INFORMATION AND COMMUNICATIONS TECHNOLOGIES IN EDUCATION IN FOUR LATIN AMERICAN COUNTRIES

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Abstract:
This article presents the methodological design and preliminary advances for a research project in process. The objective of the project is to document and analyze educational experiences and studies on information and communications technologies in Argentina, Costa Rica, Ecuador, and Mexico, from 1998 to 2003. The data were compiled from interviews and the analysis of documents. The article includes some preliminary results related to infrastructure and financing, policies and forms of incorporation, as well as projects and programs related to the use of information and communications technologies in education, especially in public institutions.

Key words: information technologies, educational technology, educational research, Argentina, Costa Rica, Ecuador, Mexico.

Background

Approximately twenty-five years ago, according to Hess (1997), the so-called information and communications technologies[1] (ICT) began to be incorporated into education, first in the industrialized nations and then in nations with less development. According to various declarations by politicians and experts, in the coming years, this incorporation will not only grow and accelerate, but will also be encouraged in both public and private institutions.[2]

To date, the number of proposals and experiences related to the use of ICT in education has grown in an accelerated manner, as shown on one hand, by the number of articles presented in recent years at numerous international events on education and ICT[3], and on the other hand, by the number of organizations that have been created around the binomial, such as the Association for the Advancement of Computing in Education (AACE); the International Society for Technology in Education (ISTE); Red Iberoamericana de Informática Educativa (RIBIE), Sociedad Mexicana de Cómputo Educativo (SOMECE), and Asociación Chilena de Informática y Computación en Educación.

Progress has also been made in research. The most important efforts include the work of Harrison *et al.* (2003), Comber *et al.* (2002), Somekh *et al.* (2002), Ofsted (2002), and Waite (2004). Outstanding bibliographic reviews are those of Berger (2001) on the effectiveness of computers in adult literacy and basic education, and that of BECTA (2005) on the progress of ICT in education.

Comparative work at the international level has been carried out by Pelgrun, Janssen and Plomp (1993), who compared data from twelve nations in their project on "Schools, Teachers, Students, and Computers: A Cross-national Perspective"; "Project for the Longitudinal Assessment of New Information Technologies in Education" (PLANIT), in which nine nations on three continents participated (Morales, Knezek, y Ávila, 2001); and the project by Fitzpatrick and Davies (2003) on the impact of ICT on the teaching of foreign languages and on teachers' roles.

In the Latin American context, five projects compared nations in the region: the project by Batista and Rumble (1992) on distance learning in Costa Rica, Mexico, the Dominican Republic and Brazil; the project by Álvarez and others (1998) on computers in schools in Chile and Costa Rica; the projects by Castiglioni, Clucellas and Sánchez (2000) on various Latin American countries and the United States and Canada; the project by Ávila (2003), which includes studies completed and published in Latin America on the use of ICT in education from 1992 to 2002; and the project of Redes Escolares de América Latina (REDAL) (2004) on the best practices in school networks in Mexico, Colombia, Brazil, Costa Rica, Chile, Paraguay and Argentina.

Important comparative studies have also been completed in Mexico, such as those by Medina, González y González (1999); Morales (1999 a and b) and Morales, Turcott y Campos (2000); Ramírez (2001); Amador (2001); ILCE (2003); Salinas *et al.* (2004); as well as the states of the art of research on ICT in education in Mexico during the decades of 1980-1990 and 1992-2002, edited by Consejo Mexicano de Investigación Educativa (Amador: 1993, 1995 and 2003).

The results of these projects have favored dialogue among researchers, decision makers, academics, professors and teachers; they have generated valuable information and have contributed to overcoming deficiencies. They have also promoted the qualitative development of educational research in the field by indicating problems, vacuums and possible paths to follow.

Much distance remains to be traveled, however, especially if we consider that the number and quality of research projects on the uses and forms of incorporating ICT into education have not grown at the same pace as the applications and experiences. In other words, there seems to be more interest in "doing things" than thinking about them or evaluating what has been done, in spite of scholars' and experts' concern and repeated demands (Daniel, 2001; Spiegel, 1997 and 1999; Escobar, 1999 and Tudesco, 1997).

Because of the above, it has become necessary to carry out more studies that allow greater understanding of Latin American problems and that provide guidelines for use by educators as well as policy designers, in order to improve educational practices.

This article, which adopts the above ideas as its framework, has the central objective of presenting the methodological design and preliminary progress of ongoing research that seeks to document and analyze the experiences and studies regarding education and information and communications technologies in Argentina, Costa Rica, Ecuador and Mexico, from 1998 to 2003.

Theoretical Focus
The theoretical stance that orients this research is a focus in construction that is recognized to be critical with regard to the dominant technocratic orientation in the field of ICT. It could be characterized by its desire for the projects, programs and actions that incorporate ICT into

education to consider not only the technological dimension—the equipment and programs to be used—but also more important dimensions like the pedagogical, cultural, and ethical dimensions.[4]

Methodological Design
The focus used to collect and analyze data is that of comparative education. The nations considered are Argentina, Costa Rica, Ecuador and Mexico.[5] The variables of analysis are: *a)* the socioeconomic context and educational system; *b)* infrastructure and financing; *c)* policies and forms of incorporating technologies; *d)* research in technology and education; and *e)* projects, programs and experiences in the use and incorporation of technologies in the educational field.

Research projects and experiences from any educational level and coverage (national, state or provincial, and institutional).

Data were collected through interviews with officials and experts, as well as through the analysis of documents. The interviews were of a semi-structured nature and were carried out with managerial personnel at the secretariats, departments of education or universities, academic leaders or producers, and researchers in education and ICT. To select the participants, the recommendations of each country's researchers were followed, as well as the suggestions of the respondents themselves. The central objective was to collect information first-hand about the educational policies of each country, state or institution, in addition to information about the topic being researched. Up to the present time, 67 participants in the four countries have been interviewed (see list in Annex 1).

The documents under revision are reports on research or experiences presented at academic events—events on educational research as well as on education and technology, held from 1998 to 2003 in the countries included in the sample; as well as official documents related to the national policies on incorporating technologies in the countries in question. Up to the present time, more than sixty have been compiled, in printed and digital form.

Preliminary Results
Although five variables are studied in the project, this article presents only some of the results that correspond to three of the variables: *a)* infrastructure and financing; *b)* policies and forms of incorporation; and *c)* projects and programs, especially in the public sector, which are related to the use of ICT in education.

Infrastructure and Financing
Infrastructure
In spite of the general growth of infrastructure for ICT, in comparison with other countries, the four nations under study dropped in the listings of the Networked Readiness Index Ranking (NRIR),[6] between 2002 and 2005; Argentina showed the largest decrease, from 45th place in 2002-2003 to 76th in 2004-2005 (Chart 1).

By nation, growth is unequal (Chart 1); an analysis of the ranking of the four nations from 2002 to 2005, shows that compared with the other three, Argentina was in first place in 2002-2003, and in third place during the following time periods (2003-2004 and 2004-2005); while Costa Rica moved up from third place in 2002-2003, to second place in the next two periods;

Mexico moved up from second to first; and Ecuador has remained in fourth place for the entire time.

By region, growth in the capitals and large cities has been greater than in the states and rural areas, as in Costa Rica—where those who have least access to ICT are the inhabitants of rural areas, and not the central part of the nation[7]–or in Ecuador, where "the existing inequalities in the availability of telecommunications infrastructure continue to be marked by the relations among provinces and cities, and especially between the urban and rural sectors" (PNUD, 2001:45). A similar phenomenon occurs in Mexico: an analysis of the equipment of the Red Escolar de Informática Educativa ("School Network of Information Technology in Education") showed that in terms of equipment in urban and rural areas, "the percentage of equipped schools in the network is 66% in the urban areas and barely 12% in rural areas" (ILCE, 2003e:8).

CHART 1

Comparison of Ranking of Latin American Nations on Networked Readiness Index, 2002-2005

Nation	2002-2003	2003-2004	2004-2005
Brazil	29	39	46
Chile	35	32	35
Argentina	45	50	76
Mexico	47	44	60
Costa Rica	49	49	61
Uruguay	55	54	64
Dominican Republic	57	57	78
Trinidad and Tobago	58	52	59
Colombia	59	60	66
Jamaica	60	53	49
Panama	61	58	69
El Salvador	63	62	70
Venezuela	66	72	84
Peru	67	70	90
Guatemala	73	86	88
Ecuador	75	89	95
Paraguay	76	91	98
Bolivia	78	90	99
Nicaragua	79	94	103
Honduras	81	98	97
Haiti	82	100	—
Prepared by author, based on data taken from the Networked Readiness Index, NRI,			

By social class, those who have most access are from the higher classes. In Argentina, for example, 17% of the homes that have 60% of the personal computers are in a sector of the population that has housing in the best condition, while those who live in conditions of most poverty (6% del total) have barely 0.07% of the total number of computers at home. According to Castiglioni, Clucellas and Sánchez (2000), the Internet is a privilege of the elite.

The situation in Costa Rica is similar, as Monge and Hewitt (2004) state:

> […] while 53.63% of homes in the fifth quintile have computers at home, only 3.18% of the homes of the poor have the same technology […] and the increased coverage of this service in homes occurs almost exclusively in the fourth and fifth quintiles, i.e., the quintiles of the highest income levels (pp. 13-14):.

The situation is no different in the case of Ecuador, according to the United Nations Development Program (UNDP, 2001):

> [...] the economic cost of personal or family use of the Internet by purchasing a computer and contracting the service, means that at the present time, most Ecuadorians are unable to have access to a computer and the Internet in this manner (p. 54).

Financing

According to most of the respondents, although projects and programs are financed by governments or institutions, an important percentage of the budget for equipment comes from international organizations, like the World Bank, the Inter-American Development Bank, and companies that produce computer equipment and programs, including Microsoft, Apple, IBM and Hewlett Packard.

Several respondents also indicated that the aspects most considered when acquiring equipment are the economic dimension (costs and financing) and the technical dimension, rather than the pedagogical and cultural dimensions. Hawkins (2002:41) states a similar finding, that "although many ministries of education around the world have made the commitment to equip schools with computers, very few have developed coherent strategies to integrate them completely into the classroom as teaching tools".

Policies and Forms of Incorporation

Two major components of policy were evident in the interviews: that of government officials and that of academics, designers and producers.

Most officials indicate that domestic or institutional policies exist. Some believe that coordination is lacking among the different organizations responsible for implementing policies (as mentioned by one of the respondents in referring to Mexico), while others point out that policies cover only connectivity or equipment purchases (mentioned by three of the respondents in the case of Ecuador).

Most of the interviewed academics, designers and producers sustained that "there are no clear or defined national policies", "there is no national vision", or that existing policies are "fragmented" or "disorganized". Their opinion of the institutional level is not better.

According to various Argentine academics, strategic planning in this area is nonexistent. In the case of Ecuador, one academic indicated that "institutional strategic plans exist […] but practice is more a function of how the surroundings change"; another respondent from the same country expressed that "there are no defined policies […] we go hand in hand with the personal initiative of researchers and teachers".

In relation to the creation of policies, some respondents from the four nations consider that "they rise from the bottom up as a state or institutional policy", and some academics believe that they are incorporated from the university sector and international organizations.

Projects or Programs Related to the Use and Incorporation of Technologies in the Educational Field
The interviews and revision of printed and digital documents revealed more than 75 projects or programs of diverse types and for different levels, related to the use and incorporation of technologies in the educational field. Without making an exhaustive listing, this section will describe some of the projects and programs with greatest coverage or most mentioned by the respondents and in documents.

Ecuador
A large number of projects (more than twenty) was found in Ecuador. The following have the broadest coverage:

Maestr@s.com: A project the nation's Ministry of Education and Culture. Its principal objective is "[...] to approve and attain learning in children and young people by incorporating ICT into the teaching work of their teachers and by using technologies to prepare classroom or institutional projects that lead to education of higher quality" (Maestr@s.com, 2005). The program offers an economic incentive in dollars in addition to lines of soft credit to teachers for acquiring computer equipment and obtaining training in using computers and their educational applications.

Educar ecuador: Educational portal of the Ministry of Education and Culture.

Comisión Nacional de Interconectividad: Under the National Council of Telecommunications; has the function of proposing a national agenda of connectivity along five lines—televised education, televised health, E-commerce, infrastructure and E-government.

Fondo para el desarrollo de telecomunicación en áreas rurales y urbano marginales (Fodetel): A project for creating polyvalent community tele-centers, with natural affinity for programs of education, health and rural commerce.

Redes Amigas: "An aid program for rural education in Ecuador, with support from the Inter-American Development Bank and the Solidarity Fund of the Ecuadorian government, and dependent on the Ministry of Education and Culture of Ecuador" (Redes Amigas, 2005).

Programa Nacional de Tele-educación: Promoted by the Ministry of Education and Culture along with the National Council of Telecommunications and various universities:

> Its objectives are to improve the quality of education by incorporating projects of tele-education; developing telecommunications infrastructure; developing national and cultural contents for Internet; and paying special attention to using computer technologies as tools for promoting the developing of higher thinking skills (UNDP, 2001).

Proyecto Navegar: Belongs to the National Union of Educators, for training teachers in basic information technology.

Edufuturo: A government program from the province of Pichincha, "with the objective of offering educational and cultural information as support, principally for students, teachers, and parents" (Edufuturo, 2005). Its projects include the website, www.edufuturo.com, a system of multimedia education for writing educational computer programs for the basic level, teacher training, and equipment for schools, including Internet connections in provincial schools.

The Ecuadorian universities also make great efforts to support incorporating and using ICT in education. Their most important projects include the following:

Escuela Superior Politécnica del Litoral (ESPOL, with two main projects.

- *Innovación de la Educación Pública Primaria en la Península de Santa Elena (IEPSE)*, which attempts to develop students' creativity and cognitive skills in the public elementary schools on the peninsula, by introducing ICT in the classrooms of rural areas and poverty-stricken urban areas.
- *Red Latinoamericana de Educación (RELATED)*, co-financed by the Ford Foundation, attempts to improve Latin American education at the secondary and upper levels by using ICT.

Escuela Politécnica del Ejército (ESPE): Has the *Cyber-espe* programs, whose central component is ICT, and training in information technology for the community.

Escuela Politécnica Nacional (EPN): Has developed computer applications for teaching the basic subjects of secondary education, has trained teachers in teaching physics and chemistry at that level, offers computer courses, and participates as a national representative of the *Thinkquest* program and in the Red Iberoamericana de Informática Educativa (Latin American Network of Information Technology for Education).

Universidad Técnica Particular de Loja (UTPL): A pioneer in distance education, with virtual classrooms and computer programs; according to some of the respondents, the clearest example of the application of ICT in the university setting.

Costa Rica
More than 35 ICT projects and programs were detected in Costa Rica. The most important because of their coverage, financing and government support are those of the Fundación Omar Dengo (FOD)[8]:

Programa de Informática Educativa MEP-FOD: created and implemented in cooperation with Costa Rica's Ministry of Public Education (MEP). The program is directed to students and teachers at the preschool and basic levels, through two learning modes: laboratories of information technology for education (for large urban schools) and small computer networks in the classroom (for small rural schools).

Programa Nacional de Informática Educativa MEP-FOD tercer ciclo: Like the previous program, this program is operated along with MEP and is directed to students and teachers, this time in the third cycle of basic education. The program contains five frameworks of action: administrative, pedagogical, operative, technological, and normative.

Red Telemática Educativa: Also cooperates with MEP; a system of networks with the purpose of "providing telecommunications services and tools to schools that participate in the Program for Information Technology in Education MEP-FOD" (FOD, 2005).

Proyecto Alianza: Designed to support schools and departments of education in the nation's state universities that train teachers, by installing information technology laboratories to permit training in ICT.

Innova: A course in educational innovation with Microsoft productivity tools; the course was created by FOD on the company's request, for the pedagogical utilization of the tools in Microsoft Office.

Intel Educar para el Futuro: A program also backed by Microsoft, and translated, adapted to the curriculum and carried out in Costa Rica by FOD; the program's purpose is to "help teachers effectively integrate the use of computers in the program of studies and thus improve students' learning and performance" (Intel, 2005).[9]

Informática Educativa para Todos: A program oriented to generating general knowledge of information technology in communities and training citizens in general.

Programa para Ciudadanos de Oro: Attempts to incorporate older adults into the world of information technology and the Internet.

World Links: "A global learning network that links thousands of students and teachers from around the world by means of the Internet, in doing cooperative projects and integrating technology into learning" (World Links, 2005). Training for using the program is carried out in Costa Rica by FOD, in coordination with the Ministry of Public Education.

Other projects in Costa Rica that are important because of their coverage are:

Fundación para el Centro Nacional de la Ciencia y la Tecnología (CIENTEC) is a nongovernmental organization (NGO) created to promote and popularize science and technology. Its mission is "to promote the equality and potential of individuals through access to relevant information and the promotion of learning in the sciences and technology" (CIENTEC, 2005).

Lincos segunda generación: Project of Fundación Costa Rica para el Desarrollo Sostenible (founded by former president, José María Figueres). The project is supported by various companies (including Hewlett Packard, Microsoft, Intel, Logo, and Alcatel), Banco Nacional de Costa Rica, the Rockefeller Foundation and Flora Family Foundation. It is "oriented to developing poor Third World nations in various areas: education, health, business, and community coordination" (Lincos, 2005).

Lastly, a third group of important projects consists of institutions of higher learning. Outstanding is the distance education program of Universidad Estatal a Distancia de Costa Rica; the programs of Instituto Tecnológico de Costa Rica, especially those related to the project, *Tec Virtual,* which offers a bachelor's degree in computer-assisted mathematics teaching, the robot programs, the design of computer programs for education, diverse programs of innovation and materials, and on-line courses developed by teachers from Universidad de Costa Rica.

Argentina

According to one of the respondents, this nation shows, in contrast with the highly centralized system of Costa Rica, "a quite fragmented educational reality in ICT […] there is no national or provincial plan. There are many micro experiences carried out in schools, there are initiatives, projects and networks in schools that constitute good experiences, but it is not easy to recognize them as national or provincial". Thus, one finds a nation where, in spite of crisis, experiences and proposals multiply in various directions, and any attempt to explain them will fall short. In this case, we shall limit ourselves to presenting some of the projects or networks mentioned by the respondents:

Educar: The educational portal of the Argentine government, and one of the most announced projects in the previous administration.

Experimentar: The science portal for children and young people of the Secretary of Science, Technology and Productive Innovation, dependent on the Ministry of Education, Science and Technology. It is composed fundamentally of experiments that visitors can duplicate.

Campaña Nacional de Alfabetización Digital: A program of the Ministry of Education that is attempting to install 50 thousand computers in the classrooms of public schools.

Reporte: la Red Porteña Telemática de Educación: "One of its objectives is to design, administrate, and promote the use of information and communications technologies in the setting of the Secretariat of Education of the City of Buenos Aires. The network is in charge of the educational Intranet of the city of Buenos Aires, the city's educational portal, and the use of Internet applications in the city's public schools" (government of Buenos Aires, 2005). Some of the projects it includes are: adults on the network, classrooms on the network, network of middle schools, web schools, technical support, young web, inclusive network, cooperative projects, and kids web.

Portal Educativo de la Provincia de Mendoza: According to one of the respondents, it is "a project with little documentation but a high level of equipment and good policy".

RUEDA: Red Universitaria de Educación a Distancia de Argentina. Promotes projects in four areas—distance education (with nine participating universities), educational technology (two universities), virtual education (five universities), and field research (five participating universities). In addition, it has the program of "My first laptop", which supports the purchase of portable computer equipment by teachers and students in higher education.

Other university projects of great importance are the first virtual campus of Universidad de Quilmes; the UBA XXI project of Buenos Aires; the Matanza project on the use of ICT for the handicapped; and the project of the Information and Communication Center of Universidad de Cuyo. Other institutions mentioned without the naming of a specific projects are the university of Patagonia, San Juan Bosco, and the national universities of San Luis, Córdoba, Rosario, Entre Ríos, Comahue and Salta.

In addition, we found a large number of independent projects:

Chicos.net: A nonprofit association that promotes, generates and stimulates initiatives of a social, educational and cultural nature through ICT, especially the Internet, among the community in general and children and young people in particular. It offers services of children's content, site development, training, and interactive programs. The association's main programs include:

- *Proyecto Red Nacional Acercándote @l Mundo:* Offers children with chronic illness or prolonged health problems "a space for virtual encounters with other children in similar situations [so that] from any computer connected to the network, the children can communicate, express themselves, play and learn new things. The goal is for more children to join the program and obtain a computer with Internet access" (Chicos.net, 2005).
- *Aventuras para vos:* Another project of the same association, for isolated schools or schools in precarious urban situations. Children report on various topics of interest for their community.

Nueva Alejandría: A project begun in the private sector in 1996, with the objective of accompanying teachers in incorporating ICT, especially computers, in their teaching processes.

CEDIPRO (Centro de Diseño, Producción, Evaluación e Investigación de Recursos Multimediales para el Aprendizaje): Oriented to the practical application of knowledge in the area of educational technology, ICT and distance education; has research and training in the production of materials and electronic learning.

Mexico

Mexico has a wide diversity of projects. Some of the most important in terms of national coverage will be described below.

e-Mexico: Consists of four areas—E-learning, E-health, E-commerce, and E-government. The project is:

> [...] integrative, and articulates the interests of various levels of government, different entities and public organizations, operators of telecommunications networks, chambers and associations linked to information and communications technologies (ICT), as well as diverse institutions, in order to increase the coverage of basic services in education, health, the economy, government and science, technology and industry, as well as other community services (e-Mexico, 2005).

It also has the following portals: discapaciNET, e-Migrantes, e-Indígenas, e-Mujer, e-Ciencia y Technología, Hacedores de las palabras, and CCTI MexCor.

Red Escolar. A program of the Secretariat of Public Education and ILCE, with the following objective:

> [...] to offer the same educational opportunities to all Mexicans, by taking to each school and teaching center, the relevant materials that aid in improving the teaching/learning process with the support of information and communications technologies; to promote the exchange of educational proposals and teaching resources, in addition to compiling the experiences carried out successfully in the nation's schools (Red Escolar, 2005).

The educational resources included in Red Escolar are grouped into three areas: collaborative projects, permanent activities, and on-line courses and workshops.

SEC 21. Like the previous program, this model is under the SEP and ILCE:

> The model concentrates the integral, intensive use of Information and Communications Technologies for improving the quality of secondary education. This project involves diverse technological components in different modes, so that secondary schools have access to general software, materials in digital format, sensors and simulators that give students access to the Internet and Red Escolar, in addition to being at the vanguard of technology use (ILCE, 2005).

The program has more than 300 videos on various topics, which are sent to schools by satellite. The videos can be stored in a server and utilized in the classroom as required. Other resources in the model are the Edusat network, graphic calculators and printed materials that support teaching and learning strategies.

Red Edusat: Mexico's educational television system, based on digitalized satellite technology. The network is under SEP and ILCE. Various programs are transmitted over this system, including tele-secondary, distance learning at the high school level (EMSAD), and distance learning at the secondary level for adults (SEA).

Encyclomedia. This project includes the digital edition of free textbooks from SEP:

Its principal characteristic is that it has linked the content of national textbooks to diverse teaching resources, such as fixed and moving images, interactive materials, audio, videos, maps, virtual visits, resources from the Microsoft Encarta® encyclopedia, and other resources. It consists of two fundamental parts: the student site and the teacher site (Encyclomedia, 2005).

Pronap en línea: The page of the national program for the in-service training of teachers of basic education, under Mexico's general directorship of ongoing training of teachers, part of the Secretariat of Public Education.

Red Normalista. The electronic page of the general directorship of higher education for professionals in education, of SEP:

The essential purpose of the project is to increase the options for accessing information to reinforce training processes and teacher/student training, based on new academic orientations from the reforms to teacher training. The project consists of a network of information services applied to education, which will permit interaction and collaboration among normal schools, schools of basic education, teacher centers, and other educational institutions—which can be accessed by any Internet user interested in educational topics (Red Normalista, 2005).

Sociedad Mexicana de Computación en Educación (SOMECE): The organization that groups a large number of persons interested in the use and application of information and communications technologies for education.

Lastly, like in other nations, Mexico's institutions of higher learning carry out important efforts related to incorporating ICT, especially in distance education and to support classroom training, through academic portals and institutions' pages. Although most of these institutions, both public and private, have projects related to ICT, a description will be given of those considered most important because of their years of experience and level of coverage.[10]

Universidad Nacional Autónoma de Mexico: A pioneer in open education in our nation, with a model based on five aspects—the curriculum, educational materials, teaching activities, student activities, and evaluation. In addition, it has support materials on line for teaching mathematics and physics.

Instituto Politécnico Nacional: Has programs in engineering and physics/mathematical sciences, social science, administration, and medical/biological sciences, as well as a large number of research projects and prototype design, teaching materials (traditional and digital), computer programs, and multimedia packages designed by the institution itself.

Universidad de Guadalajara: Offers a semi-classroom high school program, various undergraduate programs, diploma courses and master's programs as part of the UDGVirtual project.

Sistema de Institutos Tecnológicos dependientes de la SEP: Various undergraduate degrees are offered through its program in open education.

Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM): Its Universidad Virtual project has a broad supply of courses at the undergraduate, master's and doctoral levels; the school also offers an ongoing training program in teaching skills, courses in continual education, and special programs for companies and community learning centers.

Discussion of Results and Preliminary Conclusions[11]

Infrastructure and Financing

In general, since the mid 1990s, growth has occurred in the nations under study in technological infrastructure: telephone connections, Internet access, and computers at schools, homes and Internet cafés. This increase, however, has not been parallel to the degree of preparation for participating in and benefiting from developments associated with ICT. Nor is the increase homogenous by nation, region, institution or social class, as we have indicated.

In terms of financing, an important percentage of funds destined to equipment purchases seems to come from international organizations, the Inter-American Bank, the World Bank, and producers of computer equipment and programs like Microsoft, Apple, IBM and Hewlett Packard. This fact is of concern because of the traditional tendency of these organizations to condition their support to adherence to their policies or recommendations, which are not be the most adequate for the particular educational needs of each nation.

Policies and Forms of Incorporation

Although most of the responding officials stated that national policies exist to orient the incorporation of ICT into the educational sector, some recognized a lack of coordination or a limitation of policies to technical matters of connectivity or equipment. The academics, on the other hand, argued that no clear, defined policies exist.

The evidence and opinions from other studies seem to incline to the academics' opinions: a recognition of the growing tendency to incorporate ICT into education, yet in most cases, as stated by Brunner (2000), without a *comprehensive* strategy to permit incorporating technology into educational systems, or without sufficient support, as argued by Fundación Grupo Sophia (2002) for the Argentine case, and by Díaz Barriga (2003) for Mexico. In addition, a study by the UNESCO concludes that "various nations in South America have begun projects for developing and integrating ICT into education, but the lack of national policy to regulate their use is notorious" (2004:62). Along the same line, Hawkins of World Links (a program from the World Bank Institute) affirms that "one of the bottlenecks found by the World Links project is the lack of a clear ministerial policy for the use of computers in education" (2002:41).

In many cases analyzed to date in higher education, especially in public institutions, the innovations or suggestions for incorporating ICT seem to come from individuals who propose or encourage innovations. In the best of scenarios, they are later supported (or at least not detained) by the authorities; after achieving success, their ideas are instituted through policies. Further analysis of data is lacking, however, to determine the factors that influence the formulation of institutional or governmental policies. We believe, at least in institutions of higher education, that the pressures of international organizations (especially those that grant financing) as well as the demands of the labor market, interact with people's demands to exert pressure—pressure that would obligate institutions to formulate policies to guide other people or institutions.

Projects and Programs, Especially from the Public Sector, that are Related to the Use of ICT in Education
As shown in the section that describes some of the projects and programs, a large number and variety exist at all educational levels, both formal and informal. However:

1) Most seem to revolve around five major poles or topics (equipment or infrastructure, portals and networks, training for users, distance education, including the production of materials and programs) with assigned importance depending on the type of institution or organization (government or institution of higher learning).

In the case of governmental institutions, especially those related to basic education, the central topics of interest seem to be equipment and infrastructure, teacher training and the establishment of networks and portals; i.e., matters related more to how, than to what or why. Thus in Ecuador we have the project, Maestr@s.com, for buying equipment and training teachers; the Navegar project for training in basic information technology; the establishment of the National Commissions on Interconnectivity; and the Educar Ecuador portal. In Costa Rica, where almost all projects are part of Fundación Omar Dengo, most consider the components of equipment, training, and the establishment of networks. Argentina has the national campaign for digital literacy (which includes equipment and training) and the portals of the secretariats and ministries. Mexico has the portals of the federal government, SEP, and the states; the school network projects; and the teacher training programs of Pronap and Red Normalista.

The institutions of higher learning, in spite of their concern for infrastructure and equipment and their projects for producing materials and programs, seem to pay more attention to establishing portals and networks, as well as distance learning. We listed, for example, the Ecuadorian projects of RELATED, Escuela Superior Politécnica del Litoral, Cyber-ESPE, Politécnica del Ejército and virtual classrooms, and Universidad Técnica Particular de Loja. Costa Rica has the programs of Universidad Nacional a Distancia, *Tec Virtual* at Instituto Tecnológico de Costa Rica, and the on-line courses developed by professors at Universidad de Costa Rica. Present in Argentina are the RUEDA project, the virtual campus of Universidad de Quilmes, and the UBA XXI project of Buenos Aires. Outstanding in Mexico are the distance learning projects of UNAM, IPN, UdeG and ITESM.

Nongovernmental institutions, on the other hand, seem to be more centered on matters related to producing materials and programs, training in some cases, and emerging topics, as evident in websites like chicos.net and the new Alejandría project in Argentina.

2) Training continues to be centered to a large degree on the basic use of computer tools, although some new projects in the four nations approach other dimensions (pedagogical, cultural, and ethical) related to the use of ICT in education; they attempt to achieve greater connection with the contents of the school curriculum, and provide a theoretical basis to their proposals, especially from the constructivist perspective.

3) Projects and programs have begun to appear in relation to topics traditionally not addressed in the field of ICT, including:

a) Work for the handicapped, like the Mexican portal Discapa@cinet, located in the macro portal of e-Mexico; and the project of Universidad de la Matanza (Argentina).
b) Projects for children with chronic health problems, like Red Nacional Acercándote @l Mundo from the Chicos.net project in Argentina.

c) Projects for inhabitants in marginalized, rural, or poverty-stricken contexts, such as the projects of FODETEL, Redes Amigas and Innovación de la Educación Pública Primaria in Península de Santa Elena, Escuela Superior Politécnica del Litoral in Ecuador; the project for small computer networks in the rural school classrooms in the MEP-FOD program of information technology for education, and the second generation of Lincos, the Fundación Costa Rica para el Desarrollo Sostenible, in Costa Rica; the project, Aventuras para vos, of the Chicos.net association in Argentina; and the Edusat network of SEP, the community centers of CONEVyT, and the community learning centers supported by Instituto Tecnológico y de Estudios Superiores de Monterrey, in Mexico.

d) Projects for attending to people who are traditionally removed from ICT (women, older adults, migrants or Indians), especially the programs for Ciudadanos de Oro of Costa Rica, and Adultos en red, in Argentina, as well as the portals of E-Migrants, E-Indians, E-Woman, and the Distance Secondary for Adults (SEA) of the *edusat* network in Mexico.

e) The programs of association and cooperation between universities and schools or communities like those of UNAM for supporting the teaching of physics and mathematics, and the support programs for professors in diverse areas of IPN in Mexico; Cyber-ESPE at Escuela Politécnica del Ejército, and the projects for developing computer applications for teaching the basic subjects of secondary education, as well as training for teaching physics and chemistry at the secondary level, of Escuela Politécnica Nacional in Ecuador.

Results

The above sections list a large number of projects and programs of all types and levels. References include progress in coverage, infrastructure, training, access, and attention to marginalized sectors. Mention is made of projects aimed at groups that are traditionally ignored, such as Indians, people with special needs, sick children, migrants and older adults. Pages, portals and computer programs are highly original and have good technical and visual quality; and networks exist in diverse communities.

We obtain the idea of a fertile field, full of dynamism and open to innovation. Most cases, however, have a limited amount of reliable, documented, and accessible information on the impact of the programs and projects implemented, especially with national coverage. In quantitative terms, the number of articles centered on their description greatly surpasses the number of articles on evaluation or research.[12]

A vacuum of particular concern is related to the limited or null articles of national coverage that explain the impact of projects and programs on students' learning—the reason most cited for justifying the incorporation of ICT into schools.[13]

Few articles of national coverage were found to address the relation among the diverse programs and projects used at schools and the official content of the curriculum. However, some authors sustain that ICT are still unrelated to scholastic content and that they have been integrated into classes infrequently as pedagogical tools, as Castiglioni *et al.* (2000) and Woolf (1999) argued in the case of Costa Rica; Jaramillo (2001) in Ecuador; Castiglioni *et al.* (2000) for Argentina, and an ILCE study (2003) for Mexico. Similar findings are reported by Hinostroza, Guzmán and Isaacs (2002) for Chile, in relation to curricular learning.

Project reports and some research studies also allude to the impact on students' motivation and attitudes, especially those related to ICT. Yet the only available data has been collected

from user opinions or by indirect means, as Johnston and Barker mention with regard to other nations.

One of the benefits attributed to ICT is their contribution to the improvement of living conditions in communities where they are introduced, but no evidence in this regard was detected.

Our previous statements do not attempt to sustain that ICT are not useful or that they are lacking in importance for the educational field. Rather, because of the investment, expectations and promises associated with their incorporation into education, the growing number of studies concerned about attending to traditionally marginalized groups, and the theoretical wealth and educational potential of many projects, we believe that obtaining greater data is urgent, especially with regard to the differentiated impact of the use of ICT and the optimal conditions for their utilization.

Lastly, we also believe greater effort is necessary in the rendering of accounts, reflection and research, teacher training (especially with regard to the pedagogical, cultural and ethic aspects of using ICT),[14] as well as a permanent critical attitude toward the incorporation of these formidable technologies. In this manner, the incorporation of ICT into Latin American education will no longer have the "flavor of promise" as indicated so accurately by Salinas *et al.* (2004).

ANNEX 1
Interview List by Nation

COSTA RICA

Interviewee	Position	Institution	Department
Guillermo Brenes	Director	Universidad de Costa Rica	School of Geography
Guillermo Loria	Director	Universidad de Costa Rica	Center of Information Technology
Guillermo Pérez	Professor	Universidad de Costa Rica	School of Library Science
Ramiro Barrantes	Assistant Rector of Teaching	Universidad de Costa Rica	Assistant Rectorship of Teaching
Sonia Rodríguez	Professor	Universidad de Costa Rica	School of Mathematics
Perla Alonso	Professor	Universidad de Costa Rica	School of Education
Sandra García	Dean	Universidad de Costa Rica	School of Education
Jeanina Umaña	Professor	Universidad de Costa Rica	Foreign Languages

Dr. Yamilett González	Assistant Rector	Universidad de Costa Rica	Assistant Rectorship of Research
Jacqueline García	Researcher	Universidad de Costa Rica	IIMEC
Dr. Alicia Gurdián	Professor-Researcher	Universidad de Costa Rica	IIMEC
Dr. Lizette Brenes B.	Director of Graduate Studies	Universidad Estatal a Distancia	Graduate Studies
Andrei Federov F.	Academic Advisor	Instituto Tecnológico de Costa Rica	Academic Development Center
Miguel Gutiérrez	Dean	Universidad Nacional	CIDE
Magali Zúñiga C.	Director of Research Department	Fundación Omar Dengo	Research Department
Dr. Clotilde Fonseca	Executive Director	Fundación Omar Dengo	
Ana Virginia Quesada Alvarado	Director	Fundación Omar Dengo	Center of On-line Learning and Digital Production, Annex
Andrea Anfossi Gómez	Director	Fundación Omar Dengo	Costa Rican Program for Information Technology in Education CR (PIE)
Efraín López		Fundación Omar Dengo	
Alejandra León C.	Executive Director	Fundación CIENTEC	
C. Ignacio Trejo	Rector	CENFOTEC	

ECUADOR

Interviewee	Position	Institution	Department
Jaime Jaramillo	Director of Information Technology	Universidad Nacional de Loja	Directorship of Information Technology
Dr. Miguel González	Member of Virtual Networks Commission	Universidad Nacional de Loja	CEPOSTG
Dr. Guillermo Zamaniego	Director	Universidad Nacional de Loja	Institute of Distance Education
Jorge Jaramillo	Director	Universidad Técnica Particular Loja	Information Technology Center
Dr. Enrique Pelaez	Director	Escuela Superior Politécnica (Guayaquil)	Center of Information Technology
Dr. Carlos Travez	Director	FUNDACYT	Directorship of Information

Leonor Villao de Santander	Director	U de Guayaquil	Libraries
Lorena de Janón Q.	Director	U de Guayaquil	General Directorship of Graduate Studies, Research and Development
Elizabeth Flores	Director	U de Guayaquil	Research Coordinator
César Esquitinni	Representative	CONESUP	
Dr. Nelson Serrano Ojeda	National Director	MEC	Organization and Systems
Marcelo Romo	Dean	Escuela Superior Politécnica del Ejército	Information Technology and Systems
Juan Carlos Fiallas	Coordinator	Consejo Nacional Telecomunicaciones	Tele-education
Magaly Robalino	Coordinator	MEC	Maestros@com
Jorge Arroba	Director	Universidad Central	School of Science
Dr. Nelson Rodríguez	General Coordinator	Universidad Central	General Coordinator of Research
Dr. Fabián Jaramillo	Pedagogical Information Advisor	MEC	Educarecuador Portal
Fabián Carrasco	Assistant Rector	Universidad de Cuenca	Assistant Rectorship
Otto Parra	Director of Development of Information Technology	Universidad de Cuenca	
Dr. Galo Cevallo	Director	Universidad de Cuenca	Academic Training Unit
Francisco Salgado	Assistant Rector	Universidad del Azuay	Assistant Rector

ARGENTINA

Interviewee	Position	Institution	Department
Dr. Inés Dussel	Coordinator of Graduate Studies on Schools and Literacy	Secretariat of Education of the City of Buenos Aires	CEPA Training School
Fernando Tascón	Coordinator of the Televised Information Network of Buenos Aires	Secretariat of Education of the City Government of Buenos Aires	Classroom Network Program
Dr. Edith Litwin	Professor	Universidad de Buenos Aires	
Dr. Alejandro Spiegel	Expert in New Technologies in Education		
Estela María Zalba de Aguirre	Academic Secretary	Universidad Nacional del Cuyo	
Ciro Novelli	Director General	Universidad Nacional de Cuyo	Information and Communications Center
Dr. Carlos Calderón	Assistant Rector	Universidad Nacional del Comahue	
Silvia Martínez	Director	Directorship of Higher Learning of the Province of Neuquén	
Susana Murazo	Director	Secretariat of Education of the City of Buenos Aires	Area of Information Technology of the Teacher Training School
Lilliana Hindi		Secretariat of Education of the City of Buenos Aires	Area of Information Technology of the Teacher Training School
Irene Cosoy		Secretariat of Education	Area of Information

		of the City of Buenos Aires	Technology of the Teacher Training School
Rosa Cicala		Secretariat of Education of the City of Buenos Aires	Area of Information Technology of the Teacher Training School
Dr. Marcela Czarny	President	Association Chicos.Net. Buenos Aires	
Dr. Mariano Palamidessi	Professor	FLACSO	
Dr. Graciela Caplan	Professor of Educational Technology	Universidad de Buenos Aires	
Dr. Beatriz Fainholc	Director	Center of Design, Production, Evaluation and Research of Multimedia Resources for Learning	
Dr. Hugo Castellanos	President	Nueva Alejandría Program, Buenos Aires	
Paula Scaliter	Coordinator	UNESCO	Training Unit of the International Educational Planning Institute of Buenos Aires
Anahí Mansú.	Former Director	Universidad de Buenos Aires	Distance Education Program
Marian Landau	Researcher	Ministry of Education	
Norma Bennice	Professor	Instituto Superior del Magisterio #14	

Mexico

Interviewee	Position	Institution	Office
Dr. Javier Loredo Enriquez	Professor	Universidad Iberoamericana	
Dr. Marco Antonio Rodríguez	Professor	Universidad Veracruzana	
Dr. Gustavo Flores		ILCE	
Enrique Villanueva	Coordinator of educational links	SEC	Directorship of Educational Technology

Notes

[1] Based on definitions by various authors and organizations, like Ríos, Ponce y Gómez (2005), the project ICT4LT (2005), and the Wikimedia Foundation (2005), we understand information and communications technologies as the technologies and tools required to process information. In this study, we shall emphasize technologies in which computers play a central role in converting, storing, protecting, processing, transmitting and obtaining information.

[2] See, for example, the speech by John Daniel (2001), the assistant general director of education for UNESCO, on the importance of ICT in education; the declaration of the ministers/secretaries of education from nine of the most populated nations on the planet, gathered in Beijing (UNESCO, 2001); as well as the action plan of the World Summit on the Information Society held in 2003 in Geneva (ONU, 2004).

[3] For the Latin American case, see for example, the international congresses of Technology and Distance Education (organized by Universidad Estatal a Distancia de Costa Rica), the congresses on Telecommunications and Multimedia in Education, and the Ibero-American congresses on information technology in education (held by Red Iberoamericana de Informática Educativa [RIBIE]); the international symposia on computers in education,

organized by Sociedad Mexicana de Cómputo Educativo (SOMECE); and the encounters on information technology and computers in education (ENICE).

[4] For a more detailed explanation of the theoretical focus and variables used, please see the author's previous work (Ramírez, 2001:121).

[5] The selection of nations was based on the following criteria: *a)* at least one nation from each geographical region of Latin America; *b)* diverse degrees of development in educational technology; and *c)* available academics in each nation to cooperate with this study.

[6] The Networked Readiness Index Ranking consists of three factors: the setting for existing ICT in a nation or community; the availability of key individuals or interested parties (stakeholders) of the community or nation (individuals, businesses, governments) in using ICT; and lastly, the use of these technologies by the key individuals or interested parties (Dutta and Jain 2003:10).

[7] According to Monge and Hewitt (2004:13) "while 29.30% of urban homes have a computer, only 10.59% of rural homes have access to this same technological tool. In the case of the Internet, 13.42% of urban homes stated having access to the technology, in contrast with only 3.13% of rural homes".

[8] FOD is a private institution with government financing that promotes national and regional projects in educational innovation and new technologies.

[9] FOD was responsible for the initial training of a group of Mexicans who will supposedly implement the program in our nation.

[10] See for example the conference by Dr. María Dolores Sánchez Soler, former academic secretary of the national association of universities and institutions of higher learning (Asociación Nacional de Universidades e Instituciones de Educación Superior--ANUIES) at the seventh international encounter of distance education, at the International Book Fair in 1998.

[11] Since work is being carried out in data analysis, the results presented are simply preliminary, tentative interpretations that could be modified or ratified in light of new evidence and/or the theoretical framework, also under construction.

[12] This idea is reinforced by a brief glance at the articles presented at congresses on computer technology for education, or on ICT for education. For example, at the most recent congress of Sociedad Mexicana de Cómputo Educativo, in October of 2005, fewer than 20% were research projects, and most were based on opinions, narrations of experiences and/or used very elementary research designs. According to the articles we have reviewed to date, something similar seems to occur in congresses of the same type organized in other nations.

[13] In this respect, a case we find of particular concern—because of its frequent mention as a model in Latin America—is that of Costa Rica, where official information reports extensive results. However, no empirical evidence was detected to support this information or institutional efforts in rendering accounts (in spite of the FOD's obligation to render accounts because of its receipt of public subsidies). In addition, open denouncement was made (by some of our respondents, and reported by the researcher) of the institution's concealment of information, casting a shadow over the declared veracity. In spite of the large investment in ICT in Costa Rica, no information in this regard is available for public scrutiny.

[14] As indicated in the conclusion of II Congreso Iberoamericano de EducaRed "Educación y nuevas tecnologías", held June and July, 2005, in Buenos Aires, Argentina (available at http://www.educared.org.ar/congreso/panel_cierre.asp).

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