocational, Continuing Basic
Brazil	85	250,000	8	Undergraduate, Graduate, Vocational, Continuing, Secondary
Argentina	23	46,000	3	Undergraduate, Graduate, Continuing, Secondary

Source: Fabio Chacon (1997), "Distance Education in Latin America: Growth and Maturity."

In Chile *the Universidad de la Frontera* in *Temuco*, where Enlaces has its main year masters program and a 17-month diploma program. Both modalities are for experienced teachers. These programs, however, require the participant spend an extended period of time on leave from teaching while they study. The one exception is that ma studies can be done on-line, but the distance course requires that the student have access to e-mail a the Internet

learning applications are used by higher education institutions to create new kinds of distance learning options for Latin America udents:

- *The Enriched Modular Package*--combines text-based distance education with access to remote databases, advisory support rough E-mail or electronic lists, web pages, and frequently electronic libraries. This approach is being used by the *Universidad Estatal a Distancia in Costa Rica* and by the *Sistema de Universidad Abierta* (SUA), the Autonomous University of Mexico.

- *Teleconferencing*--delivery of expert lectures through audio or video communication devices, with the possibility of student interaction. Conferences are also conducted using computers at substantially reduced costs (e.g., ITESM's Virtual University and the *Universidad del Valle* in Cali, Colombia).

- *Individual multimedia packages*--on-line education, or teaching delivered entirely by means of computer networking. Some universities in the region are experimenting with on-line courses. Chile's *Universidad de la Frontera* offers to teachers an entire 17-month series of courses about applying educational technologies. This program however requires students to gain access to computers and the Internet on their own. It is available to teachers anywhere in Chile and outside the country. The *Universidad de Sao Paulo*, in Brazil, also offers individual classes on-line. Chile's *Red Universitaria Nacional* (REUNA), established in 1991 by the Council of Rectors, provides the academic community with high-speed multimedia applications in tele-education, tele-medicine, video-on-demand, and on-line multimedia libraries. REUNA also supports joint-research projects with the private sector and is developing a range of Internet-related consulting services.

- *Networks*--Argentina is creating a higher education computer network called *Red de Interconexcion Universitaria* (RIU), which was launched by the Ministry of Education in 1994. When completed, RIU will have sites in 33 public universities and enable Argentine universities to communicate over the Internet among themselves and with libraries, research centers, and cultural institutions worldwide. The network also will enable university administrators to maintain a permanent, up-to-date database for management and policy coordination. Only a few universities now have their own Internet connections. Once RIU is fully operational, access costs to the Internet should be considerably less for each public university than if it were to obtain this service independently.

Several Latin America and Caribbean higher education institutions have used a *proprietary network*, such as IBM's Global Campus. Most of the universities have a large student body and some, like ITESM in Monterrey, Mexico and *Universidad Nacional Experimental Simon Rodriquez*, in Venezuela, have several campuses. Global Campus is built around Lotus Notes' Learning Space and other software applications, which provide universities Internet access, tools to design online courses, access to digital library resources, and other databases and mobile computing. Global Campus allows universities to provide students and faculty with network access to courseware and educational materials on multimedia servers. Referred to as "on-demand learning" it offers a self-paced, flexible approach to learning that stems from students' being able to access information through the network, via on-campus intranets or off-campus Internet. Global Campus affiliates in Lati

Most students attending Costa Rica's *Universidad Estatal a Distancia* are recent secondary school graduates, heads of households, teachers, workers, farmers, public and private sector employees, community leaders, and businessmen. All have the desire to improve themselves but would find to difficult to attend a conventional university. The university has some 28 centers across the country. In the case of Colombia's Centro *Universidad Abierta (Universidad Javeriana)*, most students are women, teachers, over 30 years old, and married. This illustrates how open universities in Latin America are beginning to open doors to higher education for many that would otherwise not have the opportunity.

ITESM is one of the few universities in the LAC region using modern telecommunications technologies and computers to deliver distance education everywhere in the region. Under its five-year plan, ITESM aims to double its enrollments on its 32 campuses. Originally a small part of the *Instituto Tecnologico de Monterrey*, the *Universidad Virtual* (UV) has grown into a large institution. The *Universidad Virtual de Monterrey* now has nearly 70,000 students all over Mexico and plans to beyond its borders. The Virtual University has physical space, laboratories, and other educational resources in Monterrey, but also has built 26 academic centers throughout Mexico and in the LAC region. These campuses provide computing centers for students as well as other educational resources, although the faculty is in Monterrey. The UV offers 31 baccalaureate, 37 masters, and 7 doctoral programs.

America can be found in Brazil, Mexico, and Venezuela.

On-line formats provide a number of benefits, one of which is they allow access to more students without crowding classrooms. This is because classes are not time-bound; thus, students can more easily combine work and study because they can "attend" class when their schedules permit. Also, by increasing demand for classes, universities can offer more variety in classes, with geographic distance not a factor. Merely offering individual classes on-line has limitations in the way this format is used in Latin America. If only occasional classes are offered instead of degree programs, students still need to be physically on campus for some of their work; therefore, participation is limited to those with traditional access to universities. Also students usually need their own computers.

New Directions. Distance learning technologies have created a new set of higher education alternatives beyond rigid five-year academic programs. These technologies can also lead to an increased role for private institutions of higher learning. The push to expand higher education to reach more students, as discussed above, greatly benefits from Internet-based access to material, libraries, and international networks of expertise. Being up-to-date in disciplinary knowledge has been a major deterrent to revitalizing graduate education in the region.

In many countries, governments have used existing universities as Internet nodes to build a national backbone (e.g., Colombia and Costa Rica). One of the results is that Latin American faculty can now become part of the increasingly global intellectual colloquies through Internet, exchange of papers, and on-line conferences. University students in the region increasingly access these same activities through university E-mail and Internet accounts.

The demands of the information age are having a profound impact on higher education.[1] The very nature of information and scholarship is changing. According to Dolence and Norris, institutions are being challenged to provide students and teachers with access to the variety of networked resources available to them, challenging teachers to offer integrated views of what traditionally have been specialties, and to expand their connections with other experts. Further, the work world in a fast-changing information age demands workers who can continually adjust to new marketplace and knowledge requirements. The individual learner needs now extend far beyond familiar "start-up" curricula within specific disciplines. Higher education is being called on to meet a wide variety of learning needs: a basic liberal arts approach to lifelong learning; high-level (graduate) instruction in collaboration with faculty, researchers, and problem-solvers in specialized areas of knowledge; accommodating transitions in employment responsibilities; and daily enrichment of knowledge in employee teams.

The intellectual, social, and even political ramifications of incorporating technology-based programs into teaching methods will need to be explored more fully by the LAC higher education community. Universities are now investing in new methods of pedagogy, new delivery systems, and new access to knowledge and content. Higher education institutions, with increasingly limited budgets, will need to find ways to pay for this new way of conducting business. It will be important for administrators to evaluate their assumptions about, and measurement of, productivity relative to new technologies, their application, and relative cost.

Professional Development of Teachers

The rapid growth of the teaching force in LAC mirrors the dramatic increase in school enrollment. Many teachers are underprepared and poorly trained as a consequence of the urgent demand to speed the prepa-

ration and fill slots. The frequently- encountered inadequate professional preparation compromises the delivery of consistent, high-quality education, which is the foundation for implementing new methods and technologies. Technologies can be used to meet this need over the next decade. In fact, improving the quality of teachers' skills may be one of the most important uses of technology. Several challenges confront LAC countries that seek to strengthen their teachers' corps.

- Access to knowledge about teaching methods. Designing and developing strategies to use technologies to reach teachers in remote locations, who usually are neither prepared pedagogically nor in the content of the curriculum at their assigned grades.

- Restructuring pre-service education, which must now prepare teachers for new contents and pedagogical techniques using technology.

- Preparing both practicing and candidate teachers in ways to incorporate technologies into their teaching, and to understand more fully the information-handling skills their students will need.

- Access to better information about teaching. Many LAC countries have created distance education programs that use television, video, and networking technologies to reach teachers in remote areas.

In the Brazilian State of Minas Gerais, an in-service training project, *ProQualidade*, is attempting to reach all 90,000 primary school teachers using video and printed materials to teach a new curriculum of Portuguese and mathematics. The initial design used group tutoring and learning networks with video programs. Two-hundred-and-fifty facilitators were trained, or a ratio of 350 teachers per facilitator. *Salto para o Futuro*, another Brazilian effort, was conceived as a television program targeted to reach 80,000 teachers of mathematics and Portuguese in an effort to improve general classroom practices. Because of broadcast conflicts, the program switched to radio, with text-support materials and a 40-minute introductory video. This had serious consequences when the amount of preparation, scripting, and production time for 30 modules was reduced to just a few months.

Chile and Venezuela are exploring ways of using electronic technologies and distance education pedagogy to deliver most of their in-service offerings to teachers. Venezuela may need to train up to 10,000 teachers a year for the next 10 years, which is well beyond the number that the universities are currently training. In addition, many of Venezuela's current teachers, especially outside the major metropolitan areas, do not have university degrees. It is estimated that some 60,000 teachers need additional course work to reach the baccalaureate level.

Chile has an adequate supply entering the teaching profession. However, a significant number of teachers in Chile (perhaps 20 percent) lack university degrees. But by far the greatest challenge facing the Ministry of Education in Chile is the need for in-service teacher education, especially in the effective use of new technologies and implementation of curriculum reforms in math, science, and language. The Ministry realizes that it cannot rely on traditional in-service approaches to upgrade the skills of the country's 129,000 teachers--many of whom teach in remote areas.

Restructuring pre-service education. Important uses of new technologies in pre-service education include attempts to bring actual classroom experience into the teacher training institutes using video and network connections that permit candidate teachers to view and discuss a variety of practice situations. Such programs foster interactions among practitioners and focus on local classroom experiences and practices--without being intrusive or interfering with the daily classroom work of the teacher.

The Ministry of Education in Mexico is implementing a major in-service program, *Programa de Actualizacion Magesterial*, under which many teachers are being upgraded through training that uses a combination of text, television broadcasts, and interactivity. Training is delivered at teacher resource centers. The *Direccion de Actividades de Desarrollo y Medios Audiovisuales* in Mexico produces a series of TV programs on EDUSAT for student teachers and teacher trainers at teachers colleges. The programs support curriculum and pedagogical reform through videos of actual classroom practices leading to discussion of the activities and theories being practiced. Participating teachers pick up a "didactic packet" of text and video materials from the local

In Brasil, *TV Escola* is a federally-funded educational TV station. *TV Escola* broadcasts on Channel 2 as well as through Direct Satellite TV. The project recently has completed installing parabolic antennas in 55,000 schools. *TV Escola* purchases and translates foreign-produced programming and produces some original material for teacher training. Daily *TV Escola* occupies nine hours of broadcast time, with three hours of programs repeated three times. The repetition of material provides more flexibility for teachers to either use the programming or to videotape it. Before and after this nine hour block, *TV Escola* allows other institutions to use its facilities to emit their own educational programs.

Centro de Maestros. They then have nine months to prepare for an examination to obtain a diploma. Tutoring is available from the *Centro de Maestros* but is not required. The program, less than a year old, has 200,000 participants and has just administered the first exam. However, relatively little practical experience is incorporated into the program.

Brazil and Mexico also provide broadcast television-based professional development programs. *TV Escola* in Brazil and the Mexican SEP broadcast TV debates, panel discussions, and lectures by experts on different aspects of education. These are individual shows or weekend-long special programming. Schools and learning centers are open to teachers during broadcast hours so they can view in groups, discuss themes, and contact the studio. Both countries use phone-in (or fax or e-mail) portions of the broadcast to create interactivity. Both institutes report positive responses to these programs and a large number of questions and requests for more information regularly arrive from teachers. Both *TV Escola* and the *Direccion de Actividades de Desarrollo y Medios Audiovisuales* in Mexico are developing strategies to meet teachers' requests for curriculum support and classroom activities to follow the broadcasts.

Preparing teachers to use technologies. Several LAC countries are providing professional training in the use the new technologies. These programs are designed both as face-to-face training and delivered using various technologies. In the long run, as the LAC region increases the reach and depth of its telecommunications infrastructure, technologies can be used to address two additional problems of the teaching profession.

First, teachers benefit from having easy access to a variety of curriculum materials and ideas, and to area-specific content for their own preparation. The Internet and web uniquely provide ready access to such enrichment opportunities--especially for teachers who teach in rural areas. In addition, these technologies provide access to other teachers who have experimented with new approaches, thus providing feedback and guidance to novice teachers as they attempt new practices in their own classrooms.

Second, teaching is one of the most intellectually challenging, yet isolated professions in the world. Often teachers practice in isolated schools or behind the closed door of their classroom, seldom discussing their experiences or learning from other practitioners. The teaching profession has a very underdeveloped professional community, both in LAC countries or worldwide. Given the time and location constraints of the profession, and the generally low pay, technologies offer unique opportunities to create a new kind of dynamic professional community among educators. As educators gain access to telecommunications, new kinds of learning communities, databases of materials and ideas, and forums for exchange of professional knowledge are developing. The LAC region, both within and across countries, will undoubtedly benefit from the invigoration of the professional teaching community as this kind of activity is encouraged and developed.

Teacher training in national plans. Many other countries in the region are now developing national plans to incorporation technologies. The *Enlaces* project in Chile was designed in concert with countrywide educational reforms, and then adapted to the evolution of those reforms. The project was launched as a pilot program designed to use networking technologies to reach students in poor, isolated regions first. The program expanded rapidly to become a model for national infrastructure with a strong teacher education focus.

Like Chile, Paraguay has begun with the design of a pilot program that can be tried, revised, studied, and adapted to develop a national strategy. Paraguay faces a number of difficult educational challenges. Principal among these are: retention of students and access to secondary schooling; bilingual education (Span-

ish/Guarani); teacher training, both preservice and inservice; pedagogical reform; and competition within Mercosur.

To meet these challenges a *Plan Estrategico Paraguay 2020* was developed. To initiate this process, a meeting was convened with 280 representatives from various education stakeholder communities. For its part, the Ministry of Education concentrated on building a technology program in the context of the *Plan*. This approach was both timely and prudent, in that pedagogic improvement and not technology integration and use for its own sake is the driving force of the teacher education reform.

Teacher training is crucial to the r[illegible] because the previous curriculum was widely perceived to be weak. To reach teachers in the field, the Ministry established CINAPs (*Círculos de Autocapacitación Permanente*) in every school. Teachers can seek help from a *Unidad Pedagógica Departmental* (UPD) created for every province. UPD staff are trained in Asunción in workshops and then sent to the field. A distance education, inservice teacher-tra[illegible]ogram is also being created with help from the [illegible] Government. Within the new *Plan de Estudios*, the teacher training institutes would be reformed to include technology as an area of knowledge and a teaching tool. Although Internet is not yet in place in the school system, Paraguay intends to use e-mail and Internet to connect teachers, which is a part of its overall strategy.

Further, the MOE is promoting a program to involve the *private sector* in education. Schools in marginal areas are being given technology infrastructure donated by private companies. Private sector involvement is highest in technical education, where there has been a successful relationship with the *Union de Industriales Paraguayas* in setting standards, and designing curriculum. Large multinational corporations are donating computers to schools as well.

Chapter III

Financing Educational Technology

Overview

Most Latin American governments today spend relatively little of their education budgets on educational technology, with the possible exception of Brazil, Chile, Costa Rica and Mexico. However, this situation, is fast changing, as more and more governments are either planning or already implementing new investments (or upscaling smaller previous investments) in school computerization and networking, radio instruction, and television broadcasting to remote schools.

In this chapter, comparative costs are examined of radio, television and computers in education, drawing upon data from Latin America and other countries. Focus then shifts to issues of affordability and equity in an attempt to assess under what circumstances these technologies are affordable to governments with rather meager per-student budgets. The main conclusions of this assessment are:

1) Even the poorest countries can afford to adopt and financially sustain the use of radio to enhance the quality of instruction in primary education, especially in rural areas.

2) Television is a costly option for distance education, but offers economies of scale that can substantially reduce per capita costs; further, it may be the only way to extend education to remote rural areas.

3) Most countries are unable to afford large-scale national school computerization programs, involving computer laboratories and regular access for students and teachers, without increasing or supplementing educational budgets. However, even the poorer countries, can afford to adopt computer/Internet programs in higher education.

4) Computer/Internet packages generally appear more financially feasible at the secondary and higher education levels, in light of what governments currently spend per capita. However, various schemes that reduce access to computers (e.g., using them in libraries for research on the Internet) could make them feasible for primary schools, provided recurrent service connection fees and telephone rates for the Internet could be kept low.

5) At the experimental or pilot level, school computerization projects would appear to be financially feasible for all ministries of education, particularly where budgetary support can be mobilized from external sources.

Notwithstanding the growing consensus among policy makers and educators as to the benefits of technology to education, there is almost no reliable research anywhere in the developing world to demonstrate its cost effectiveness. As a consequence, this report focuses on cost and affordability issues, rather than on cost effectiveness.

Comparative Costs of Educational Technology

Table 4, provides estimates of the per capita costs of different educational technologies. These costs were derived from models constructed for interactive radio instruction and for computer instruction, using the Internet. They are for a typical middle-income LAC country, and are based on actual country data. International prices, have been constructed to account for inflation and technology changes and for judgments as to input levels required for minimum educational effectiveness. The cost models for large

Table 4 : Comparative Per-Student Costs of Educational Technology, 1998			
Technology	**Application**	**Scale**	**Per-Capita Cost**
Radio - Large Program	Distance Learning - Basic Education	1 million learners	$3.26
Radio - Small Program	Distance Learning- Basic Education	100,000 learners	$8.12
Computer with Internet - Large School	Primary or Secondary School Laboratory	600 students	$72.00
Computer with Internet - Small Rural School	Primary or Secondary School Laboratory	150 students	$98.00
Television Broadcast by Satellite	Secondary Education for remote sites with populations under 2,500	700,000 students	$500.00-700.00

Source: The World Bank, 1998

and small school computer projects appear in Annex I, Tables 1a and 1b. The costs for radio projects in large primary schools are provided in Annex I, Table 2. The costs for satellite television were derived from rough preliminary and unofficial estimates of costs of Mexico's *Telesecundaria* project.

These cost data are generally consistent with findings elsewhere which show that there is an approximate tenfold difference in costs between radio, computers and satellite television broadcasting.

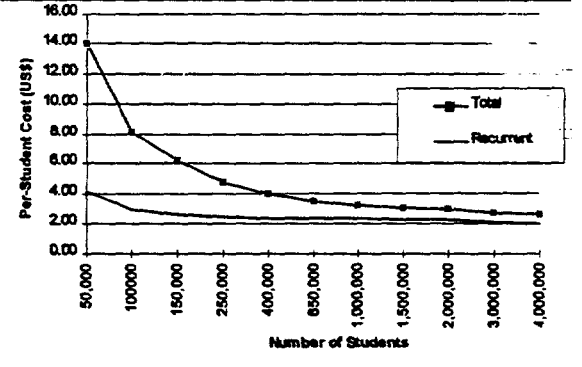
The aforementioned cost models in Annex I also show, rather surprisingly, that the per-student recurrent costs of most technology projects are usually higher than the annualized investment (including equipment costs. This is not good news for those concerned about sustaining investments. For example, in the two models for computer projects (large school and small, rural school), investment costs constitute only 27 to 29 percent of total annual costs and recurrent costs 71 to 73 percent. (And if the cost of money were not accounted for, annualized investment cost would be even less as a percentage of the total annual cost). In the large-scale radio project, the recurrent cost again is 71 percent of total per-student annual cost, with investment cost only 29 percent.

LAC country policy-makers and educators may wonder why recurrent costs are substantially higher than investment costs in these projects. The cost reality in such projects is like that of most other educational projects: personnel and other recurrent costs particular to technology programs are the largest part of total costs. Indeed, technology projects would not operate at all without significant non-personnel recurrent costs --maintenance, telecommunications/ Internet services and training-- whereas traditional teacher-classroom programs in some developing countries have been starved of everything but personnel compensation and still continue to operate.

Economies of Scale

Economies of scale are also important determinants of per capita costs of some distance learning technologies. For example, the economies of scale are such in IRI that when the cost model is run on a smaller program of 100,000 students, the percentages of investment and recurrent cost per-student are reversed. As shown in Table 5 investment costs for this smaller program are 63% of per-student annual costs. The chart shows that still smaller programs are

Table 5: IRI Per-Student Cost at Various Program Scales--One Instructional Subject



Source: World Bank

even more investment-intensive. It is the program production and broadcasting aspects of IRI that result in major economies to scale. The costs that vary per student, class, or teacher do not exhibit economies to scale, but in the smaller programs, they are overwhelmed on a per-student basis by the lumpy investment costs.

Using a term of general use in distance learning, costs of this type would be designated "learner-support activities." For instance, the presentation of university course material could be transmitted by satellite television to thousands of students over many years. Large economies of scale thus would result from learner-support activities for such a course; on the other hand, face-to-face tutoring in learning centers or interaction with a tutor by E-mail, for instance, would not exhibit strong economies of scale. Annex I, Table 3, illustrates this concept for a number of distance-learning technologies.

Computer instruction, in general, whether used as learner support for distance education or as a standalone instructional medium does not exhibit strong economies of scale because few of the costs are fixed program costs, which once incurred can be distributed over large numbers of students. Most costs in computer instructional programs vary per student, with fixed costs being mainly the set-up costs of the computer lab and compensation of laboratory staff. When a second lab is established to a second 100 or 1,000 students, you have to make the investment again. The economies of scale that exist depend mainly on the size of the computer lab. Our cost model for a large school of 600 students, with two contact hours per student per week, for instance, requires a lab or 22 computers, with an estimated annual cost of $72 per student (Annex I, Table 1a). The cost model for a small rural school of 150 students (with an electric connection) requires a lab of six computers and costs an estimated $98 per student with the same amount of student contact (Annex I, Table 1b). Thus, economies of scale are modest.

Equity Concerns and Costs

Equity concerns surface when affordability is an issue. Even if computer labs are not affordable for every school, a government might be able to afford computers for a minority of schools and students. If these favored students were those attending selected academic high schools, whose students tend to come from a higher socioeconomic background, this could be perceived as an example of an inequitable use of public money.

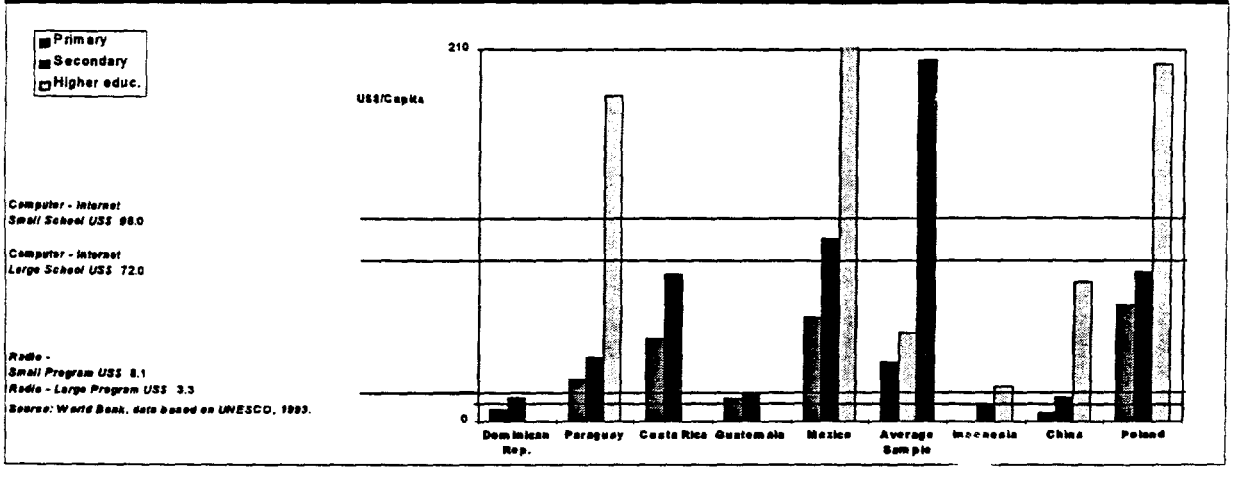
By definition, pilot projects treat pilot and non-pilot students unequally. If wealthier urban children were further advantaged by participation in a pilot program, an equity problem also could arise; however, this is somewhat mitigated by the program being identified as a pilot. On the other hand, if the children in the pilot were those from poor rural schools, as in the *Enlaces* program in Chile, or in Jamaica's 20/20 Project, the equity problem is mitigated even more.

Spending more on some children than on others is not always inequitable. Suppose that providing televised secondary-level instruction to disadvantaged rural students costs significantly more than providing conventional secondary instruction to students in urban and suburban areas. In this case, an argument could be made that the disadvantaged rural students deserve compensatory finance to achieve equal educational opportunity. The principle of equality is preserved, even though the expenditure is unequal. The case of Mexico's *Telesecundaria* program--which provides lower secondary instruction by television to nearly a million of the country's rural students-- has not received sufficient cost analysis to make a firm cost comparison with conventional secondary instruction. However, a preliminary accounting of all program production and satellite transmission, and other inputs, suggests that the program is more expensive than conventional instruction. Moreover, it may cost 36 percent more per student to provide computer/Internet instruction in a small rural school than in a large urban one, as in the cost models presented above, but it does not violate equity considerations.

Affordability and Financial Sustainability

One the many issues facing ministries of education in the LAC region today is how--not whether--to fund the introduction of computers in schools, and on what scale. With support at executive levels of government and the education ministry, the funds to cover a pilot educational technology program to benefit selected schools usually can be found, particularly when donors also provide support. But for the program to be extended equitably to all students at a given level, it must be affordable within the resources allocated to that level or must win resources from other levels or other budget categories.

Table 6:
Costs of Educational Technologies in Relation to 20% of Discretionary Educational Expenditure Selected LAC and Other Developing Countries



To obtain an estimate of the affordability of radio computers, and satellite television instruction to countries in the LAC region, the estimated costs of these technologies were compared to a rough measure of discretionary spending for a sample of LAC countries for which data are available. A threshold of 20 percent for per-student expenditure was used as a pro-forma upper boundary for discretionary spending. (The calculations appear in Annex I, Table 4.) In reality, it would difficult to approach this threshold for any new educational program. Table 6 below, shows what educational technology could be purchased with this 20 percent discretionary amount at the primary, secondary, and higher education levels.

Conclusions

Table 6 illustrates that the cost of the large-scale IRI program could fit comfortably into the primary education budgets of most large countries. For example, $3.26 would fit into Mexico's per-student indicator of discretionary primary-level spending of $59 (see Table 3). Note, however, that $3.26 would constitute a large percentage of China's per student discretionary spending at the primary level of $5. The $8.12 per-student cost of the small-scale IRI program (which does not benefit from the economies of scale of the large one) is less affordable. Its per-student cost of $8.12 would exceed the per-student discretionary budget of some low-income countries and take a significant portion of many lower-middle-income countries. For instance, the per-student discretionary allocation for Guatemala at the primary level is $14; the $8.12 cost of the small-scale program would consume 60 percent of it. The cost of the small-scale program would, however, easily fit into the discretionary spending of most upper-middle-income countries.

The situation is much less favorable for the computer/Internet programsas shown in the cost thresholds above. The $72 cost per student for large schools would exceed the generous pro-forma measure of discretionary spending for most countries at both the primary and secondary levels.[1] Only Mexico and Costa Rica from the Latin American sample would have discretionary expenditure exceeding this, and only at the secondary level. For the other LAC countries in the sample, only a large increase in the education budget, a major reallocation or funds among expenditure categories within education, or a much less expensive computer/Internet program would permit funding for all students at the primary and secondary levels. If only some students were funded, the program would generate serious equity issues.

The position of higher education, including teacher education, is quite different. Using the measure of discretionary spending per student of 20 percent, but one of the countries in the sample would qualify -even the low-income countries would be able to cover the $72 per-student cost of the computer/Internet program. Distance learning using computers and the Internet can be considered straightforwardly

[1] If the mix of schools were 33 percent large schools with 600 students and 50 percent small schools with 150 students, the average would be $77 per student.

within current budget parameters in the case of higher education. The equity case for providing all students with computer/Internet access is also less strong in higher education. Virtually any academic areas can benefit from Internet access, but arguably some scientific, mathematical, and business-related subjects and pre-service teacher training could claim priority. Cost recovery would also be more applicable to higher education.

What possibilities are there for radically reducing the cost and thus increasing the affordability of computer/Internet programs? Reductions in computer costs, training, and salaries for laboratory personnel are feasible under some scenarios and should be considered to adjust the affordability observations obtained in this report. For example, schools can begin to use computers in the library rather than in the classroom, making them available for research on the Internet and similar educational purposes. Where there are too few computers to give all students routine access (i.e., two hours per week), schools could limit computer use by grade, especially at the primary level.

An important conclusion of the analysis is that in the budget context of countries in LAC, programs that require large per-student funding relative to current allocations will be difficult to fully fund for more than a minority of students, and, if funded, even more difficult to be financially sustained.

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Chapter IV

Telecommunication Issues

Background

In LAC, a well-developed telecommunications infrastructure is emerging compared to elsewhere in the world (see Tables 7 and 8, below). LAC is second only to Eastern and Central Europe in terms of per capita investment in technology infrastructure. However, there is a substantial gap between urban and rural sectors in such investment, which could intensify current system-wide educational inequities. Such resources covering infrastructure and current costs ideally should be affordable to all and wireless applications.

Coordinated planning for primary and secondary education use will become critical as telecommunications technologies and connectivity capacities are deployed to meet business, private sector and university needs. Pilot and demonstration projects with the networked technologies will be needed in LAC countries; however, experience from developed regions can be used to guide this deployment and avoid shortcomings of earlier efforts.

The installed base of personal computers in LAC, although expanding, lags that of the developed world. Reliable numbers are available for 1995, and the installed base undoubtedly has grown in most countries. According to *The 8th Annual Computer Industry Almanac, 1995*, Chile (25.9 computers per 1,000 people in 1995), Argentina (26.2), Mexico (27.4), Venezuela (28.9) have relatively higher numbers of computers in the region. Colombia (19.1), Peru (18), and Brazil (15.1) have relatively lower numbers of machines. These data can be compared to 364.7 personal computers per 1,000 people in the United States with 201.6 in Switzerland, 97.9 in Taiwan, and 47.7 in the Czech Republic, respectively. The numbers in the LAC region are expected to grow, as several countries are now making investments to acquire substantial numbers of computers for schools (e.g., Brazil).

The development of telecommunications as part of the computational environment has changed the potential of new technologies to address education problems. In the 1980s, most attention focused solely on the distribution and use of stand-alone computers; however, during the 1990s attention shifted to the development of infrastructure to support computer networks. This means that the state of development of telecommunications infrastructure in LAC countries will be critical in planning for education uses of technology by countries and in the region generally as discussed below.

Telecommunications Infrastructure

The LAC region, as observed, compares favorably to the rest of the developing world in terms of the availability of basic telecommunications infrastructure. As shown in Table 7, LAC's average of 8.7 lines/100 inhabitants ranks second only to Eastern Europe's 16.9 lines/100 inhabitants.

Similarly, in terms of the average number of radio and TV receivers (Table 8), the LAC countries with 32.6 and 22.4 receivers per 100 inhabitants, respectively, is second only to ECA in media service density.

The gap in services between urban and rural areas--which it is by no means insignificant--is not as large in Latin America as in other regions. In LAC, the residents of the largest city are provided with 2.4 times as many telephone lines as those who reside in the rest of the country. By comparison, this gap is as

Table 7: Number of Internet Hosts per 1 million Inhabitants in Selected LAC Coun-					
Region	Largest city	National average	Outside the largest city	/ National Average	Outside the largest city
[OECD and Other]	51.4	50.8	45.0	1.0	1.1
[illegible]	4.4	1.1	0.8	4.0	5.8
EAP	19.9	4.1	3.6	4.8	5.6
ECA	34.2	16.9	15.0	2.0	2.3
LAC	16.7	8.7	7.0	1.9	2.4
MNA	13.2	6.1	5.0	2.2	2.7
SAS	7.0	1.2	1.0	5.9	6.8

Source: International Telecommunications Union, "World Development Report," Geneva, 1997

Table 8: Number of Radio/TV Receivers Per 100 Inhabitants by Region				
Region	Radio	TV (including Cable and Satellite	Cable TV	Satellite TV
[OECD and Other]	117.2	60.0	14.5	3.61
AFR	21.1	3.5	0.0	0.03
EAP	17.9	22.3	2.8	0.13
ECA	34.2	30.2	3.3	3.19
[illegible]	32.6	22.4	1.7	0.36
MNA	24.4	14.3	0.1	0.82
SAS	10.9	5.0	1.7	0.10

Source: International Telecommunications Union, "World Development Report," Geneva, 1997.

large as 6.8 times in South Asia and 5.6 times in Africa.

There is considerable variation among LAC countries in Teledensity and the availability of television and radio receivers (Annex II, Tables 1 and 2 highlight the variance). The variance in the urban-rural gap is also significant. While it is as little as 1.1 times in St. Lucia, it is 16.5 times in Guatemala. Where the gap is large, countries face a dilemma. Rural schools often lag urban schools in availability of well-trained teachers and subject specialists, as well as access to useful educational materials and information. Telecommunications technology may be able to narrow this gap by supporting distance training of teachers, making useful information available both to teachers and students. Unfortunately, such potential may be difficult to expilot due to poorer telecommunications infrastructure in rural areas.

Reliability of telephone lines can vary significantly from country to country, e.g., from about every 100 telephone main lines experiencing 5 line faults to as much as 133 faults per year, and from 5 percent to 55 percent of local calls attempted being unsuccessful.

Obtaining telephone service is expensive in many countries. The initial fee for a subscribed telephone connection costs hundreds of dollars in many countries (Annex II, Table 3). Monthly fees can be as high as US$40 in Belize (residential) or US$30 in Argentina. Furthermore, unlike in the United States, where unlimited local calls are permitted from a subscribed line with a fixed monthly fee, there are fees for individual local calls in addition to the monthly subscription fee (US$0.06 and US$0.30 per three-minute call). These costs represent a relatively high percentage of personal income, which in LAC could be an

Table 9: Trends in Annual Telecommunications Investment by Region (US$ million)						
Region	1991	1992	1993	1994	1995	1996-2000
[OECD and Other]	100,940	102,859	100,180	102,157	112,281	129,287
AFR	1,035	1,393	1,727	1,431	1,622	2,917
EAP	6,734	8,763	13,078	14,843	20,776	348,478
China	1,617	2,947	7,015	7,921	11,917	301,767
EAP w/o China	5,116	5,817	6,063	6,921	8,859	46,71
ECA	4,546	4,175	6,733	4,354	5,747	51,208
LAC	9,536	9,424	10,872	11,776	11,022	39,208
MNA	1,575	1,691	1,627	1,685	1,806	21,522
SAS	1,813	2,196	2,293	2,824	2,572	29,728
Y1996-2000: Projected Five-Year Total (not yearly average)						

Source: International Telecommunications Union, "World Development Report," Geneva, 1997

obstacle for school systems who wish to use telecommunications services As in the United States, remedies could take the form of specially negotiated rates for the education sector.

Telecommunications Investments

The state of telecommunications infrastructure in LAC could change dramatically quickly resulting in improved service quality and accessibility as well as cost reduction. Most of the countries in LAC have either privatized or are in the process of privatizing telecommunications services. Recent studies show that privatization has a number of positive effects (see Telecommunications Sector Reform in Latin America, World Bank Discussion Paper, forthcoming).

During the 1991-95 period, LAC as a region invested nearly US$53 billion in telecommunications (Table 9). LAC investment is second to EAP's US$64 billion (of which, China accounts for US$31 billion). The corresponding figure in AFR was short of US$3 billion. On a per-capita basis, LAC sustained the highest level of investment (US$25.89 in 1994, US$23.60 in 1995) within the developing world during the same period, more than twice as much as the second highest ECA (US$8.95 in 1994; US$11.76 in 1995 (Annex II, Table 4). During the period of 1996-2000, LAC is expected to maintain the same level of investment or to decline slightly, while EAP and ECA are expected to be far more aggressive. Within LAC, the largest telecommunications investments were made by Brazil (US$21 billion), Mexico (US$11 billion) and Argentina (US$9 billion) during the 1991-95 period (Annex II, Table 5). On a per-capita basis, Caribbean countries with smaller populations were far more aggressive than Latin American countries (Annex II, Table 6).

The Internet

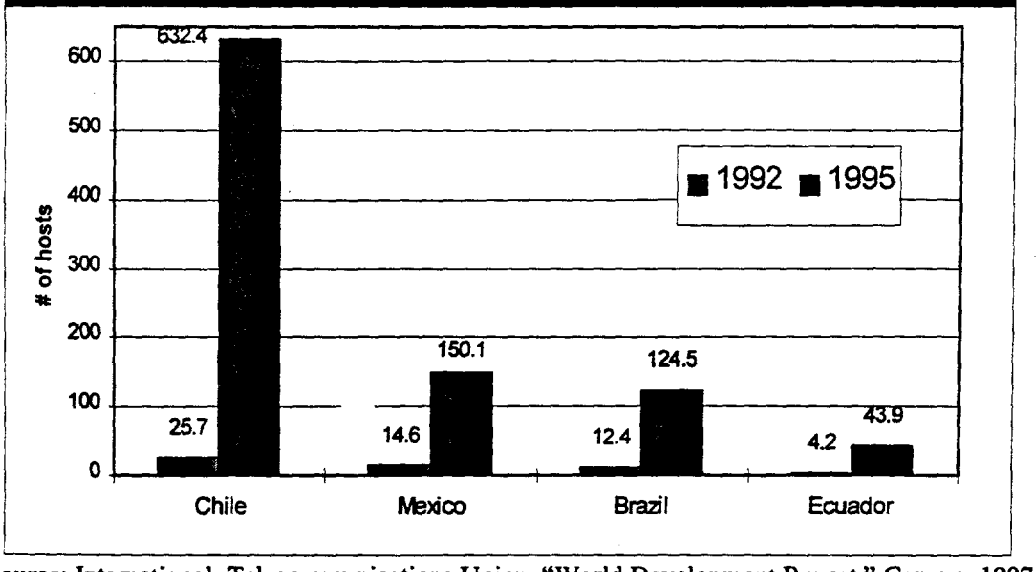
The Internet has grown exponentially in the LAC region, as in other parts of the world during the decade. By end 1995, there were some 200 Internet hosts for every 1 million people in the region, compared with only 2 hosts per million three years earlier. However, in relative terms, LAC still had considerably less hosts per million population than the countries of Eastern and Central Europe (ECA) and of the OECD, although more than in Africa, Asia and the Middle East. (Table 10).

In LAC, Chile, with 632, had the largest number of hosts per million population among the larger countries, followed by Brazil's 124 and Mexico's 150. Costa Rica with 439, Uruguay with 346 and some of the Caribbean countries, e.g. the Bahamas with 989, had a relatively large number of hosts per million as well. (Annex II, Table 7).

Internet Access and Cost Issues for Education

Internet access costs are still high in most LAC countries, although prices have come down dramatically owing to the increase in competition among Internet Service Providers (ISP). For urban users, most ISPs offer a flat-rate pricing scheme. However, rural and suburban users are forced to pay for relatively

Table 10:
Number of Internet Hosts per 1 million Inhabitants in Selected LAC Countries



Source: International Telecommunications Union, "World Development Report," Geneva, 1997

costly long-distance calls. In addition to relatively costly services, residents in Latin America and the Caribbean often need to pay for local calls on a per-r e basis. There is less competition among ISPs i aller economies and low-income economies, and as a result, residents of those economies cannot take advantage of the Internet very easily. Internet access fees for selected LAC countries as of----are provided in (Annex II, 8)

In many countries, the cost of the Internet for end-users could be even lower. As the supply of international data communications capacity expands, the marginal price for additional capacity should continue to decline. For instance, George Gilder, the futurist, has stated in "Gilder's Law" that international bandwidth will continue to trip very 12 months. As international communicatio mpanies scramble to lay transatlantic fiber-optic cables, and wide bandwidth satellite schemes come on-line, the globe will have abundant data transmission and connectivity capacity. Over the next five years alone, at least US$30 billion will be spent to launch some 430 communication satellites into orbit--more satellites than have been launched to date (Table 11). These send-and-receive satellites offer opportunities to provide high bandwidth connectivity to people everywhere as never before.

With $29.8 billion worth of connectivity in the sky, and computer-chip prices falling daily, the opportunities for rural connectivity via satellite look bright for schools in Latin America.

While costs for Internet connectivity will continue to decline, particularly for urban schools, they are still expensive for most schools today. As noted in the previous chapters, schools face three major hurdles to Internet access: recurrent cost of connections, equipment cost, and adequate training resources. Equipping schools to connect to the Internet and cope with high recurrent costs of maintaining this connection represents one of the greatest challenges for many Latin American schools--particularly the poorest.

The real challenge for school connectivity in LAC is to extend the reach of the Internet infrastructure to rural areas, specifically to the poorest schools. Today, few options exist for schools in the most remote areas to obtain connectivity. Also, few rural schools have access to a local ISP. The small rate of return of ISPs for rural areas combined with poor telecommunications infrastructure account for their concentration in the urban areas. For end users Internet access outside of the large cities remains an expensive luxury. Factors such as expensive domestic long-distance calls, lack of technical support from Internet service

Table 11: Investments in Satellite Communications			
Company	US$ billion	Technology Type	Year of Operation
Skybridge	3.9	64 LEOs 1 GEO	2001
Teledesic	9.0	288 LEOs	2002
Celestri-Motorola	12.9	63 LEOs 1 GEO	2002
Expressway-Hughes	4.0	14 GEOs	2003
Total	**29.8**	**429**	

Source: The World Bank

providers, poor quality telephone lines and exchanges, and limited end user training contribute to the lack of rural connectivity.

Rural schools currently have several options for connectivity: they can connect to an ISP through either a domestic long-distance call or through a wireless option such as radio. A connection to an ISP over a domestic long-distance call is still an expensive option for schools. For instance, 30 hours of Internet access for a school outside of Asuncion can cost as much as four times more than a school with local number access. The radio option also presents problems. The major drawback to radio is the low bandwidth connectivity (maximum 9,600 bps). Web surfing is out of the question at this bandwidth. Another option is connectivity via satellite. With a Direct PC dish, schools would be able to receive information via satellite through high bandwidth connectivity, and then would send information through either a wireless or fixed-line solution.

One solution a number of countries (e.g., El Salvador) are pursuing to deal with imbalances between rural and urban access is the use of "telecenters." A telecentre is a community access structure where the fusion of telecommunications, information, multimedia, and computing functions help address a variety of community problems and needs. Most telecenters charge the community a nominal fee to use the facility. Support of the development of telecenters represents a shift from a concept of universal service to one of universal access.

For the education sector, the telecenter concept could be transformed into a community learning center in which the public school with Internet access would be open to the community for after-school functions. This would help a rural school meet the immediate problem of high recurrent costs for communications. For example, Jamaica has been extending its use of school-based computer centers--which now are being connected to networks--to members of their communities.

Options for Reducing Internet Costs

There are several technical and policy options for reducing Internet costs or charges to schools.

There are two technical options: a cache proxy and wireless connections to dial-up the net. Another technical option is a program such as Web Wacker, which a teacher can download entire web sites onto a hard disk to be viewed again, off-line. The key feature of both these options is the ability to save information. A cache proxy-server can give schools a viable technical option. Frequently accessed or pre-downloaded web pages can be accessed from the server's cache. The student who accesses this page does so off-line, without dialing out to the net. A wireless connection allows the school to bypass completely the existing telecommunications structure and its inherently high cost. The down side to wireless connectivity is the tradeoff between distance and bandwidth. Wireless equipment can also be expensive and difficult to maintain.

The policy options for reducing recurrent connectivity charges:

- Free installation of direct or leased lines to the schools and, where appropriate, waving the monthly exchange-line rental costs. This will help schools get connected, but does not address the underlying cost issue (someone has to pay telephone company costs; if not the school, then all other telephone company subscribers);

- A flat-rate charge for all schools dialing into an ISP regardless of where they are located. This option does not put too much excess capacity on the network, while allowing teachers and students to make the full use of Internet resources;

- A bulk rate negotiated between the Ministry of Education and the PTT for all schools on the network. A Ministry of Education could even negotiate a bulk-rate Internet connection for the entire education sector.

This is the time when the telecommunications industry can be most helpful to education. Most companies in LAC will be privatized within a year, including Brazil. Industry policies and cost structures are needed favoring the incorporation of technology into education. In general, governments should now focus on policy rather than operations, the latter usually the main emphasis.

In sum, a country with primitive infrastructure and low rate of investment in telecommunications should not plan for substantial Internet-based professional development or curriculum support. Similarly, a country that is rapidly deploying relatively high-end connectivity should consider how this can be used best (for example, to upgrade teacher skills) and what policies are needed to encourage and support the appropriate infrastructure. Education should not have to pay for the inefficiencies caused by monopolistic practices of currently or formerly owned stated enterprises.

Chapter V

National Strategies for Education Technology Use

Many governments stand at the threshold of the twenty-first century without clearly-defined plans and strategies about the use educational technology--but they are making major new investments anyway. Each country in LAC will need to prepare its own educational development plan and related investment strategy—but only after a careful assessment of basic education issues and how technology can be used to meet national goals and objectives within the planning framework.

Lessons about the effective incorporation of technologies for education can be gleaned from experience in LAC as well as from similar investments around the world. This section draws on these lessons and identifies generic issues that should be considered when developing national strategies. Options to consider in the selection and application of educational technology are then given to meet the *key challenges* identified in this report for Latin America and Caribbean countries; namely, *access, quality,* and *relevance.*

Developing a National Strategy

National strategies for technology in education can be considered as encompassing three general areas: *Education Policy and Goal-setting, Teaching and Learning, and Institutional Development and Capacity-building.*

Education Policy and Goal-setting

National and Regional Dimensions. Strategies for the introduction of technology in education should be linked to existing and planned programs for education improvement, identifying where technologies can make the greatest impact. Countries should: (a) be aware of educational developments in technology as they come on-stream and not wait for them to occur; and (b) build the capacity to pilot any promising education technology applications, acquire appropriate expertise, and develop locally-adapted applications.

The diversity among countries in Latin America and the Caribbean means that strategies will differ in design and resource requirements; hence, countries will need to carefully weigh the array of policy decisions they confront and the consider their respective capacities to deploy these occasionally expensive educational resources. This of course depends on the scope and cost of the technology used.

Extending Educational Opportunities. Governments now face the challenge of extending schooling beyond basic primary (which is usually six years) to include an additional three years or more. Some countries provide children a basic education of nine years (an extended primary), or are creating new opportunities at the junior-secondary and upper-secondary levels. Whichever system is deployed, governments are encountering major difficulties in providing secondary education--particularly for children in remote rural areas, where cost-per-student is generally much higher due to low teacher-student ratios and a limited number of qualified teachers.

Enriching the professional skills of teachers should be considered equally with direct instructional benefits to students from applied technologies.

Equity. The possibility exists that unless governments take steps to remedy unequal access to educational technology in schools, the gulf between the wealthy and the poor could widen considerably. Im-

proving the quality of basic education will also mean paying attention to achieving more equitable access to educational opportunities, of which technology will increasing become an integral part.

The most practical way to address this challenge is to target various groups of schools. For example, some governments--such as Chile, Jamaica, and Costa Rica--deliberately focused their programs on schools in poor and remote areas. Chile initially targeted its Enlaces program on the poor children in Temuco. Jamaica's Project 2000 selected clusters primary schools in remote rural regions.

If telecommunications infrastructure does not exist, a possible strategy would be for governments to undertake investments that target the education sector's access to the national telecommunications infrastructure. Until such basic infrastructure is provided (which may include electricity), schools could be at a great disadvantage in the potential to access the Internet.

Teaching and Learning

Building Basic Education Teaching Capacity. Countries typically cannot train teachers fast enough or well enough to meet demand. Results of efforts to upgrade teacher skills have been mixed in the past. The need to find new ways to do so is acute in the region-- especially allowing teachers to remain in classrooms while they are learning. On-line courses could be designed to help teachers adopt approaches adapted to their unique classroom environment. Television-based projects in both broadcast and cassette form also can enable teachers to observe and discuss new practices.

Additionally, distance learning strategies, especially transnational or "twinning," can help university faculty members earn higher degrees and remain current in their fields.

Higher and Continuing Education. Telecommunications and information technologies have the potential to increasing access, improve quality, and enhance productivity in higher and continuing education. In preparing national strategies for the use of technology in education, policy-makers and university officials should consider this option and develop plans and programs for the short- and medium-term.

Higher education institutions--whether conventional distance education or dual- mode--should exploit the full potential of computer networks--both the Internet and intranets--to design and test pedagogical methods and on-line environments, deliver instruction and learner-supported activities at a distance as well as to promote administrative efficiency and reduce costs.

There are two cooperative and inter-institutional initiatives outside LAC that successfully pursued these goals and should be considered as important examples: one is the National Learning Infrastructure Initiative (NLII) in the United States; and the other the Tele-Learning Network of Centers of Excellence in Canada.

Higher education institutions that have not developed a technology plan as part of their overall institutional development strategy should consider doing so. Technology planning is needed to identify basic infrastructure requirements, hardware and software applications, and overall investment priorities for teaching, research, administration, and community outreach. Strategies for efficient use of scarce capacity will need to be carefully planned.

Backbones for higher education and research institutes can be created and used by several institutions to share computing facilities. Higher education institutions that plan to undertake distance or distributed-learning will need to decide what type of technologies they will use to deliver instruction and to support student learning.

Faculty development is another area that should be considered relative to the faculties ability to use emerging technologies and in gauging teaching and research effectiveness, alongside other measures of faculty productivity. In addition, networking with international research programs benefits faculty and should be encouraged using emerging technologies.

Most LAC higher education institutions could become more involved in the education system as a whole. One way would be to provide technical and pedagogical support for the introduction of technology in primary and secondary education. Another would be to support the search for solutions to national educational problems on an ongoing basis. Faculties of Education are often isolated from faculties of communications or engineering, which have the knowledge and capacity to use technology. Encour-

aging a sustained and dynamic collaboration across professional fields and disciplines could improve the education sector of a country.

Higher education institutions clearly are uniquely positioned to provide technical support to primary and secondary school technology projects and should be encouraged to do so. While there is not a tradition of such cooperation in most countries, such partnerships are beginning to appear. The most well-known is that created under the *Enlaces* project in Chile, where higher education institutions have been contracted to provide teacher training, computer maintenance, and other services to a group of elementary and secondary schools in their vicinity. Another example is the collaboration between the Universidad de Puebla in Mexico and Puebla's secondary schools.

Strategies to create institutions similar to "community colleges" could be considered as well. These types of institutions have enjoyed dynamic and rapid growth in the United States, greatly expanding educational opportunity beyond secondary school. They offers alternatives to complete university education, and provide an alternative to facilitating transition and preparation from upper-secondary to employment and eventually complete university training and continuing education. Many offer technical training in computer sciences and other practical degrees. They also can respond much more quickly to market demand for new skills than can other higher education institutions with more traditional academic programs.

Institutional Development and Capacity-building

Decentralization and Administration. Administrative and institutional efficiency is essential for any sound educational system. Technology can play a vital role in many countries of the Caribbean and Latin America, since pedagogical reform generally has accompanied decentralization and other institutional reform initiatives.

Decentralization can lead to increased effectiveness of education systems, as each region is empowered to develop policies tailored to the needs of its student population. Decentralization could help in the tailoring of programs to differing educational environments.

Clearly, decentralization presents a major challenge. Many provinces may lack the expertise and experience in project planning, curriculum development, scheduling, administration, and building infrastructure. Communications technology could play a role both through distance education for administrators and planners and as a means to develop on-line professional communities for administrators, planners, and school principals. The Internet also disseminates large volumes of information about planning, curriculum activities, administrative techniques, pricing, and supplies.

Computerization engenders administrative efficiencies for cost control and accountability. One of Mexico's major computer initiatives was the automation of its largest single payroll--that of its public teachers. Recently, one Argentine province computerized its payroll and discovered a large number of teachers who were drawing salaries for more that one teaching assignment with overlapping (conflicting) hours. Computerizing student rosters increases the ability to evaluate student progress and assure universal coverage. At the local level, planning accounting, scheduling, and related tasks can be facilitated by computerization.

Data from the United States and Europe suggests that training should occupy at least 20 percent to 30 percent of any connectivity budget. Training is often under-funded, and yet is a critical aspect of a school's connectivity program. Various models have proven successful. Many training programs focus on training of trainers. The key to training trainers is identifying a leader from each school who can drive the program forward at the school level. Frequently an individual with vision can mount a campaign to get a school connected and remain connected. Another approach is to focus on support for teams who work cooperatively and receive continuing guidance--on-line or in person--from mentors as they attempt new tools and techniques.

To reduce costs for maintenance and technical support, secondary schools can become partners with post-secondary institutions, where students may have the level of technical expertise, and, more importantly, the time to get a network established and operational. A computer club at a university, for instance, may adopt a school and provide monthly visits, training, and perhaps a "help line" for the school when technical problems arise.

Chapter VI

The World Bank's Current and Future Roles

Overview

The World Bank is currently funding a total of 47 education projects in 27 countries in the LAC region, at a total cost of US$4 billion. Lending for education accounts for about 10 percent of total Bank lending to LAC countries.

Distance education and information technology components in education projects are increasing rapidly. There are now 25 operations underway in 16 countries, with an additional 9 projects in 6 countries planned for 1998/99. The Bank's innovative *World Links for Development* Program is operating in four countries: Brazil, Chile, Paraguay and Peru. *Info*Dev is also supporting a pilot school computerization project in Jamaica. The total amount of Bank lending for distance learning and information technology project components is estimated at nearly US$400 million. Information projects supporting distance education and technology in LAC are listed in Annex III, Tables 1 and 2.

The World Bank plans to expand its role in the areas of technology and education, knowledge development, and distance learning--in line with the goals of the Strategic Compact approved by its Board of Directors in 1997. To this end, it has taken measures to upgrade communications links among its field offices and to build up its video- conferencing and computer-networking capabilities to handle distance education for client countries and Bank mission staff. Several Bank offices currently have the ability to accommodate distance learning via video conferencing (128kb bandwidth), including: Mexico, Haiti, Peru, Bolivia, Guatemala, Venezuela, Argentina, Columbia, and Brazil. Field offices in Ecuador and Paraguay will be added to this list by September 1998.

The Bank's future role will focus on five key priorities:

Priority One: *To provide technical support to countries in defining sound plans and strategies for increasing the effective use of technology in education and training systems.*

The Bank will work with client countries in defining sound plans and strategies for incorporating technology into education and training that are adapted to each country's sector priorities. Such work would involve helping countries to define a vision statement and goals for the use of technology in support of overall sector development, as well as devising a plan of action for investment in programs and projects to achieve sector development objectives. To this end, the Bank also plans to issue a technical note on master planning for technology in education to help countries develop well-conceived plans and strategies.

Priority Two: *To develop knowledge that helps countries keep abreast of good practice in the use of technology in the effort to extend access and improve the quality and relevance of education at all levels.*

The Bank will help countries to obtain timely and relevant knowledge and information for the formulation, management, and assessment of education programs and projects involving distance education and technology. The Bank will soon make available to all countries via the Internet a new online resource of knowledge and information on distance learning. Known as Global Distance Learning Net (URL: http://www.globaldistancelearning.com/), this new on-line resource will enable policy- makers and program managers to obtain timely and practical information on

such themes as teaching and learning, technology use, and the management and financing of distance learning projects.

The Bank's *Education and Technology Series* will continue to focus on knowledge dissemination about the application of educational technologies. The series consists of technical notes intended for education policy-makers and specialists and covers a wide range of subjects of special interest to LAC countries such as: Chile's Learning Network, Training Teachers at a Distance, Interactive Radio Instruction, Cost Analysis of Information Technology Projects in Education, Chile and Costa Rica. A report on Mexico's *Telesecundaria* will be issued shortly and another on the Internet is under preparation.

The Information for Development Program (*info*Dev) of the World Bank is supporting initiatives that explore the use of information and communication technologies in development. *Info*Dev not only tests ideas but also disseminates lessons learned and best practices to the global community. *Info*Dev also has funded numerous education-related activities. In LAC, the Jamaica *Partnership for Technology in Basic Education* is being supported by *info*Dev. *Info*Dev funding also supports further development of the Jamaica Computer Society Education Foundation's *Jamaica 2000* and the *EDTECH 20/20* programs, geared to improve the quality of education through computer usage.

Projects are being added to *info*Dev's work program. The *Network for Innovation in Technology and Teacher Training* will establish an international network to facilitate the exchange of knowledge and the lessons learned of 10 developing countries (including LAC countries) that are developing innovative approaches in teacher training using computers and the Internet as a means to enhance the learning process in the classroom. *Proyecto Conexiones* is a Colombian initiative (see Chapter II) that will create and evaluate new learning environments using information and communications technologies to improve the quality and equity of basic education in urban and rural schools.

Priority Three: *To conduct training courses and build knowledge networks for client country specialists aimed at building capacity to design and manage distance education programs for teachers professional development.*

The Bank's Education Development Institute and the Education and Technology Team in the Human Development Network, will offer training courses for client country officials on the use of distance education for teacher training. The Bank is also funding through INFODEV a new research and dissemination program on innovation in the use of technology in teacher education. Several Latin American countries involved in innovative teacher education programs are expected to participate in the network. Lastly, the World Links for Development Program will continue its training courses on the use of the Internet. The Program has developed training materials to be used in Latin America that have helped teachers acquire the capacity to build their own web pages.

Priority Four: *To use distance education to help countries improve their development effectiveness. The Bank will help countries improve development effectiveness by building country capacity through distance education for sector staff and other officials.*

The Bank's Education Development Institute (EDI) is converting many of its courses for distance education delivery to reach more clients across the region. It offers complete courses as well as short policy dialogues on current topics, including pension reform and anti-corruption. In a joint program with the Human Development Network's Education and Technology Team, EDI is also assisting other groups in the Bank to broaden the reach of their training programs and support capacity-building efforts through the use of distance education. In addition, EDI is working with partner organizations throughout LAC, like Monterrey Institute of Technology and the University of the West Indies to deliver some of the EDI courses. Some joint course development is underway with these and other institutions. A schedule of policy dialogues is being created, with the first one a dialogue on issues related to gender and poverty, which will take place April 29 between the Bank's Washington Headquarters and four resident missions in the LAC region.

The World Bank's Resident Missions throughout LAC play important roles in the Bank's Distance Learning initiative, in that their interactive classrooms will become important access points for local development practitioners. Through the Resident Missions, clients also will participate in defining the distance

learning program by suggesting topics, requesting events and identifying presenters.

Priority Five: *To make use of traditional and new lending instruments to assist LAC countries to fund distance learning and education technology projects consistent with their educational goals.*

The Bank will use both traditional and new lending instruments for free-standing educational technology projects and for distance education or educational technology components in sector education projects. Lending for the development of national capabilities in the critical areas of instructional design and the adaptation of existing training materials and educational software will also be a focus.

The Bank has developed two new investment instruments that can be used by client countries to fund innovative distance learning and technology in education projects: *Learning and Innovation Loans (LIL) and Adaptable Program Loans (APL)*. The LILs can be used for experimenting and piloting initiatives to determine the best course of action before attempting larger operations. They are the lending instrument of choice when a full-scale investment project faces significant uncertainty because of one component critical for project success-a component that could instead be piloted under a Learning and Innovation Loan. APLs offer more flexibility to Bank clients than traditional sector investment loans. They consist of a sequence of smaller loans to support phased implementation of long-term development programs.

The Bank also will adopt measures to enable it to more quickly respond to requests from client countries for technical assistance in distance learning and technology in education projects. One such measure would be to expand its roster of technical specialists available on call to countries for short-term advisory assignments. The Bank has recently allocated an increase in the resources now available under INFODEV, which is designed to support innovative projects in informatics and telecommunications.

Annex I:

Cost Tables

Table 1a: Cost Model of Computer/Internet Instruction in a Large School in Latin America and the Caribbean

Cost Category	Item	Useful Life (Years)	Unit Description	No. of Units	Average Unit Cost	Investment Cost	Annualized or Annual Cost*	%
INVESTMENT*								
Facilities	Computer Room Renovation	15	Contract	1	$ 3,000	$ 3,000	$ 394	1
	Furniture	10	Set	1	2,500	2,500	407	1
	Wiring, Installation, Testing	10	Unit	1	2,500	2,500	407	1
	Contingency & Other	10	2% of Facil.	1		110	18	0
Subtotal Facilities						***8,110***	***1,226***	***3***
Equipment	Server, Hub, Network Cards	5	Unit	1	5,500	5,500	1,451	3
	Student Computers	5	Unit	20	1,000	20,000	5,276	12
	Instructor/Prodn Computer	5	Unit	1	1,700	1,700	448	1
	Peripherals	5	Set	1	2,000	2,000	528	1
	Air Conditioning	5	Unit	1	500	500	132	0
	Telecom Equipment	5	Computer	22	50	1,100	290	1
	Power Equipment	5	Set	1	2,200	2,200	580	1
	Security (Locks, etc.), Other	10	Computer	22	50	1,100	179	0
	Contingency	5	5% of Equip.	1		1,650	435	1
Subtotal Equipment						***35,750***	***9,320***	***21***
Software Site Licenses	Network Software	4	Set	1	2,000	2,000	631	1
	Educational (unbundled)	5	Computer	22	50	1,100	290	1
	Other (unbundled)	5	Set	1	500	500	132	0
Training (Upfront)	Lab Coord. & Instructors	7	Vendor Contract	1	15,000	15,000	3,081	7
Subtotal Software and Training						***18,600***	***4,134***	***9***
Total Investment						$ 54,350	$ 13,454	31
RECURRENT**								
Personnel	Prorated Cluster Support		Share	1	$ 1,000		$ 1,000	2
	Lab Coordinator Salaries		Annual Salary	1	4,200		4,200	10
	Other Personnel Services		Annual Average	1	5,700		5,700	13
Maintenance	Equipment		Computer-Year	22	75		1,650	4
	Software		Computer-Year	22	30		660	1
	Routine		Year	1	250		250	1
Insurance & Theft	Facilities and Equipment		5% purch. pr.+ $1,000	1	3,193		3,193	7
Training	Lab Coord. & Instructors		Annual Average	1	10,000		10,000	23
Utilities			Year	1	500		500	1
Telecommunications	Telephone		Year	1	2,000		2,000	5
	Internet Provider		Year	1	500		500	1
Computer Supplies			Year	1	2,000		2,000	5
Total Recurrent							$ 30,653	69
Total							$ 44,107	100

COST PER STUDENT (School with 600 Students - Averaging 2 Hours Computer Contact Per Week With 2 Students Per Computer; Lab assumed to be used 30 hours per week)	Recurrent Cost	Total Cost
	$ 51	[illegible]

* Costs of 20-station computer laboratory estimated for a middle income Latin American and Caribbean country based on actual data for Chile, Jamaica and Belize, adjusted for generality, technology changes and inflation. International equipment prices are generally assumed. Where applicable, therefore, local premia, import duties and local taxes would have to be added.

** Long-lived training, facilities and equipment costs are annualized, i.e., presented as average annual costs, using a 10% discount rate and with varying useful lives. Depreciation is included.

*** Does not include marginal costs for classroom teacher time and computer room space, which are assumed to be zero, since the focus of the analsysis is on affordability rather than cost-effectiveness.

Source: The World Bank

Table 1b: Cost Model of Computer/Internet Instruction in Latin American and the Caribbean, Small Rural School* (US$)

Cost Category	Item	Useful Life (Years)	Unit Description	No. of Units	Average Unit Cost	Investment Cost	Annualized or Annual Cost**	%
INVESTMENT*								
Facilities	Computer Room Renovation	15	Contract	1	$ 1,500	$ 1,500	$ 197	1
	Furniture	10	Set	6	120	$ 720	117	1
	Wiring, Installation, Testing	10	Unit	1	1,000	$ 1,000	163	1
	Contingency & Other	10	5% of Facil.	1		111	18	0
Subtotal Facilities						***3,331***	***495***	***3***
Equipment	Server, Hub, Network Cards	5	Unit	1	3,500	3,500	923	6
	Student Computers	5	Unit	5	1,000	5,000	1,319	9
	Instructor/Prodn Computer	5	Unit	-	-	-	-	-
	Telecom. Equip.(e.g., modems)	5	Computer	6	50	300	79	1
	Peripherals	5	Set	1	700	700	185	1
	Air Conditioning	5	Unit	-	-	-	-	-
	Power Equipment	5	Computer	6	150	900	237	2
	Security (Locks, etc.), Other	10	Computer	6	50	300	49	0
	Contingency	5	5% of Equip.	1		520	137	1
Subtotal Equipment						***11,220***	***2,929***	***20***
Software Site Licenses	Network Software	4	Computer	6	100	600	189	1
	Educational (unbundled)	5	Computer	6	50	300	79	1
	Other (unbundled)	5	Set	1	200	200	53	0
Training (Upfront) #	Lead & Oth. Teach, Others	5	Person-hours	300	10	3,000	791	5
Subtotal Software and Training						***4,100***	***1,113***	***8***
Total Investment						**$ 15,320**	**$ 4,042**	27
RECURRENT**								
Personnel	Prorated Cluster Support		Annual Share	1	$ 1,000		$ 1,000	7
	Lead Teacher Add'l Salary		Year	1	500		500	3
	Other Personnel Services		Annual Average	1	500		500	3
Maintenance	Equipment		Computer	6	150		900	6
	Software		Computer	6	30		180	1
	Routine		Year	-	-		-	-
Insurance & Theft	Facilities and Equipment		5% Cost	1	728		728	5
ing #	Lab Coord. & Instructors		Hours	480	10		4,800	33
es			Computer	10	20		200	1
communications	Telephone		Year	1	1,500		1,500	10
	Internet Service Provider		Year	1	800		800	5
Computer Supplies			Computer	6	100		600	4
Total Recurrent							**$ 10,708**	73
Total							**$ 14,750**	100

COST PER STUDENT	Recurrent Cost	Total Cost
(School with 150 Students - Averaging 2 Hours Computer Contact Per Week		
With 2 Students Per Computer, Lab assumed to be used 30 hours per week)	$ 71	$ 98

* Costs of computer laboratory estimated for a small school in a middle income Latin American and Caribbean country based on actual data for Chile, Jamaica and Belize, adjusted for generality, technology changes and inflation. International equipment prices are generally assumed. Where applicable, therefore, local premia, import duties and local taxes would have to be added.

** Long-lived training, facilities and equipment costs are annualized, i.e., presented as average annual costs, using a 10% discount rate and with varying useful lives. Depreciation is included.

*** Does not include marginal costs for classroom teacher time and computer room space, which are assumed to be zero, since the focus of the analysis is on affordability rather than cost-effectiveness. If extras space is contructed, this should be included under facilities.

\# aining estimated @ 1 person trained per 25 students and a per-trainee average of 50 hours of upfront training plus 80 hours per year.

Table 2: Costs of IRI Programs in Primary Schools—Typical Large-scale Program

Program Assumptions:

Instructional Programs	Students	Student-Class Ratio	Participating Classes	Teachers Per Class @ 1.1	Participating Classes Per School	Schools	Radio Markets/2	Number of Schools Per Radio Market	Opportunity Cost of Finance	Life of Programs (Years)
1	1,000,000	30	33,333	36,667	4	8,333	50	167	10%	8

Cost Item	Unit	Investment Amount Per Unit	Annual or Annualized Fixed Cost/3	Annual or Annualized Variable Cost Per Unit/3	Number of Units At Given Scale	Annual Variable Cost	Annual Total Cost At Given Scale	Annual Cost Per Student	%
Investment Cost									
Scripts	Program	500,000		93,722	1	93,722	93,722	0.09	3
Program Production	Program	1,000,000		187,444	1	187,444	187,444	0.19	6
Printed Materials, Preparation	Program	250,000		46,861	1	46,861	46,861	0.05	1
Start-Up Costs	Fixed	500,000	93,722				93,722	0.09	3
(Incl. Upfront	Program	250,000		46,861	1	46,861	46,861	0.05	1
Training)	Class	75.00		14.06	33,333	468,610	468,610	0.47	14
Total Investment Cost /4		5,000,000	93,722			843,498	937,220	0.94	29
Recurrent Cost									
Air Time, Other Broadcasting	Radio Market			10,000	50	500,000	500,000	0.50	15
Radios (3 Year Life)	Class	30		12.06	33,333	402,115	402,115	0.40	12
Radio Repair and Batteries	Class			3.50	33,333	116,667	116,667	0.12	4
Prod'n Print Materials, Cassettes	Student			0.50	1,000,000	500,000	500,000	0.50	15
Distribution of Materials	Student			0.10	1,000,000	100,000	100,000	0.10	3
Training & Training Supplies	Teacher			10.00	36,667	366,667	366,667	0.37	11
Continuing Program Devel.	Part Fixed, Part Per Student		5,000	0.03	1,000,000	25,000	30,000	0.03	1
Administrative Expense	Part Fixed, Part Per Student		40,000	0.20	1,000,000	200,000	240,000	0.24	7
Other Fixed Expense	Part Fixed, Part Per Student		5,000	0.03	1,000,000	25,000	30,000	0.03	1
Other Variable Expense	Class			1.00	33,333	33,333	33,333	0.03	1
Total Recurrent Cost			50,000			2,268,781	2,318,781	2.32	71
Total Investment and Recurrent Cost		5,000,000	143,722			3,112,280	3,256,002	3.26	100

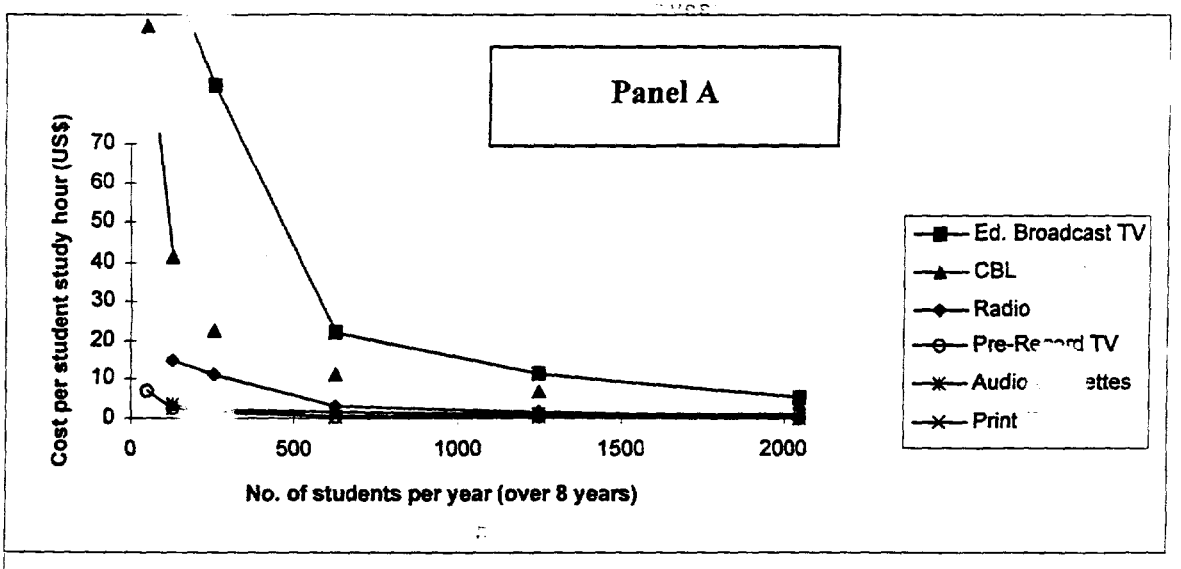
Source: World Bank

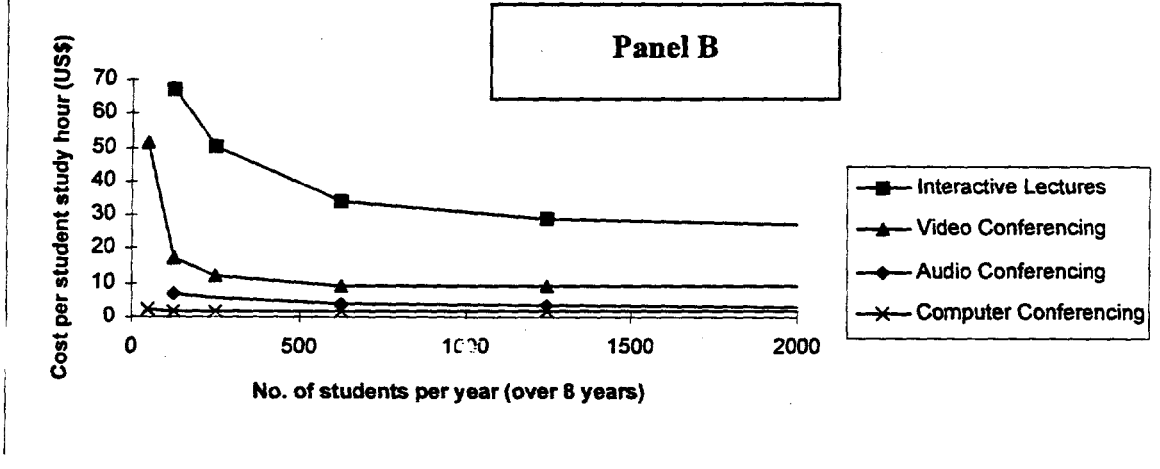
/1 Based on actual costs from Bolivia, Dominican Republic, Honduras, Lesotho, South Africa and Venezuela, adjusted for generality and inflation to 1997.

/2 Air time cost assumed to relate to the number of radio markets. The number of radio markets assumed to be between 7 and 100.

/3 Investment costs are annualized according to the technique described in Appendix 1.

Table 3: Economies to Scale in Distance Learning Technologies





Source: Bates (1995), with axes extended. Data are estimates mainly for the United Kingdom.

Note: These graphs are largely based on data from the United Kingdom's Open University; thus the per student cost estimates are not directly applicable to distance learning programs in LAC. Panel A shows the strong economies to scale of course presentation technologies. Panel B shows the corresponding lack of economies to scale in learner support activities.

Table 4: Calculations of Potential Discretionary Spending for Technology in Selected LAC and Other Developing Countries (US$)

Country	(1) GNP Per Capita	(2) Per-Student Annual Public Expenditure on Primary Education	(3) Per-Student Annual Public Expenditure on Secondary Education	(4) Per-Student Annual Public Expenditure on Higher Education	(5) Potential Discretionary Spending = 20% of Expenditure: Primary: 20% of Col. (2)	(6) Potential Discretionary Spending = 20% of Expenditure: Secondary: 20% of Col. (3)	(7) Potential Discretionary Spending = 20% of Expenditure: Higher: 20% of Col. (4)
Latin America and the Caribbean							
Guatemala	1,060	66	81		13	16	
Dominican Republic	1,260	36	70		7	14	
Paraguay	1,540	121	181	919	24	36	184
Tunisia		204	426	1,390	41	85	278
Costa Rica	2,230	235	419		47	84	
Chile	3,190	273	238	745	55	48	149
Mexico	3,800	297	517	1,402	59	103	280
Average	*2,180*	*176*	*276*	*1,114*	*35*	*55*	*223*
Selected Other Developing Countries							
China	490	27	71	395	5	14	79
Mauritania	500	64	366	1,004	13	73	201
Indonesia	810		51	101		10	20
Macedonia, FYR of	820	182	235	597	36	47	119
Romania	1,200	260	90	560	52	18	112
Tunisia	1,680	226	411	1,771	45	82	354
Poland	2,240	330	426	1,010	66	85	202
Malaysia	3,090	336	655	2,707	67	131	541
Average	*1,354*	*204*	*288*	*1,018*	*41*	*58*	*204*

Basic Source of Data: UNESCO

1 The country averages in this table do not have statistical validity as regional averages, since the inclusion of countries is determined

Annex II:

Telecommunications Tables

Table 1: Teledensity in LAC Countries - Number of Telephone Main Lines per 100 Inhabitants					
Country	Largest city	National average	Outside th largest city	Largest city / Outside the largest city	Largest city / National average
Haiti	2.3	**0.8**	0.6	4.0	2.8
Nicaragua	5.5	**2.3**	1.2	4.6	2.4
Guatemala	11.7	**2.7**	0.7	16.5	4.3
Honduras	10.2	**2.9**	1.6	6.4	3.5
Paraguay	11.0	**3.4**	1.5	7.3	3.3
Bolivia	8.8	**4.7**	4.0	2.2	1.9
Peru	10.5	**4.7**	2.0	5.1	2.2
El Salvador	13.8	**5.3**	2.0	6.9	2.6
Guyana	10.1	**5.3**	3.4	2.9	1.9
Ecuador	18.9	**6.5**	4.1	4.6	2.9
Dominican Republic	15.0	**7.3**	4.3	3.5	2.1
Brazil	12.7	**7.5**	6.9	1.8	1.7
Mexico	16.2	**9.6**	8.3	1.9	1.7
Colombia	22.7	**10.0**	7.4	3.1	2.3
Venezuela	28.5	**11.1**	8.6	3.3	2.6
Panama	21.4	**11.4**	5.8	3.7	1.9
Jamaica	16.6	**11.6**	9.9	1.7	1.4
Suriname	22.5	**13.0**	3.7	6.0	1.7
Chile	19.2	**13.2**	9.5	2.0	1.5
Belize	29.2	**13.4**	9.4	3.1	2.2
Argentina	22.4	**16.0**	12.5	1.8	1.4
Trinidad and Tobago	16.8	**16.0**	13.3	1.3	1.0
Costa Rica	17.4	**16.4**	15.8	1.1	1.1
St. Lucia	19.2	**18.4**	18.0	1.1	1.0
Uruguay	29.9	**19.6**	12.1	2.5	1.5
Dominica	68.8	**25.1**	19.5	3.5	2.7
Grenada	39.5	**25.5**	14.0	2.8	1.6
Bahamas, The	33.0	**27.6**	19.9	1.7	1.2
Antigua and Barbuda	31.7	**30.3**	28.0	1.1	1.0
Barbados	39.9	**34.5**	27.7	1.4	1.2

Source: International Telecommunications Union, *World Telecommunication Indicators Database*, Geneva, 1997.

Table 2:
Number of Radio/TV receivers per 100 inhabitants Latin America and the Caribbean

Country	Radio	TV (including Cable and Satellite)	Cable TV	Satellite TV
Antigua and Barbuda	42.4	40.9		
Argentina	65.3	34.7	11.6	
Bahamas, The	51.3	23.3		
Barbados	87.0	28.7		
Belize	28.1	16.7		
Bolivia	62.1	20.2	0.3	
Brazil	36.8	27.8	0.5	
Chile	32.8	28.0	4.0	
Colombia	15.2	18.8	0.3	
Costa Rica	24.2	22.0	1.6	
Dominica	59.2	14.1	12.7	0.03
Dominican Republic	16.4	8.7	1.6	
Ecuador	30.6	14.8	0.4	
El Salvador	41.4	24.1	0.5	
Grenada	59.3	15.9		
Guatemala	6.1	12.2	1.7	
Guyana	47.3	4.2		
Haiti	5.9	0.5		
Honduras	10.8	8.0	0.8	0.01
Jamaica	76.4	30.6	5.4	1.82
Mexico	24.5	19.2	1.3	
Nicaragua	25.1	17.0	0.5	0.01
Panama	21.2	22.9	1.1	
Paraguay	15.7	14.4	0.7	
Peru	[illegible].2	10.0	0.2	
St. Kitts and Nevis	65.9	24.4		
St. Lucia	62.7	30.1	4.2	0.03
Suriname	73.2	19.5		0.03
Trinidad and Tobago	47.9	31.8		
Uruguay	59.4	30.5	2.2	
Venezuela	40.7	18.0	1.0	

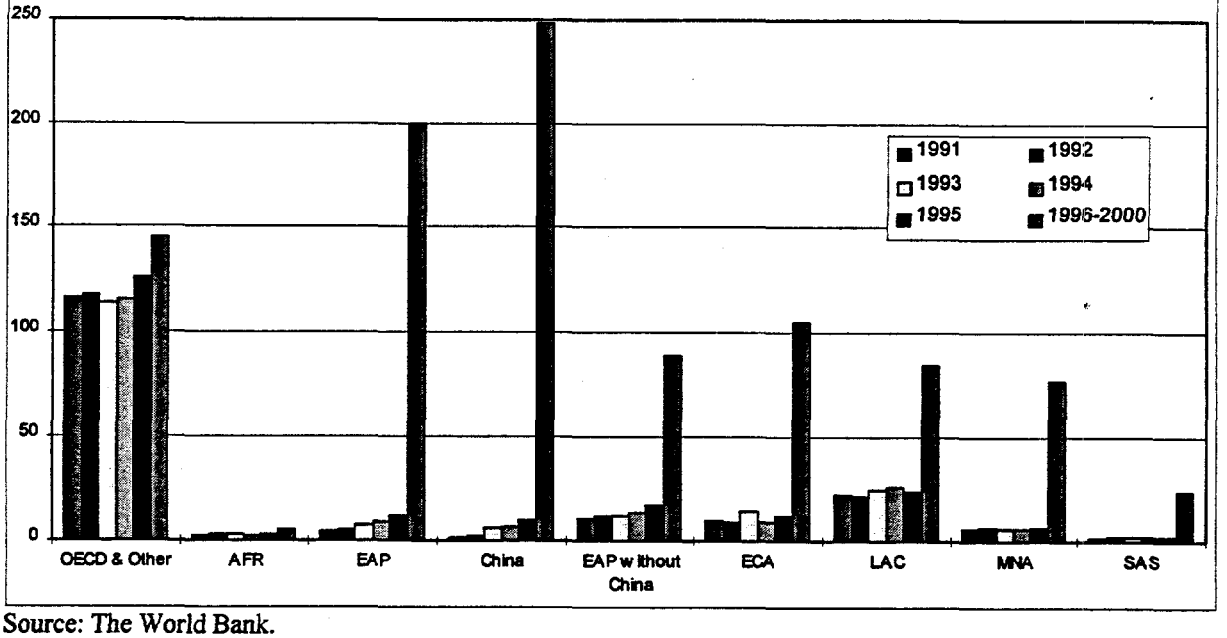
Source: International Telecommunications Union, *World Telecommunication Indicators Database*, Geneva, 1997.

Table 3: Costs for Telephone Services Selected Countries in Latin America and the Caribbean (US$ equivalent)

Country	Residential Connection Fee	Business Connection Fee	Residential Line Monthly Subscription	Business Line Monthly Subscription	Cost of 3 minutes local call
Argentina	500	750	8	30	0.08
Barbados	49	49	14	41	
Belize	45	45	40	5	0.08
Brazil	1,217		0	6	0.02
Colombia	357	552			0.01
Dominica	21	21	3	8	
Ecuador	167	397	1	4	0.01
El Salvador	343	343	3	6	0.02
Guatemala	258	258	1	2	0.03
Honduras	30	61	2	4	0.06
Mexico	279	484	6	14	0.08
Nicaragua	33	33	7	7	0.04
Panama	10	20	10	20	0.00
Paraguay	530	530	3	6	0.07
Peru	504	901	9	16	0.10
St. Lucia	46		9	10	0.30
Trinidad and Tobago	12	24	5	29	0.04
Uruguay	384	593	9	21	0.06
Venezuela		63	3	18	0.06

Source: International Telecommunications Union. Telecommunication Development Report, Geneva, 1996-1997.

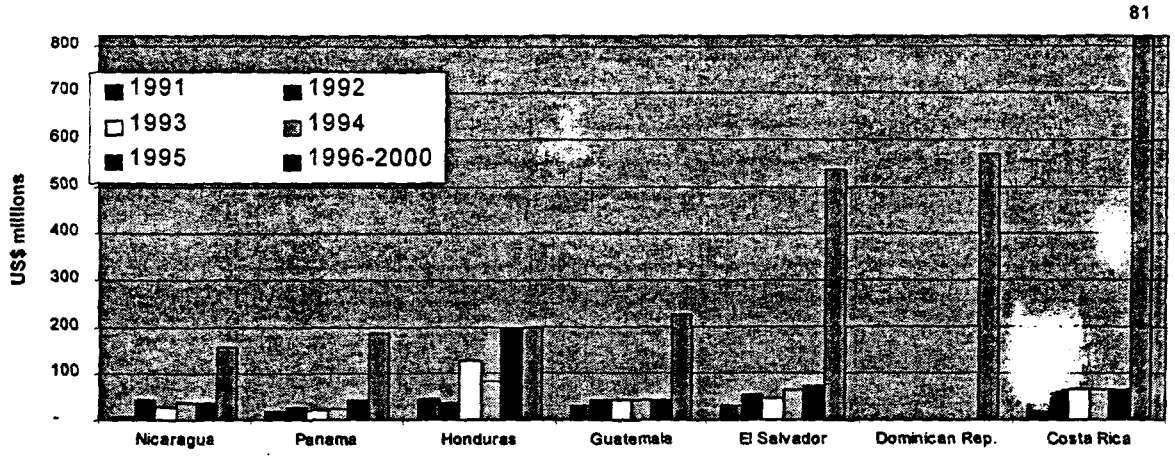
Table 4: Trends in Annual Telecommunications Investment by Region (US$ million)



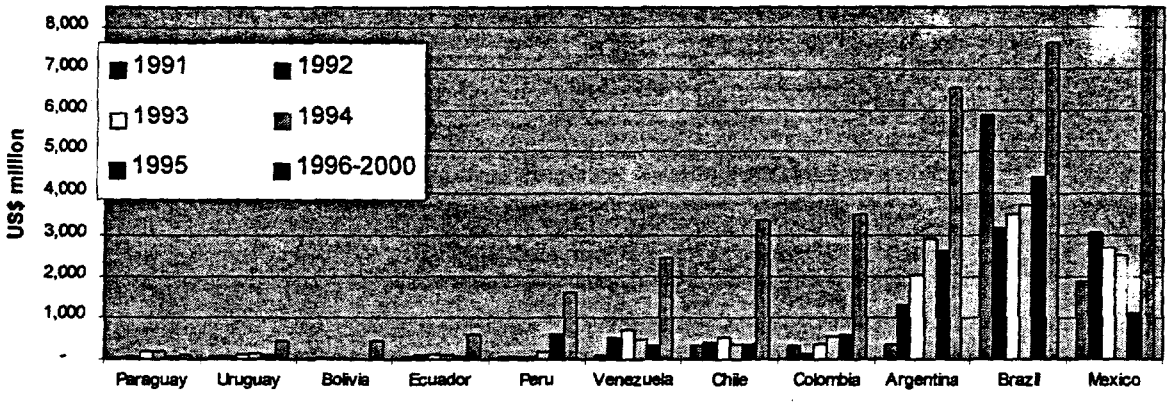
Source: The World Bank.

Table 5: Trends in Annual Telecommunications Investment in Central and South America and the Caribbean

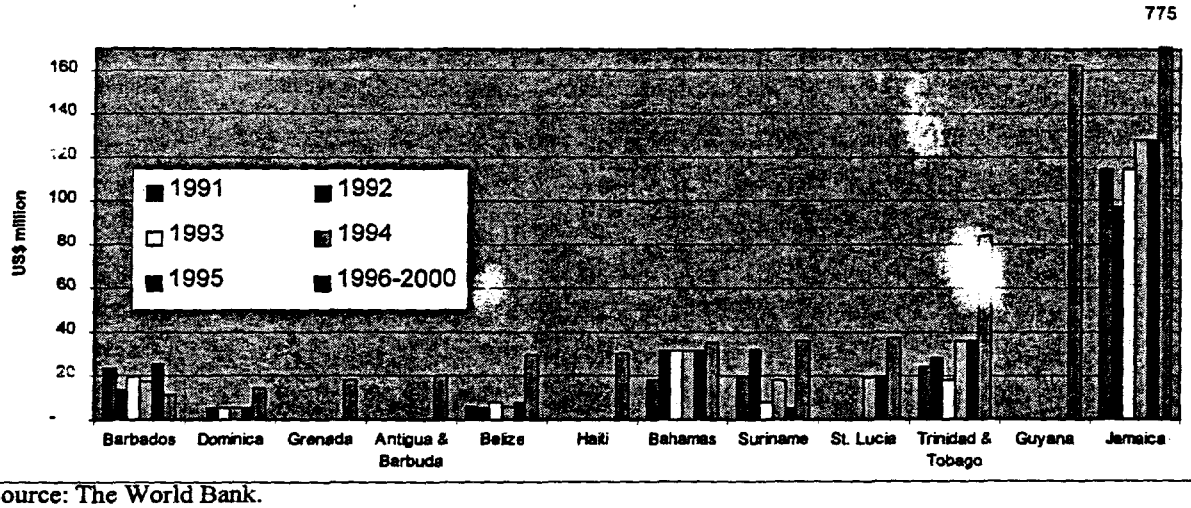
Trends in Annual Telecommunications Investment in Central America



Trends in Annual Telecommunications Investment in South America

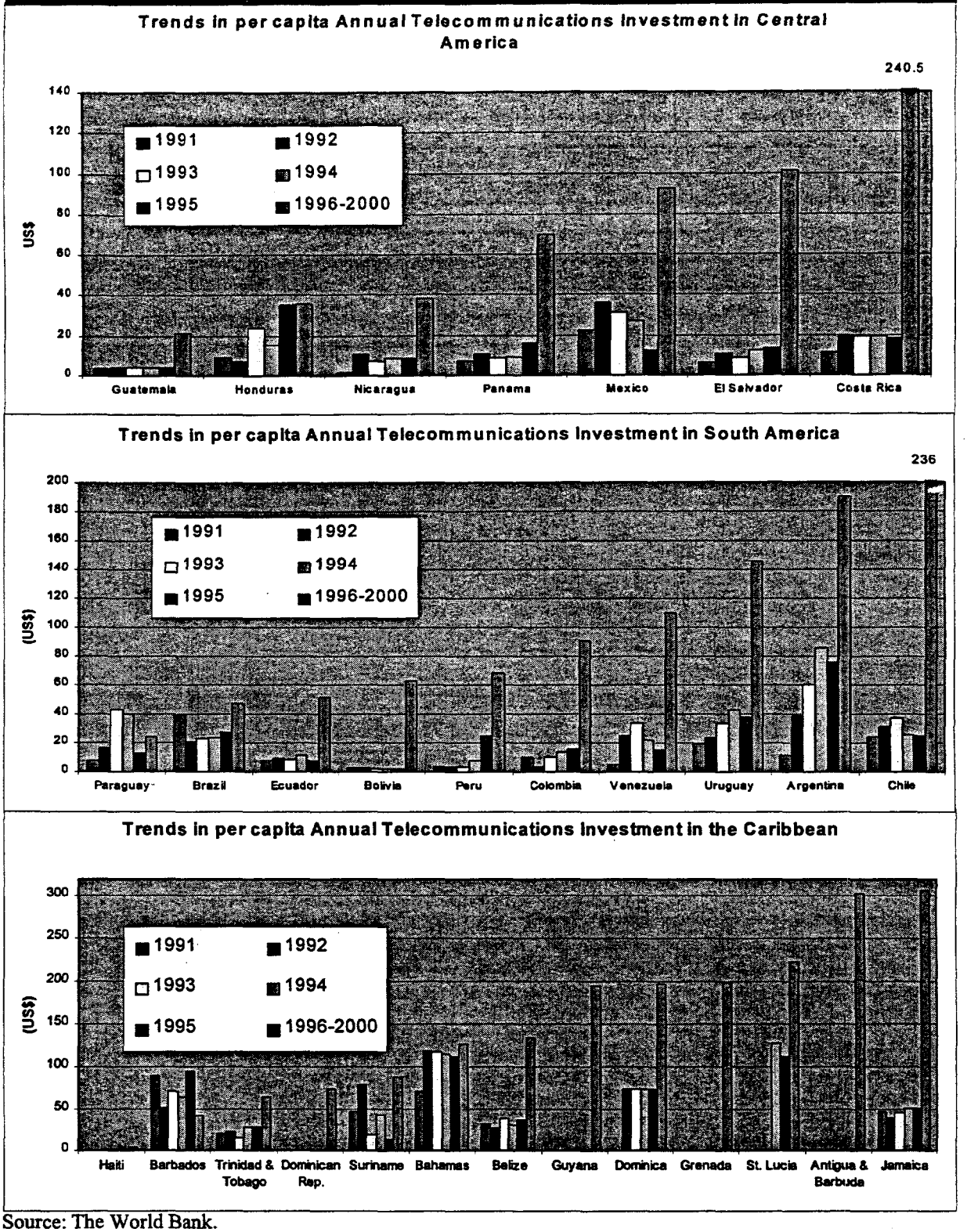


Trends in Annual Telecommunications Investment in the Caribbean



Source: The World Bank.

Table 6: Annual Per Capita Investment in Telecommunications in Central and South America and the Caribbean (US$ million)



Source: The World Bank.

Table 7: Number of Internet Hosts per 1 million Inhabitants in Latin America and the Caribbean

Country	1991	1992	1993	1994	1995
Antigua and Barbuda	-	-	-	-	2,424.2
Argentina	-	3.2	29.6	36.9	153.6
Bahamas	-	-	-	-	989.2
Barbados	-	-	-	-	7.7
Belize	-	-	-	-	4.6
Bolivia	-	-	[illegible]	-	[illegible]
Brazil	2.0	12.4	23.[illegible]	37.0	12.[illegible]
Chile	-	25.7	99.3	217.5	632.4
Colombia	-	-	-	29.6	5[illegible]
Costa Rica	-	0.9	66.5	241.5	43[illegible]
Dominica	-	-	-	-	521.1
Dominican Rep.	-	-	-	-	17.8
Ecuador	-	4.2	13.5	29.0	43.9
El Salvador	-	-	-	-	4.3
Grenada	-	-	-	-	-
Guatemala	-	-	-	-	2.5
Guyana	-	-	-	-	-
Haiti	-	-	-	-	-
Honduras	-	-	-	-	-
Jamaica				30.4	65.0
Mexico	3.4	14.6	41.1	72.5	150.1
Nicaragua				11.5	34.2
Panama				6.6	55.6
Paraguay	-	-	-	-	-
Peru				7.3	34.5
Saint Lucia	-	-	-	-	6.0
Suriname	-	-	-	-	-
Trinidad and Tobago	-	-	-	-	42.1
Uruguay				54.3	345.9
Venezuela	-	5.5	17.8	24.4	52.4

Source: The World Bank

Table 8: Internet Fees in Selected LAC Countries			
Brazil	1	Monthly Payment	$28 for 130 hours
	2	Monthly Payment	$33 for unlimited time
	3	Monthly Payment	$40 for 20 hours, $2/hour for additional hour
	4	Installation Fee	$9
		Monthly Payment	$29 unlimited time
	5	Monthly Payment	$75 for 50 hours, $2/hour for additional hour
		Monthly Payment	$35 for 35 hours, $1/hour for additional hour
	6	Installation Fee	$34
		Monthly Payment	$39 unlimited time
Chile	1	Monthly Payment	$19.50 unlimited
	2	Monthly Payment	$39 unlimited time
Colombia		Monthly Payment	$30 unlimited
Dominican Republic		Installation Fee	$13
		Monthly Payment	$27 for 60 hours, $0.50/hour for additional hour
Guatemala		Monthly Payment	$20 for 25 hours; $30 for 35 hours; $40 for unlimited time
Honduras		Monthly Payment	$60 unlimited time
Jamaica	1	Hourly Payment	0-10 hours, @2.20/hour 10-20 hours, @1.90/hour 20+ hours, $1.70/hour
	2	Installation Fee	$50
		Monthly Payment	$33 for 20 hours; $2/hour for additional hours
Nicaragua	1	Installation Fee	$42
		Monthly Payment	$26 unlimited time
	2	Monthly Payment	$30 unlimited time
Paraguay		Installation Fee	$30
		Monthly Payment	$30 for 30 hours, $40 for 40 hours, $50 for 120 hours; $1-3/hour for additional hours
Trinidad and Tobago		Monthly Payment	$100 for 100 hours; $5/hour for additional hours
Venezuela		Monthly Payment	$67 for additional hours

Source: Codetel Internet Business Group, cited in *Miami Hearld*, "Latin America, Caribbean Internet Rates," July 22, 1997, p. 2A.

Annex III:

World Bank's Education Projects

Table 1 Projects Supporting Distance Education Initiatives in LAC countries as of 3/31/98

Table 2 Projects Supporting the Use of Educational Technologies in LAC Region as of 3/31/98

Table 1:
Projects S[illegible]ng Distance Education Initiatives in LAC countri[illegible] 3/31/98

Country	Loan	Cost Information					Level				Outcomes						Technology							
		FY Approved	Loan Amount (US$ millions)	Base cost of DE component	Total project costs (US$ million)	% of base cost	Primary	Secondary	Tertiary	Nonformal	Access	Quality	Focus on Teachers	Cost Reduction	DE Institutional Strengthen	Focus on Remote Areas	Print	Radio/Audio	TV/Video	Computers	Internet/WWW	Videoconferencing	Face-to-Face Instruction	Other
Argentina	Decentralization and Improvement of Secondary Education and Polymodal Education Development Project	95	115.5	35.7	164.4	21		✓				■	■				✓						✓	
Belize	Primary Education Development	92	7.13	2.08	10.56	19.7	✓					■	■	■	■		✓						✓	
Bolivia	Education Reform Project	95	40.0	10.4	158.5	6.5	✓					■	■			■	✓						✓	
Brazil	Innovations in Basic Education Project	91	245	91.5	524.8	17.4	✓					■	■				✓		✓				✓	
Brazil	Parana Basic Education Quality Project	94	96.0	24.9	179.1	14	✓					■	■				✓		✓				✓	
Chile	Primary Education Improvement Project	92	170.0	63.5	199.2	3	✓					■	■				✓	✓	✓	✓	✓			
Costa Rica	Basic Education Rehabilitation	92	23.0	1.5	53.8	3	✓					■				■		✓		✓				
Dominican Republic	Second Basic Education Development Project	[illegible]	37.0	7.9	[illegible]	8.7	✓					■	■				✓	✓					✓	
El Salvador	Secondary Education	98	58.0	2.0				✓			■	■						✓	✓				✓	
Grenada	Basic Education Reform Project	96	3.8	2.17	8.5	25.5	✓					■	■				✓						✓	
Honduras	Basic Education Project	95	30.0	1.6	49.2	3.3	✓					■	■			■	✓						✓	
Jamaica	Reform of Secondary Education Project	93	32.0	1.2	32.5	3.7		✓				■	■				✓						✓	
Mexico	Primary Education Project	92	250.0	13	305.0	4.2	✓					■	■		■	■	✓	✓	✓					
Mexico	Initial Education	93	80.0	.8	102.8	0.7				✓	■	■				■	✓	✓					✓	
Panama	Basic Education Project	96	35	.39	51.7	0.8				✓	■	■		■		■	✓	✓					✓	
Venezuela	Basic Education Project	94	89.4	9.09	155.2	5.9	✓					■					✓	✓						

Table 2:
Projects Supporting the Use of Educational Technologies in LAC Region as of 3/31/98

Country	Loan	Cost Information					Level				Outcomes						Technology							
		FY Approved	Loan Amount (US$ millions)	Cost of Tech. Component	Total project costs (US$ million)	% of base cost	Primary	Secondary	Tertiary	Nonformal	Access	Quality	Focus on Teachers	Cost Reduction	DE Institutional Strengthen	Focus on Remote Areas	Print	Radio/Audio	TV/Video	Computers	Internet/WWW	Videoconferencing	Face-to-Face Instruction	Other
Argentina	Decentralization and Improvement of Secondary Education Project	95	190.0	17.6	222.9			✓				■						✓		✓				
Argentina	Decentralization and Improvement of Secondary Education and Polymodal Education Development Project	95	115.5	37.5	164.4	23		✓				■						✓	✓	✓			✓	✓
Brazil	Parana Basic Education Quality Project	94	96.0	31.2	179.1	15.7	✓					■							✓					
Chile	Primary Education Improvement Project	92	170.0	6.36	199.2	3.2	✓					■								✓	✓			
Chile	Secondary Education Quality Improvement Project	95	35.0	29.85	172.59	17.3		✓				■				■				✓	✓			
Colombia	Antioquia Education	98	40.0	33.2	80.0	48.8		✓				■								✓	✓			
El Salvador	Secondary Education Project	98	58.0	17.3				✓			■	■	■			■		✓	✓	✓	✓			
Jamaica	Partnership for Technology in Basic Education	97					✓	✓				■								✓	✓			
Trinidad and Tobago	Basic Education Project	96	51	12.28	102.69	12	✓					■	■							✓				

Annex IV:

Selected Educational Websites: Latin America and the Caribbean

1.<http://www.anayamultimedia.es/>
ANAYA.- Spanish site with a list of multimedia resources and books.
Here you can access the "Club de los Chavales", the stories of six young people from different countries who utilize the Internet as a communication means.

2. <http://www.enlaces.ufro.cl/Recursos>
Resource Center of the Educational Informatics Institute, Universidad de La Frontera, Temuco, Chile.

3. <http://wwwprof.uniandes.edu.co/~ludomati/docums.html>
"Ludomatica" project in Colombia, and information regarding collaborative learning in virtual environments.

4. <http://www.arrakis.es/~mapelo/indice.htm>
Educational resources and links under subject areas and curriculum courses.

5. <http://www.wp.com/89444/edu/en_caste.html>
"The School", with links to documents, list of educational links, teachers' forums, etc.

6. <http://ww2.grn.es/josepss/maest2.htm>
"The Teachers' Web", with links to resources, forums and schools.

7. <http://www.civila.com/educacion/foro-profesores>
As part of the Virtual School, they have the Latin Professors Forum. Interesting web site to meet colleagues from the region and share ideas about topics of professional interest and teaching collaboration.

8. <http://www.civila.com/educacion>
"The Virtual School". The purpose of this site is to promote the work and exchange between teachers and students in Latin America. They have links to some of the schools' web pages as well as educational publications.

9. <http://www.pitt.edu/~rmvega/EdDev_journals.html>
Links to electronic educational magazines as well as documents on educational informatics and educational development (some of the magazines are in English)

10. UNESCO
<http://www.education.unesco.org> Main page
<http://www.education.unesco.org:80/educnews/new_idx.htm> Web page exclusively for educational events
<http://www.education.unesco.org.br> Office in Brasilia, Brazil
<http://www.education.unesco.org.uy:80> Office in Montevideo, Uruguay

<http://www.education.unesco.org:80/orea[illegible]lex.html> Office in Santiago, Chile

11. Educational systems acco[illegible]g to UN[illegible]
<http://unescostat.unesco.org/yearbook/ybframe.htm>

12. Some curious problems for the mathematics class
<http://algebra.us.es/~aranda/01_pract.htm>

13. Teachers in the Network. Purpose: To make known educational web sites and foster the contact and debate among teachers.(from Asturias, Spain)
<http://www.airastur.es/jimena/profes2.htm>

14. Quipunet, Peru. It has links to diverse sites of interest to teachers.
<http://sirio.dit.upm.es/~csanchez/Proyecto_Peru.html>

15. Universidad Federal de Sao Paulo, Brazil -- Molecular Biology -- Educational Program in Multimedia in the Internet.
<http://www.epm.br/ge/biomol/BIOMOL.HTM>

16. Universidad Federal de Sao Paulo, Brazil -- Genetic Engineering --
<http://www.epm.br/ge/engenet/htm/ENGENE.HTM>

17. <http://www.copesa.cl/icarito>
"Icarito Interactivo": Electronic magazine with materials for classes on Spanish, Literature, Math, History, Geography, Natural Sciences, Culture, Astronomy, etc. Resources for both students and teachers.

18. <http://www.nodo50.ix.apc.org/aedenat/ener_sol.htm>
Information about thermal energy and its use.

19. <http://www.nodo50.ix.apc.org/aedenat/ener_fot.htm>
Information about electric energy generation from solar energy.

20. <http://www.weirdrichard.com/spanish/solaren.htm>
Description about some educational applications on solar energy.

21. <http://www.fem.unicamp.br/~jannuzzi/solar.htm>
Web page in Portuguese that presents several ideas on why the use of solar energy is not developed.

22. <http://www.iztapalapa.nam.mx/iztapala.www/cemanahu.ac/numero05/ecotip.htm>
Site with a variety of information about solar energy.

23. <http://www.cab.cnea.edu.ar/difusion/res_03.htm>
Information about the lack o[illegible]tiatives to develop methods for a greater use of solar energy.

24. <http://www.darwin.futuro.usp.br/energía>
Web page in Portuguese with general information about solar energy and a learning project about the subject (it includes essay proposals, constuction of experimental devices and more).

25. <http://www.iearn.org> Main Page of I*Earn. Some web sites of interest are:
<http://www.igc.apc.org/iearn/projects.html> The I*Earn World, see the Latin I*Earn "iearn.latina
<http://www.uanl.mx/circulos> Circles of Learning

26. <http://www.iecc.org>
Intercultural E-Mail Classroom Connections

27. <http://www.fumsoft.softex.br/~pitag/planets/nineplanets>
Web site in Portuguese about the solar system.

28. <http://bang.lanl.gov/solarys.portug/homepage.htm> Solar system, origins, evolution and other related subjects. Web page in Portuguese.

29. <http://www.tsc.upna.es/Multimedia/SistemaSolar.html>
Information about the Solar System.

30. <http://www.esrp.pt/departam/g04/04astro.html>
Site in Portuguese with information about astronomy.

31. <http://www.ccinet.ab.ca/dc/Spanish/cool.htm>
Web page with links to environment information sites. Some of the links are to Portuguese web pages.

32. <http://www.ccinet.ab.ca/dc/Spanish/home.html>
A link from the site mentioned above, this web page presents information about conservation and recycling, and they provide ideas for educational activities.

33. <http://www.geocities.com/Athens/Forum/5265/conhecen.htm>
Portuguese page about water cycle.

34. <http://www.uco.es/ccc/glosa rio/glosario.html>
A glossary on terms used frequently in the Internet.

35. <http://www.pitt.edu/~kavst9>
Literature, stories, art, movies, both in English and Spanish.

36. <http://lanic.utexas.edu> University of Texas. General and specific information about Latin America. Resources on the Social sciences.

37. <http://www.mundolatino.org /123/educa.htm> Latin World: Diverse links to web pages on education and research.

38. <http://www.nacion.co.cr/zur qui/home.html>
Educational supplement from "La Nación", Costa Rica

39. <http://nti.uji.es>
New information technologies applied to the education.

40. <http://linux.soc.uu.se./mapuche/indgen/indgen00.htm>
Facts on Americas' Native Population. It includes complete texts about UN resolutions regarding the natives population in the Americas. Interesting for the Social Sciences curriculum development.

41. <http://linux.soc.uu.se./mapuche>
Web page about the "Mapuche" people in Chile, both in English and Spanish.

Annex V:

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