Telecommunications
& *Education*

THIS SECTION of *Telecommunications in Action* examines what telecoms can do to further the goal of education for all in the developing world. Problems that planners and educators face include lack of infrastructure and qualified teaching staff, particularly in rural areas, class sizes that are too big and substandard facilities and utilities. This section examines a broad range of telecom applications that can help, and highlights examples of what is being done in different countries in education and teacher training. Drawing from experience to date and on knowledge of the capabilities of the various technologies, several working models are sketched to suggest what is possible. It is emphasized that the effective use of telecommunications for education depends on selection of the appropriate mix of affordable technologies to meet the particular needs of the individual country and its education system. The costs and benefits of using information and communication technologies for education are summarized and sources of finance are discussed. It is clear that access to telecommunications is the key. Without access no progress is possible. With access and some resources, there is a great deal that can be done.

telecommunications
in Action

EDUCATION FOR ALL is a goal that is becoming more achievable as technology extends ever further. Opportunities to learn are provided to children, women and men over the Internet, computers and CD-ROMs, e-mail, audio and video teleconferencing, video or television broadcasts and radio. Students and other learners can access the content directly. Teachers can develop their skills and knowledge, especially the skills needed to help their students learn and to find the particular content and curriculum they require. Telecoms can improve both subject coverage and delivery and expand access to education in even the most remote areas.

While this section deals mainly with formal education, there is also a need for continuous skills training outside the formal sector, for adult literacy and numeracy and for training in the workplace. Here, too, telecoms can help deliver quality content across a wide geographical area.

Educating and training their youth is one of the major responsibilities of governments. Education has always been a foundation for economic and social development and it will be essential for the knowledge economies of the 21st century. Countries have the opportunity to develop their intellectual capital, and it will become increasingly necessary for all nations to invest wisely to educate and train their citizens, of all ages.

Investments in education and learning are critical. Wise investments that utilize the power and reach of the information and communication technologies available can help achieve the goal of universal access to education. The investment formulas have changed, as have the economics of education and distance learning. Just as the cost of computing falls exponentially, so does the cost of communicating across the global network,

Enrolment in all levels of education, 1994

- 90% or more
- 70–89%
- 50–69%
- 30–49%
- Less than 30%
- No data
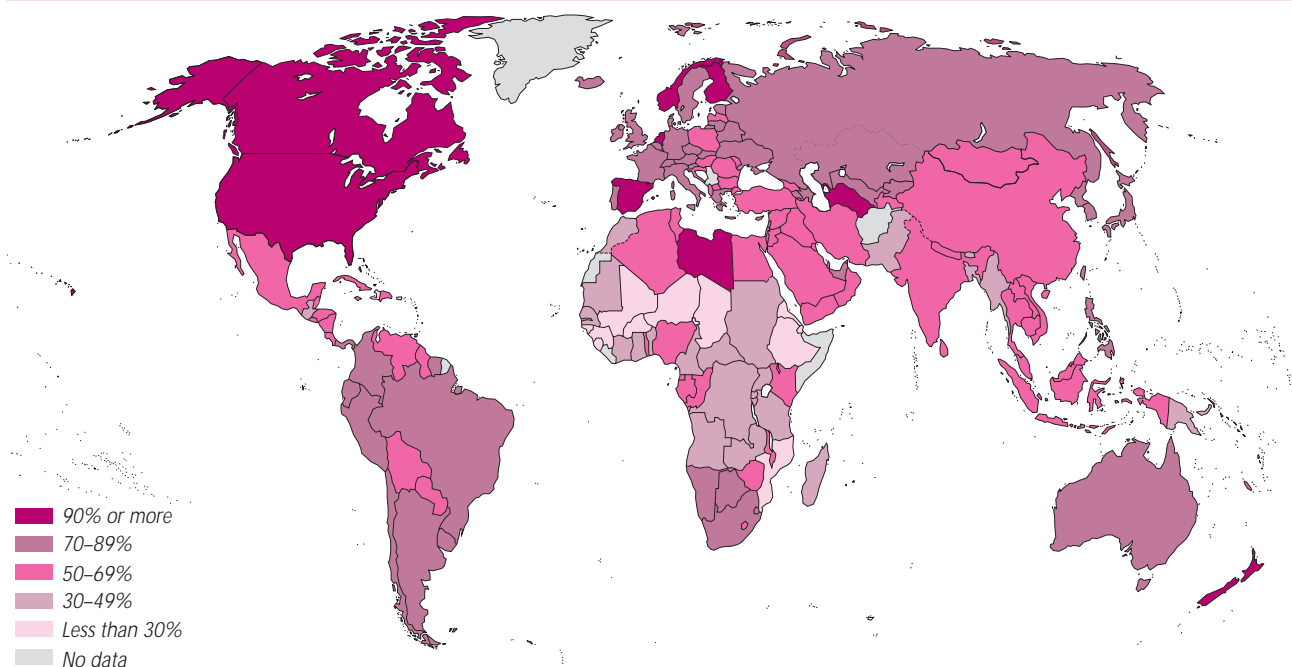
Source: *Human Development Indicators, 1997*, United Nations Development Programme

as the quantity of digital information multiplies and moves through ever higher capacity networks. Information can now travel to all parts of the world, across a city or nation, in basically the same time and at the same cost. Infrastructure investments will now go into information and communication technologies rather than into bricks and mortar, and it is incumbent upon policy makers and educational planners everywhere to become aware of the technologies available. They must be able to select the appropriate mix of affordable technologies to meet the needs of the country and its education system.

WHAT TELECOMS CAN DO

Radio and broadcast television have been used for years to extend the reach and delivery of education to many who wish to learn, particularly those in rural areas, while print has been the basis of distance education in correspondence courses. These one-way technologies can now be combined with two-way, interactive, multimedia systems that bring to learners, on demand, voice, video and data in text and graphics. These computer and network-based systems bring significant differences in both the application and the cost of technologies available for education.

"The complexity and cost of these technologies should not deter innovative experimentation that must precede large-scale use in educational settings," says a recent World Bank paper on Latin America and the Caribbean.[1] "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."

The challenge is to wisely integrate investment in technology with the national goals and strategies for education. "One of the greatest opportunities is that technology may eventually provide higher quality education to substantially more of the population." To work towards this vision, what educators such as Dr. Jon Peha of Carnegie-Mellon University in the United States propose is that programmes use a variety of technologies and services to help achieve a variety of functions in the learning process. He identifies the following categories of tools for delivering education.

Telecommunication tools for education

One-way, non-interactive

■ broadcast radio, e.g. All India Radio broadcasts farmer education and teacher training; Nepal and South Africa have hands-on training programmes for caregivers and kindergarten teachers; the Dominican Republic has a radio in-service Associates degree for teachers, including subject matter and pedagogy;

■ broadcast television, e.g. British Open University higher education on television is a model for mega-universities in the developing world; China's Television University trains science teachers; Thailand's Open University School of Education offers in-service certificates and degree programmes;

Singapore Telecom

Information and communication technologies can help countries reach the goal of universal access to education.

■ satellite television, especially to select audiences, e.g. Telesecundaria's well-established closed-circuit television to rural schools in Mexico and neighbouring countries; South Africa, Brazil and Zimbabwe's new satellite transmissions to 3,000 higher education sites; Galaxy Latin America's free access to two of 200 direct television satellite channels for teacher education;

■ satellite radio, such as the planned WorldSpace digital audio broadcast transmission that will cover whole continents, providing audio and data;

■ video and audio tape, e.g. Brazil's in-service programme for primary school teachers of mathematics and Portuguese; the USAID (United States Agency for International Development) rural health education programme; and Open University courses in the United Kingdom that use tape cassettes.

One way, interactive

■ interactive radio instruction such as the OLSET programme in South Africa;
■ the World Wide Web (the Web);

CORPORATE VIEW	Training in cable

CABEL-CON is keen to play a major role in the development of communication networks in countries where these services are new. A leading European manufacturer of coaxial connectors, the company is committed to training inexperienced technicians and installers wherever it operates worldwide.

Mobile telephone systems and cable television technology have made considerable advances over the last few years, increasing the need for fully trained personnel to install and maintain these networks. Cable networks have developed from simple, one-way networks to sophisticated, two-way communication tools, providing digital transmission services for television, radio telephone and data.

A chain is only as strong as its weakest link. The vital connections between cables and components on cable television and cellular radio networks are the most fragile elements in the system. If these connections fail to function properly the system will not be able to deliver data to the required standard. Additionally, badly fitting, poor quality connections have a detrimental affect on technical elements in the system including signal responses, and corrosion and mechanical damage is caused when cables are exposed to rapid changes in temperature. All these factors will adversely affect the system's operational capability and durability, service to customers and maintenance costs.

Cabel-Con's extensive knowledge and proven experience in this field is a result of many years of technical research and product development. Working in close cooperation with customers and leading cable manufacturers including Comm Scope and Alcatel, the company, which shares its industry expertise with its customers, has earned itself a reputation as an innovative market leader.

To avoid potential problems caused by inexperienced installation of modern communication networks, the company is actively involved in promoting education and training programmes. Seminars are being staged in the Middle East, the Russian Federation and Turkey in cooperation with local authorities, investors, operators, installers and distributors. These will enable system installers to update and extend their knowledge and techniques before becoming involved in the installation of new networks or upgrading existing, older cable networks to provide customers with two-directional communication on cable television networks. Tailor-made educational programmes are being developed to highlight the reasons for the importance of correct cable connection technology and the seminars will include papers on the use of audio/video equipment. In order to achieve the highest possible system performance levels, a long service life and minimum service costs, Cabel-Con is extending its training packages to existing projects.

Cabel-Con
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For further information see Annex B

■ Web-casting courses with interactive multimedia, streaming audio and video;

■ CD-ROMs with multimedia courses, including training;

■ read-only information sources, e.g. on-line journal archives.

An interactive approach can be used to help meet different educational levels and learning paces.

Two-way interactive

■ satellite two-way access to the Internet, or one-way downlink with return by telephone, such as eSat's Satellite Accessed Materials for Schools (SAMS), AlohaNet or Direct PC and OneTouch;

■ video conferencing in various formats with two-way video or audio return path, such as the multisite video broadcast and two-way audio from the United States Information Agency's Worldnet service; desktop or conference room compressed video for two-way or multisite video conferencing;

■ interactive multimedia with video conferencing window, shared whiteboard and applications, and chat window, such as CUSeeMe, ShareVision, NetMeeting over the Internet or an ISDN (integrated services digital network) line which can handle a lot of data very quickly;

■ audio conferencing by telephone conference calls with high-quality audio conferencing equipment or speakerphones and service provided by national and international carriers, used for discussion seminars, lectures with keypad response, support sessions for teachers;

■ e-mail, computer conferencing, listservers, file transfer and other one-to-one or one-to-many data exchanges;

■ widely shared information resources, e.g. shared databases.

In planning for distance learning and the use of education technology, Dr. Peha emphasizes that it is important to remember that education takes place not only in educational institutions (schools and universities), but also in homes, libraries and workplaces. These settings are growing in educational importance in many industrialized countries such as the United States, and this pattern may soon be replicated in other countries. Multi-purpose telecentres or community learning centres will provide access to such learning opportunities. Outside the traditional classroom, there may be more need for an interactive approach to meet different educational levels and learning paces. Using new technologies, courses can be distributed anywhere at times that are convenient to the learner.

TELECOM APPLICATIONS

Distance or distributed learning programmes have been the main vehicle for bringing new technologies to the classroom. From a combination of broadcast, wired or satellite-relayed transmissions, as well as radio, television and computers, students may respond to distance learning programming through the use of mail, faxes, telephones, microphones, keypads or computer transmissions. Radio, especially interactive radio instruction, has been widely used, from Bolivia to South Africa, and has been generally effective. These technologies continue to improve. Digital audio radio, via broadcast or satellite, is coming soon from WorldSpace. Television has been widely used in the United States and Canada, but its spread has been slower in developing countries.

The foundations of distributed learning

Pre-school radio in Bolivia

Jugando en el PIDI (Projecto Integral de Desarrollo Infantil) uses radio to create active learning environments in small, home-based child care centres throughout Bolivia. Pidis are run by women who have been in formal education for two years or less. The programmes encourage the children and their caregivers to play games, engage in learning activities and sing songs, following what the radio characters do. One of the characters, Tía Clara, also explains to the caregivers how they can help the children's development. The programme provides stimulating age-appropriate activities for the children and professional development for the caregivers so they can continue to support the children in their care.[2]

Interactive radio instruction…

Interactive radio instruction (also known as IRI) has evolved over the last 25 years since Stanford Professor Patrick Suppes and his team in the United States first developed a radio mathematics curriculum for use in Nicaragua in the 1970s. It has been implemented in Africa, Asia and Latin America with remarkable results in learning and in cost-effectiveness. Summarizing the research findings and analysis of programmes in over 20 countries, Andrea Bosch reports that interactive radio instruction is still proving to be cheaper and more effective than alternative programmes, more cost-effective even than printed textbooks. Bosch describes its methodology:

"the 'audio teacher' carries the main weight of the teaching, and directs learning activities (exercises, answers to questions, songs, and practical tasks) which take place during carefully timed pauses in the audio script, utilizing the classroom teacher as a facilitator… The IRI methodology is also different in that it requires learners to react to questions and exercises through verbal responses to radio characters, group work and physical and intellectual activities while the programme is on the air."[3]

In their 1980 report on the five-year Radio Mathematics in Nicaragua programme, the Stanford researchers Suppes, Friend and Searle summarize their findings on student achievement: "At all grade levels, students learn the topics taught by the radio lessons better than students learn in traditional classrooms, as measured by a test of mathematics achievements."[4] They also found that in many homes in rural and urban areas (37 per cent of those surveyed) the mathematics lessons were listened to regularly, suggesting that the popularity of the programme could serve to reach the large rural adult population.

… and the development into computers

While interactive radio instruction was being expanded, refined and implemented in many countries, the Suppes team continued during 1968-1980 to develop computer-assisted instruction for university courses on mathematical logic and set theory, which have been taught without lectures since 1974. Foreign language instruction by computer-assisted courses was also developed.[5] The Suppes team has now developed a multimedia computer and Internet-based distance learning Education Program for Gifted Youth offering

OLSET INSTRUCTION BY RADIO: COSTS PER STUDENT DECREASE AS NUMBERS INCREASE *(projections)*

Cost per student

Number of students

Source: OLSET

telecommunications
& *Education*
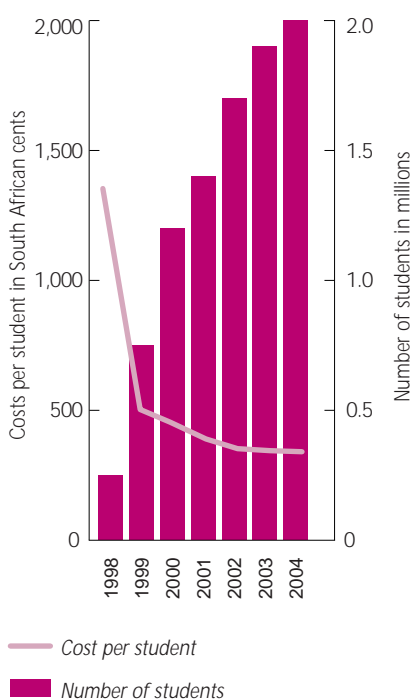
30 courses in mathematics, physics and expository writing to over 1,500 elementary and secondary school students in countries including Brunei, China, Mexico and the Republic of Korea, as well as within the United States.

Costs of interactive radio instruction

The World Bank has done a cost analysis of interactive radio instruction programmes as they have been implemented in various countries. The costs of

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CASE STUDY | Improving teaching quality

OBJECTIVES

■ The OLSET programme was begun in the 1990s to teach language and mathematics in a cost-effective way to primary school children (although students' ages may range from 6 to 16 years).

■ To improve the quality of teaching and make learning more relevant and fun.

■ To reduce the high drop-out rate from schools in South Africa (50-60 per cent).

BACKGROUND Gordon Naidoo, Director of the OLSET programme, explains that there is a fundamental shift in the area of education as South Africa goes into the new millennium. He says that the interactive radio instruction approach was chosen for a number of reasons, partly because of its success in Latin America, parts of Asia and in the Caribbean, and partly because radio is a dominant medium in South Africa. Mr. Naidoo makes no apologies for the use of traditional radio as opposed to the more advanced technologies available. Interactive radio instruction makes the learning process participatory for students who had been on the margins of the education system under apartheid.

DESCRIPTION The student is seen as the key element, supported by the teachers and the radio programmes. The radio programme, the teacher, the student and the teacher notes and other print materials all work together. The radio programmes are produced locally in South Africa, in cooperation with the South Africa Broadcasting Corporation. The print materials are prepared in conjunction with the radio programme, all carried out in-house by OLSET's own staff.

The English in Action programme was designed specifically for African primary pupils in South Africa. It included a strong teacher support and development component. Audio lessons were delivered by cassette during the pilot phase, and then broadcast on the radio.

COSTS OLSET spent about US$1.43 million (5 million Rand) over a three-year period to produce its English in Action programme. Salaries, including managers, writers, radio producers, engineers, desktop publishing staff, actors, musicians and composers, and regional coordinators accounted for some US$386,370. Travel costs came to US$100,100, of which half was for regional coordinators visiting schools and communities. Studio rental; training; buying radios, tapes and batteries; and printing teacher guides, workbooks, posters and charts came to some US$328,900. US$71,500 was allocated for evaluation, and administration and overhead charges were US$543,400.

Implementation varied between schools, and the cost per student per year for materials acquisition and airtime therefore ranged between US$1 and US$8.50. The cost of teacher development and support was US$40-180 per teacher for the first, most intensive, year and US$25-60 in subsequent years.

RESULTS Recent analysis found the cost per student of OLSET's English in Action programme ranged from one-third to one-half of that of other English language programmes analysed. It is now broadcast countrywide, suggesting that the recurrent costs associated with maintaining the programmes are considered justifiable.

Formal evaluation is now being carried out and is critical for quantifying the success of the approach. In the meantime, Mr. Naidoo considers the programme "best for the country, as well as being cost-effective". The students enjoy it, because of the games, music, rhymes and dancing. The programmes are repeated so students who miss any as a result of illness, or for other reasons, can catch up.

Mr. Naidoo concludes, "The half-hour radio programme in the classroom is critical in engaging the children in a dialogue with the teacher. This may seem a very simple idea, but in rural areas the exercise works extremely well."

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running an interactive radio instruction programme in primary schools in a typical large-scale programme in a Latin American country[6] provide a useful guide for those wishing to consider such a programme elsewhere. Based on an eight-year programme for a million students, the total investment cost would be US$5 million, of which US$1 million is needed for programme production and some US$3.25 million for start-up costs, including upfront training. The investment cost per student, spread over the eight years of the programme, comes to 94 cents a year. This compares with an annual recurrent cost per student of US$2.32. The recurrent costs include US$500,000 a year for airtime (a good area for savings if time can be donated for educational programming); US$500,000 a year for production of related print materials and cassettes; and US$366,667 a year for training and training supplies. The total cost per student per year, over the life of the programme, is US$3.26. This figure is low relative to the cost of providing books, and the cost per student decreases proportionally with increased numbers of users.

CORPORATE VIEW	The CyberLibrary

FOUNDED in 1995 in the United States, Helius is committed to improving server-based networks in ways ranging from faster access and delivery of information to more user-friendly approaches to server software.

The company developed the first software to manage Internet transmissions from satellite to local area networks, bringing this service to all computer users on the server network.

Insufficient infrastructure often limits the use of the Internet in schools where it should be a valuable educational tool. Satellite-based Internet access solves this problem by delivering information at high speed and low cost anywhere in the world.

In 1998 the company teamed up with IBM to provide a remote school in Canada with this service, which had previously been available only in metropolitan areas. This was achieved by combining Helius's software with IBM's Net Vista satellite to provide a complete Internet solution designed to work with computer networks in schools today.

Before being able to tap into this system, the school was limited to five computers positioned in the library. Accessing some Internet sites could take several minutes, which meant that students became distracted while waiting for the information to be delivered. The speed and efficiency of the Net Vista satellite have transformed the Internet into an effective teaching tool. The school has moved the computers from the library into the classroom and expanded Internet access to 30 computers. The caching feature, which is part of the package, gives students and teachers instant access to any site that has been called up in the last 24 hours, making broader classroom use possible for the first time.

In another joint venture, this time with JDL Technologies, Helius is delivering a similar service to schools. Software developed by Helius is used by JDL's satellite server to receive high-speed satellite transmission of Internet data on a schools' local area network.

Research on learning shows that "time on task" is a critical element in student achievement levels. The difficulties of trying to access appropriate curriculum material from immense resources rapidly can be a negative aspect of Internet use. The CyberLibrary, which forms part of this system, channels the right information to the right people, enabling students to practise their on-line accessing skills while at the same time reducing their surfing time. This in turn provides more opportunities for using, and learning from, the downloaded materials.

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For further information see Annex B

Other important measures are incremental costs to continue the programme and the marginal cost of adding students. For example, running the mathematics programme in Bolivia in 1991 cost US$1.51 per student the first year, including the development costs, for 200,000 students. That would fall to US$1.04 per student for 600,000 students. For the initial 200,000 students the incremental cost to sustain the programme per year was only US$0.81 per student after the development stage. The highest cost item is radio broadcasting. Bolivia educated over a million learners over nine years through its mathematics and health broadcasts integrated into the national curriculum.[7]

The printed matter

Instructional radio – programmes such as OLSET in South Africa – and educational television, such as Telesecundaria in Mexico, use print materials to

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| CASE STUDY | Education via satellite |

OBJECTIVES
■ To reach everyone, in even the most remote rural areas, with quality education by satellite television.
■ To provide tele-education for students aged 12-14 years.

DESCRIPTION The Telesecundaria system has been running in Mexico for the past 30 years. It is the largest tele-education, curriculum-based system in the world, used by over a million students in 12,000 schools, and covering the first three years of secondary school (ages 12-14). Telesecundaria's satellite television broadcasts reach everywhere in Mexico, as well as parts of the southern United States and Latin America. An agreement is under discussion with seven Latin American countries to use the system, with some modifications that will adapt it to their own needs.

"Telesecundaria has been developed to reach everyone with quality education which means equity and democracy," says José Calderoni, Research and Development Coordinator at the Instituto Latinoamericano de la Comunicación Educativa (ILCE) in Mexico City.

Teachers and students both enjoy this way of learning. The television lesson on geometry, for example, is broadcast from 08:00 to 08:15 hours. From 08:15 to 08:50 the teacher opens the linked books and follows up on all the exercises. By this time the student has a good understanding of the visual presentation. Lessons are available in a number of subjects including chemistry, sociology, mathematics and geography.

COSTS Telesecundaria delivers education to students and training to teachers in remote rural areas of Mexico at a cost of US$554 per student per year, less than the regular secondary school system. The investment costs are mostly in programme production and facilities, and total about US$95 million per year. Recurrent costs of broadcasting, all school personnel, training, maintenance and operations, and central administration costs are about US$331 million. Total annual costs for Telesecundaria are US$425.75 million to teach 767,700 students. The television component of these costs (scripts, programming, materials, satellite antennas, television receivers, video cassette recorders (VCRs)) is only $44.34 million per year, or $57.76 per student, plus another $2 million in broadcasting costs, or $2.66 per student. About $60 of the $554 per student is for the television programming and delivery.[8] Mr. Calderoni indicated that Telesecundaria was very proud of what it has achieved so far. He is also aware that the system is not yet interactive, but this is not financially feasible at the moment.

RESULTS The Telesecundaria model is so popular that there are requests to increase it to ages 15-18 years, and the organization is working towards this goal. Plans are for a complete secondary school programme to be distributed on a national scale by 2002.

The future of Telesecundaria is interaction, with computers and the Internet, and this is planned within the next few years. RED ESCOLAR, a pilot begun in 1996 by ILCE, uses computers and the Internet in 144 primary and junior high schools and 32 teacher centres across the country.

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Reforming primary and secondary education

OBJECTIVES

The Costa Rican Computers in Education Programme was created in 1988 to help improve the quality of Costa Rican education and to provide access to technology to students in rural and marginal areas. The programme, which is a joint effort of the Ministry of Public Education and the Omar Dengo Foundation, has been designed to stimulate creativity, cognitive skills and collaborative work.

Chile launched Enlaces as a pilot project in 1993 as part of a much larger and more comprehensive reform to enhance the quality of primary and secondary education. The goal of Enlaces was to create a telecommunication and computer network among 100 Chilean primary schools and associated institutions, to promote cooperative learning, higher level thinking, data management and communication skills.[9]

DESCRIPTION

Typical schools in the programmes	Costa Rica	Chile
Student enrolment per school	1,080-1,604	400-1,100
Student: computer ratio	53-73:1	68-137:1
Principal software applications	e-mail, LogoWriter	e-mail, KidPix, ClarisWorks, La Plaza
Availability of computers per school	18-20	5-9
School locations	urban, rural, peri-urban	urban, peri-urban
Community access to technology	in all 5 schools	1 school of 6
Integration of technology applications and curriculum	not a programme priority	high priority
Years in technology programme	5-8	2.5-4
Ages with access to technology programme	pre-school to 11	pre-school to 13

COSTS Cost models for computers in schools, drawing on experiences in Chile, as well as Jamaica and Belize,[10] were developed for large urban schools of 600 students and small rural schools of 150 students. Both had the same two contact hours per student per week. The large schools had 22 computers with an estimated annual cost of US$74 per student, of which US$51 is recurrent. Rural schools had six computers with a cost of US$98 per student per year, of which US$71 is recurrent.

Surprisingly, the recurrent costs are substantially higher than the annualized investment cost. For example, the investment costs in equipment, software and training were US$54,350 for large schools, which are annualized at about US$13,500 per year. The recurrent costs for personnel, maintenance, computer supplies, training, utilities, telephone and Internet service totalled US$30,653 per year. The total annualized cost therefore is US$44,153 for each school. For small rural schools, the investment costs were US$15,320 and annualized at about US$4,042 per school. The annual recurrent costs for rural schools are estimated at US$10,708. The total annual cost per rural school is about US$14,750.

The cost data for the Enlaces programme are similar.[11] For a small primary school with 75 students, total costs average US$78 per student annually, of which only US$17 is for recurrent expenditure. For larger schools of 200 primary students, the costs are US$56 per student, US$16 of which are recurrent.

RESULTS The Costa Rican programme reaches nearly 30 per cent of the total elementary school population, and the Ministry of Education has now expanded its high-school programme to cover 100 per cent of high schools.

By the end of 1995, Enlaces had substantially surpassed its original targets and had incorporated computers into some 180 schools at both the primary and secondary levels (although this number is only a small percentage of Chile's 8,250 primary schools and 1,700 secondary schools). Enlaces was recently converted into a national programme by the Ministry of Education and given the political and financial support to incorporate all secondary schools and half of all primary schools by the year 2000. By the end of 1997, there were close to 900 primary schools and 450 secondary schools engaged in the Enlaces network.

Both projects are undergoing important changes. Costa Rica is currently launching a new phase of its computer programme which has many exciting features, including a new computer platform with up-to-date telecom and multimedia capabilities, in primary schools, and is expanding its programme generally, investing in the pre-service training of teachers and helping teachers acquire their own personal computers at a discount.

Meanwhile, Enlaces is fast becoming a large national programme which will make the Internet increasingly available to teachers and students in Chilean schools. This development promises to bring about new opportunities for using computers for teaching and learning in the next century. Likewise, within the Costa Rican Computers in Education Programme, training and follow-up will increasingly take place through distributed learning processes using Internet and Intranet sites.

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supplement the broadcast lessons. An underpinning of electronic publishing will soon deliver customized texts, workbooks and activity sheets to learners and teachers. The electronic networks and the Web will store, find and deliver the information, or content of the curriculum, to the schools and learning centres. Up to now this information has usually been delivered as text to be read on the computer or printed out in the chosen language. Now the content can come as video or audio presentation with the new video streaming and audio streaming technologies.

Active and interactive: the way forward

Interactivity plays an important role in retaining the student's interest and ensuring quality education. A constraint on the effectiveness of early distance learning was the isolation of the learner, the lack of timely feedback, and the limitations of one-way broadcast of print, audio and video content. Interactive radio instruction was still one-way radio, but students learned in a group, were active and responded to the radio teacher's prompts, and they had the support and guidance of a local teacher or aide.

Information and communication technologies offer tools that can make active, and effective, learning possible. Efficiency is increased as learning is delivered electronically to large numbers of students. A master teacher can teach students in many schools and sites at the same time, or produce learning materials that can be accessed and used anytime, anywhere from the Internet.

Key elements to consider when planning interactive distance learning are that:

■ it can be delivered anywhere the network reaches;
■ it combines the voice (audio) of the teacher, a short lecture or demonstration (video) and text and graphics (data);
■ it can be received or accessed when convenient (anytime, on demand);
■ learners can question the teacher and submit assignments;
■ learners can discuss with peers at other locations (conferencing).

Two initiatives that are part of the UNESCO (United Nations Educational, Scientific and Cultural Organization) Learning Without Frontiers programme exemplify the interactive approach. In Istanbul, Turkey, the Faith Park project provides a distributed learning environment for low-income urban youth and others (including older adults) in an abandoned Byzantine cistern. Computers, video equipment, Internet connections, software and videos are available, as well as more traditional learning, recreational and sports spaces, so that users can move freely between rooms to learn about whatever they wish. Facilitators are there to help as required. Some 17,000 members have paid US$1.00 each (plus 10 cents for each additional family member) to join, and the project has been so successful that three more Turkish learning parks are being developed.

In Malaysia, the Smart Schools project is being piloted in 90 schools in 1999. Each school will be equipped with computers and Internet connections to allow new possibilities for accessing information from multimedia resources including a specially designed learning network. Students will be encouraged to follow a balanced curriculum at their own pace, with the aim

Using the Internet as a learning tool helps students become technologically literate and creative researchers.

3COM

of fostering the development of technologically literate, critically thinking and creative individuals.[12]

Higher education

The Zimbabwe College of Distance Education is launching an interactive distance learning system, transmitted by satellite. Connecting 3,000 sites, it will deliver higher education at a system cost of US$4.2 million. Australia, Brazil, Chile, Ecuador, Ethiopia, Israel and South Africa have also built such networks for adult and higher education. South Africa transmits skills training and adult education to over 100 sites. In Brazil, Bahia is one of two states to team up with a university to deliver distance learning to remote campuses. São Paulo business television operator KTV provides interactive distance learning services. The sophisticated teaching studio equipment enables instructors to produce their course material and presentations in a record two-three hours per one-hour presentation.

CORPORATE VIEW | Business television

BUSINESS television via satellite is a fast, cost-effective way of delivering high-quality video information, to provide companies with a well-developed and totally secure link to dealer networks, regional branches, stores, shareholders and customers.

Companies in South Africa are now benefiting from the considerable possibilities of business television. A firm can take its key messages to an unlimited number of sites across the country, marketing the corporation to managers and their employees monthly, weekly or even daily and obtaining instant feedback, as well as motivating, encouraging, congratulating and training staff.

With business television, messages are transmitted, immediately and simultaneously, to everyone a company needs to reach, wherever they are. As with commercial satellite television programmes, the material is transmitted in a scrambled format, through the Global Access network, to a number of designated receiving points. Each one has to be equipped with an integrated receiver decoder, a de-scrambling device, a television set and dish antenna.

A company using business television for corporate communication has to decide whether it wants to transmit live or pre-recorded material. A team of production specialists assists with the programme. Business television can be transmitted from one of the Global Access television studios or, using outside broadcast vehicles and temporary microwave links, from any venue, including the corporate head office.

Global Access South Africa is also at the forefront of a new, emerging requirement for satellite transmissions called "data casting" – the transmission of information from one central source to a large and potentially unlimited number of geographically dispersed receiver sites at the same time.

The company already offers data satellite services for this "broadcast" approach to handling information. Demand for these services is growing as companies start to exploit the various business opportunities the new technology makes possible. For example, new electronic tills can be updated via satellite if the same pricing is required across the continent. All transmissions can be encoded to stop unauthorized reception.

Global Access has formed a number of alliances with leading educational institutions across South Africa, to package existing and new course material to the specific requirement of the individuals. This alliance broadens the student base by providing true national coverage through implementing a cost-effective solution and ensuring that a wide range of fully accredited and certified courses are available to an unlimited number of people.

Global Access South Africa
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Website: http://www.globalaccess.co.za
For further information see Annex B

telecommunications
& *Education*

Early experiments in Web-based courses for adult or tertiary education indicate that properly designed Web-based lessons, modules, courses and learning opportunities for children will also be effective. This should be an efficient and cost-effective means of providing educational opportunity as the content is available, in multiple languages, and accessible worldwide to millions of children who have access to the Internet and Web. The cost of moving the information across the global network is not the problem. The limitation is likely to be in providing access to networked computers for enough time for the many millions of children and adults who want to learn.

CASE STUDY | **Science and engineering**

OBJECTIVES
■ To train engineers, scientists, business managers and health care providers in sub-Saharan Africa.
■ To promote the production of academic content and research by African academics.

BACKGROUND
Lack of funds, infrastructure and teaching staff has meant that sub-Saharan Africa lags behind the rest of the world in tertiary-level learning opportunities. The use of new technologies in the "virtual university" model means quality lecturers, libraries and laboratories can be shared by students and organizations in physically unconnected, and even remote, places.

DESCRIPTION
The African Virtual University is being set up to provide distance education in science and engineering to higher education institutions in sub-Saharan Africa. Courses are offered by satellite television, supplemented by the Internet, and at an affordable price. This virtual university is designed as a collection of educational franchises located throughout Africa, coordinated by a central umbrella organization. Headquarters staff purchase the best distance education curricula and instructional materials available worldwide and adapt them for local use. The staff also provide tutoring, train professors and assistants, and install and service required hardware and software.

FACILITIES AND EQUIPMENT
■ Cordless push-to-talk conference system.
■ Personal computers for classrooms.
■ Laser printer.
■ Fax machine (Group III).
■ Access to the Internet.
■ 4.5 metre C-band receive-only antenna.
■ Large colour television monitor.
■ Video cassette recorder.
■ Compressed video receiver decoder.

COSTS
Currently funded by the World Bank and infoDev in its research and development phase, the university is being structured to be self-financing once it is fully up and running. Students pay for their courses and this income pays for investment and operations.
■ Student tuition and fees for credit courses will be US$300 per academic year and students will take four credit courses in each of three terms, giving a per course tuition cost of US$25.
■ A conservative estimate of the cost of international satellite transponder access is US$2 million per year for the initial four digital channels.
■ All other costs of operating the university on an annual basis are estimated at a multiplier of three times the cost of transponder access (based on the operating budgets of other satellite-based distance learning networks, but adjusted by a significant increase for course development and production, student support services and international operations).

To achieve positive net income when the university is fully operational with eight channels of programming serving students in 35 countries in sub-Saharan Africa, it will be necessary to have four to five student registrants paying US$25 tuition for each of the 442 credit courses at the 260 sites.

RESULTS
Begun in 1997 on a pilot basis, the university now operates with 16 partner organizations in Africa. In the 1998-1999 academic year it is offering courses at 25 campuses in 15 African countries including Ethiopia, Ghana, Kenya, Uganda, Tanzania and Zimbabwe.

Obviously no quantitative results are yet available, but the project has already developed a central digital library to compensate for the low numbers of scientific journals in African universities.

CONTACT
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The World Bank
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Fax: +1 202 614 0188
E-mail: avu@worldbank.org
Website: http://www.avu.org

UNIVERSITY	STUDENTS
Anadolu University, Turkey	577,804
China TV University	530,000
Indira Gandhi National Open University, India	424,000
Universitas Terbuka, Indonesia	353,000
Sukhothal Thammathirat Open University, Thailand	216,800
CNED (Centre national d'enseignement à distance), France	184,614
Open University, United Kingdom	157,450
University of South Africa	130,000
Payame Noor University, Iran	117,000
UNED (Universidad Nacional de Educación a Distancia), Spain	110,000
Korea National University	21,057

Links from the African Virtual University site include this page which gives access to student news worldwide.

University distance learning in the Caribbean

Distance education connects the islands of the Caribbean through a programme of the University of the West Indies and the Caribbean Development Bank called the University of West Indies Continuing Studies and Distance Education Project. The region puts a major emphasis on education, typically spending the equivalent of 5 per cent of gross domestic product (GDP) on this sector. However, enrolment in tertiary education is still low (6 per cent of the population). The goal of the project is to increase this tertiary enrolment level and double distance education enrolment in the region by the year 2000. The impetus of the initiative is to position the Caribbean region to take advantage of any changes in future economic activity (the knowledge economy).

The initiative, started in 1992, involves the development of 27 learning centres in 16 Caribbean nations. Overall, the technological aspects are secondary to the development of a support system for human resources development. The Caribbean Development Bank is investing over US$9 million in infrastructure (equipment), content development and human resources development and support.

Mega-universities at a glance

In addition to the African Virtual University, described in the case study, there are other mega-universities delivering distance learning degree programmes. The table shows their respective number of students per year. These 11 mega-universities serve 2.8 million distance students at an average annual cost of US$350 per student.[13]

Teacher training and development by distance education

Teachers in remote villages are said to be the most isolated and unsupported professionals in developing countries. Research done by Hilary Perraton on the use of communications and distance learning for teacher training, development and support highlights new opportunities for professional development for those teachers on the periphery.

The number of teachers that need and want pre-service and in-service training, continuing upgrading of skills, training in using the new technologies and instruction on teaching new curricula and advanced subject matter are huge. These training needs cannot be met by on-site teacher training. The communication technology of the Internet/intranet, wide area networks and video and audio teleconferencing can provide the infrastructure ministries of education and teacher training colleges need so they can deliver ongoing instruction, guidance and support.

Distance education programmes are providing pre-service, in-service and continuing training for teachers in many countries. A few examples include:
- Pre-service training for inexperienced teachers was provided to 45,000 school leavers in Tanzania for universal primary education.
- In-service training for experienced teachers is provided by Brazil in its Logos II programme.
- The Open University in Sri Lanka offers courses for secondary teachers lacking professional qualifications.

telecommunications & *Education*

■ The University of Nairobi offers a B.Ed. by distance learning as an in-service programme aimed at professional development of teachers in Kenya. Distance education technologies that allow teachers to increase their competence without leaving their schools, and technologies that support interaction between students and tutors, will play major roles in reducing isolation and in developing professionalism. Interactive technologies using sound, animation, video and visualization enable teacher training courses at a distance to demonstrate good teaching practices, enable visualization of difficult or abstract concepts and create opportunities for effective simulation of experience.

New sources of information and knowledge for self-development and use in classroom instruction are now available on the Internet. Educators in developing countries can design their own national websites for education. Active two-way communication such as e-mail keeps teachers involved, learning, exchanging ideas and feeling less isolated.

CORPORATE VIEW — Helping educators

A S THE WORLD's largest producer and buyer of non-fiction television programming material, serving 143 million subscriber homes on all continents, Discovery Communications is helping to satisfy the desire of people everywhere to learn, through its television and non-television media platforms.

The company currently distributes 25 distinct network services, achieving a global reach through 32 different network feeds that are transmitted over 15 satellites in 24 languages across 144 countries. Its network and programming distribution division around the globe includes Discovery Channel and Discovery Kids, as well as joint-venture channels Animal Planet and People+Arts with the BBC. Programming covers science and technology, nature, history, human adventure and world culture. The networks offer customized content for each regional outlet. The company gives priority to education, helping educators, students and parents to expand the boundaries of learning through quality programming and interactive educational tools. Through alliances, both in the United States and, increasingly, in developing countries, it continues to create a library of content for the classroom, as well as provide the ability to deliver that content over various electronic platforms.

In Argentina, for example, Discovery Latin America-Iberia and the Confederation of Education Workers are partners in a project to enrich schools' curricula using cable or satellite television and the Internet. Discovery Asia is working with education ministries in countries from the Philippines to Thailand on inter-school quiz competitions for prizes that include computers, television sets, video cassette recorders and educational materials for their schools. Discovery Channel India recently launched a two-hour children's programme block, and is increasingly seen in the region as an educationally valued service. The company is also spearheading the establishment of the Discovery Channel Global Education Fund, a public non-profit organization which aims to provide hardware and culturally appropriate programming, as well as training, free of charge to disadvantaged populations worldwide. The Fund has installed equipment in ten schools and community centres across South Africa, reaching 9,000 students and their families. The Fund actively seeks corporate donors as the initiative continues to expand around the world.

The company began as a small cable programming set-up in 1986. Today, it is a global media enterprise, with nearly 4,000 employees, also encompassing multimedia, on-line services, video, publishing, catalogues and licensing. Through factual, entertaining and culturally appropriate programming and services, it aims to provide people around the world with the information they need, and to use state-of-the-art telecommunication technology to deliver educational benefits, particularly to developing and emerging economies.

Discovery Communications
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Website: http://www.discovery.com
For further information see Annex B

Teachers have been trained for years by correspondence courses, but information and communication technologies create a more efficient and perhaps even more cost-effective means of teacher education. Recent analyses compare the costs of teacher training by distance learning with conventional on-campus training costs. They range from 17-33 per cent of the alternative in Sri Lanka to 40 per cent in India, 50 per cent in Tanzania and 60 per cent in Indonesia.[14]

The ITU and distance learning for telecoms

The International Telecommunication Union (ITU), which is the United Nations agency dealing with telecommunication matters, has over the last 30 years done a great deal in the domain of training for people in developing countries and has used, in recent years particularly, electronic distance learning techniques. A pilot project called TeleProject was initiated in the early 1990s and at the outset concentrated on the development of stand-alone computer-based training material. This initial activity has evolved, with the increasing

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CASE STUDY | Training primary school teachers

OBJECTIVES
■ To strengthen primary school teachers' competence in curriculum subject areas.
■ To create awareness of child-centred and activity-based approaches.
■ To ensure uniformity of standards by bridging gaps in teachers' qualifications and training.
■ To improve academic standards among pupils.

BACKGROUND The National Council of Educational Research and Training is operating a scheme, sponsored by the Ministry of Human Resource Development, which will eventually provide training to 1.8 million primary school teachers. It has started with a pilot phase.

DESCRIPTION The scheme is called SOPT – Special Orientation of Primary School Teachers. It consists of a seven-day training course, using one-way video and two-way audio links, uplinking programmes from the studios of the Indira Gandhi National Open University. The course is presented to a group

of teachers, averaging around 50 at any one location.

Each half-day session consists of a video presentation/demonstration, a panel discussion, two interactive sessions and a group activity session. Facilitators are trained in advance to handle the equipment and to conduct the sessions in a face-to-face mode. The interaction is made possible by telephone and fax connections to the University.

COSTS The pilot project was budgeted at Rs5,600,000 or approximately US$145,000 for both hardware and software components, including the installation of receiving dish antennas at reception sites. It aims at providing training to about 6,200 primary school teachers in six cycles, and covering the three states of Karnataka, Madhya Pradesh and Assam. The cost per teacher is therefore Rs900 or approximately US$23.

In addition, the project has helped install permanent receiving facilities at about 70 locations.

RESULTS Evaluation of the pilot sessions at eight centres found a

significant gain in teachers' knowledge and confidence after attending the training. Testing was carried out before and after the course and the highest levels of improvement were found in art education, the concept of minimum levels of learning, health and physical education, and the teaching of mathematics.

The centres initially faced problems in receiving the television signals because of lack of information and technical difficulties, but these were overcome by the second or third day of the course.

The teachers all participated enthusiastically in the interactive sessions, welcomed the training, including the technological element, and considered that the course content would be useful to them in their work.[15]

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sophistication of information and communication technologies, to the delivery of distance learning from the ITU Virtual Training Centre (i.e. a training centre offering its services via networks). Through this centre ITU has already provided a number of courses on distance learning including Developing Distance Learning Material and Using the Internet for Distance Learning. Additional courses now in preparation will include network planning and management.

The Virtual Training Centre also purchases and redeploys thousands of technology-based training licences among ITU members. For example, 300 one-year site licences for the computer-based Communications Manager series (more than 150 hours of management training in telecoms) have already been redeployed. Twice in 1998 a virtual course on radio spectrum management was delivered to 40 participants who work for some 30 telecommunication organizations in various countries of Latin America. Three tutors, in different locations, led the training while guest experts, for example in legal and financial considerations, were used at appropriate

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CORPORATE VIEW	New ways to improve the system

IN PREPARATION for deregulation Korea Telecom (KT), the Republic of Korea's leading telecommunication carrier, undertook a series of tests on the latest technology to ensure that it was well positioned to meet the competitive challenges of the future. By installing two cutting-edge networks, KT Fiber City and KT Wireless Testbed, Korea Telecom ensured its position among the market leaders.

MainStreetXpress switches, supplied by Newbridge Networks, were used as the main switching elements for both networks. The KT Fiber City project initially identified which applications were considered to be important by Koreans and where their priorities lay. One of the most important requirements to emerge from this project was the need to find new ways of improving the education system in response to demands from parents, schools and universities. As a result, Korea Telecom invested in the infrastructure to provide, amongst other facilities, interactive distance learning and video-on-demand educational services.

This system was one of Asia's first commercial high-speed multimedia services. The network, which consists of three different sites on Yoido Island, is connected by high-speed trunks, and traffic on the network is directed by three Newbridge Networks MainStreetXpress switches. Servers supplying video-on-demand, electronic news, libraries, distance learning programmes and access to the Internet are also positioned at the Yoido Island site, where telemedicine is soon to be incorporated. Another MainStreetXpress switch has been installed at the KT Multimedia Interactive Centre, which is open to the public who can experience the latest technology in action.

The wireless test bed developed by KT uses high-frequency radio signals. This system provides an enormous amount of capacity, making it an ideal vehicle for the delivery of high-speed, capacity-hungry multimedia services. In addition, it bypasses the need for copper cable pairs and the challenges posed in providing and commissioning these cables to carry the high data rates required for modern applications. Here, the MainStreetXpress switch was used as a base station for the wireless network, demonstrating its flexibility. The full capabilities of the network are still being tested and Internet, voice, data and video are being analysed with a variety of interface options.

This technology, which can also handle the new, digital, video broadcast standard, is likely to revolutionize television and video viewing in the very near future, with implications for developing countries seeking to upgrade their systems as deregulation in the telecommunication industry increases.

Newbridge Networks
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For further information see Annex B

moments during the course. Regional workshops on distance education and training and telecommunications have been held around the world, from Mauritius to the south Pacific, in many cases using personal computers (PCs) connected to the Internet plus small, low-cost video cameras, giving video conference capabilities. In 1999 the Virtual Training Centre of ITU expects to provide distance learning experiences to some 5,000 students around the world.

This evolution of the Virtual Training Centre was planned so it could provide a test bed for a virtual telecommunication university. The idea of a tertiary-level organization followed discussions at the 1994 World Telecommunication Development Conference in Buenos Aires. The idea was pursued through electronic and traditional round tables and a feasibility study (carried out by a small task force). The Virtual Training Centre, as it develops, could represent a partial response to this idea, but discussions with interested universities and professional societies around the world are now at an advanced stage.

CORPORATE VIEW	Finding the money

ESTABLISHED in 1995 with the emergent telecommunication industry as its focus, V-COMM delivers telecommunication engineering and consulting services to its clients in the sector. With a unique blend of engineering expertise, operational experience and financial capabilities, the executive management team has significant experience in the operation of large telecommunication networks. This experience, combined with the operational skills of the engineering team, allows the company to assist its clients in planning, designing, implementing and operating high-quality networks which are both reliable and competitive.

Operators in emerging markets often lack the expertise of an in-house engineering facility to assist with their business plan development, system design and project implementation. Through its "virtual engineering department" approach, the company has enabled many of its clients to design and implement their telecommunication networks. During the first phase of this approach a solid business plan is developed, incorporating market statistics, competitive landscape information, technology analysis, infrastructure and working capital requirements. A full network design and roll-out plan is then integrated into the marketing plan. Finally, this information is consolidated in a format which will be acceptable to financial institutions. By approaching financial institutions on behalf of its clients, V-COMM has a high success rate in obtaining finance for their projects. A similar process occurs when infrastructure vendor finance is sought, often in combination with a formal request for a proposal.

During implementation, the company assists its clients in developing an operations plan to manage the network once it has been launched, including the interviewing, hiring and training of personnel. Additionally, it develops accounting and administrative functions, billing and collection services and customer service systems. These value-added services are crucial in emerging markets where resources can be limited.

The company's virtual engineering department suite of services is also available to existing operators. As worldwide competition in the telecommunication industry escalates, it is the expertise to be found in companies like V-COMM which make the difference, delivering uncompromising network quality, significantly increasing a client's return on investment. The company's value-added products, experience and expertise have enabled its clients to improve network performance, plan for the future and offer their customers a high-quality, reliable and efficient service, resulting in significantly improved financial performance. This complete suite of services, backed up by proven operational experience, positions the company to play an important role in developing telecommunication networks in emerging markets worldwide.

V-COMM
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For further information see Annex B

The ITU is now the driving force behind another virtual organization in the field of education, the GTU/GTTI (Global Telecommunication University/ Global Telecommunication Training Institute). A group of universities and training centres, working in coordination with the ITU, will offer developing countries programmes and courses to meet both technical and managerial training needs in the telecommunication sector. A round table was organized with the University of Belgrano in Argentina in September 1998 which resulted in participation and programme agreements with a number of universities and the setting-up of an electronic discussion forum on distance education.[16]

COSTS AND FINANCING

Detailed breakdowns of the costs of different methods of implementing distance learning can be found earlier in this section. The rule of thumb in comparing the costs of distance learning by radio, computers and the Internet, and broadcast television is that there is about a tenfold difference between each. The other rule of thumb is that the number of students involved is a crucial factor, since cost per student is the usual measure and economies of scale are important. World Bank figures show that a large eight-year radio programme for a million learners can be run at a cost of US$3.26 per student per year whereas a small programme of 100,000 learners would cost US$8.12 per student.[17] Economies of scale have been achieved, and the costs per student are affordable for even the poorest countries. Radio costs are about a tenth of the cost of programmes using computers and the Internet which average US$85 per student.[18] Programmes using television broadcasts cost US$500-700 per student (based on 700,000 students).[19]

A cost analysis for the various technologies shows that the major costs are not actually in the equipment. Cost models generally calculate the investment costs of facilities, equipment, software (purchase and licence) and teacher training. Investment costs are annualized over the useful life of the product, usually five years for equipment. The annual recurrent costs cover personnel, maintenance, insurance/loss, training, utilities, telecommunications (telephone and Internet) and computer supplies. These recurrent costs to date have been high relative to the investment costs, primarily for salaries and training of instructors.

A cost model

As a guide, the estimated costs of some components of providing computers and Internet services for education were identified in 1997 (see left).[20] Equipment costs are calculated using world prices but other costs will be significantly lower in most developing countries, where teachers' salaries and building costs are less and upgrades may be made infrequently.

Financing distance learning and educational technology

Ultimately the funds for education come from national budgets. This is particularly true of the recurrent costs. There are potential funds to support pilots, trials and development of the infrastructure from the World Bank and other development banks. (See Annex A for organizations and contacts.)

	US$
Network server	7,400
Student workstations (PCs), each	1,850
Auxiliary equipment (printers, scanners and similar)	7,300
Local area network operating system (Windows NT)	2,000
Courseware	18,000
Internet (line plus router)	1,750
Total initial investment (including buildings and other infrastructure at highest likely cost)	151,000
Annualized cost plus maintenance, training, personnel (at highest likely cost)	75,480

Cost-sharing arrangements with the private sector, whether for corporate training over the same network or use of the network and services for other sector purposes, should be explored. Private schools and universities can also be invited to share costs.

An important consideration when planning for information and communication technologies for the education sector is to remember that the same networks will be used by several other sectors. The computers and software at multi-purpose community telecentres will have different users, including health care practitioners, small businesses, government administrators, farmers and possibly banks or other financial service providers. The shared use of the network as well as the computer equipment should generate enough demand and traffic to make the shared costs affordable for all of the sectors.

Vendor financing for equipment and software through project finance, loan guarantees and export credits is usually available. Even in the case of

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CORPORATE VIEW | More choice

TELEVISION VIEWING in Africa has undergone a significant change recently, with state-of-the-art satellite technologies offering a far wider and much better choice of programmes to many more people than before.

Until recently, viewers on the continent had just two choices: a limited selection of programmes from national broadcasters which could not reach many areas because of the broadcasters' poor transmission facilities, or a menu of very expensive satellite options. Today, however, they can choose from 39 digital channels, available to them through direct-to-home satellite television.

Orbicom, the signal distributor for MultiChoice, a global pay-television subscriber management company, provides the technology which is driving this revolution. It has set up a system to allow the PAS-4 satellite to transmit programmes to almost the whole of the African continent. The choice of frequency means that satellite television viewers can use a satellite dish as small as 1.9 metres.

Orbicom has played a leading role throughout this process, opting for a modern television signal compression technique which enables a 1,000 per cent increase in television channel availability compared to analogue technology.

The company has provided quality coverage throughout South Africa using a combination of fibre-optic, microwave and satellite links, and a terrestrial network of 66 broadcast transmitting stations countrywide.

Orbicom also manages another 124 "self-help" stations in more remote areas of the country.

It also has considerable experience in the coding techniques used for pay television, and now manages, for MultiChoice, the terrestrial networks that relay MultiChoice programme packages throughout Africa to Botswana, Burundi, Egypt, Ghana, Kenya, Lesotho, Namibia, Nigeria, Tanzania, Uganda and Zambia.

Outside Africa, Orbicom's consultancy arm has planned a terrestrial network for a private operator in Cyprus, a system which has won government acclaim as a model for frequency planning and signal coverage. In 1995 the company established a satellite up-station in Athens and a large network of terrestrial television transmitting stations throughout Greece and its islands. More recently, it played a key role in the successful launch of a multiple-channel, direct-to-home, pay-television company in Thailand. The company has also built a 70-station multichannel television distribution network for one of South Africa's leading banks, serving both distance education and business needs.

Orbicom
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For further information see Annex B

The APEC Multimedia Distance Learning project makes resources available at <http://www1.sphere.ne.jp/mdl/index_e.htm>.

pilot projects, buyers should always attempt to negotiate the best price on the grounds that future sales will be likely. Leasing of equipment is another alternative that is particularly attractive in an industry that changes so rapidly and where obsolescence is always a problem. Financially, leasing can be an attractive alternative to purchasing, and as suppliers retain ownership of their computers or other equipment, repairs are included in the terms of the lease. Effective procurement procedures are also important for cost reduction and maximization of available finance. Buying equipment and services in bulk, for example for more than one school or more than one area, will produce economies of scale and consequent cost benefits.[21]

The cost analysis of early pilot projects, mostly providing computers in the classroom but also interactive radio instruction and television delivery, can be helpful guides. Chile demonstrated the value of pilot projects in planning its national programme for computers in schools, Enlaces. The viability of the overall concept, as well as hardware and software requirements, training solutions and operating expenses were worked out in the pilot phase, leading to more cost-effective implementation of the final programme. However, it is advisable to explore the current prices of new technologies and services at each stage. In the competitive markets of information and communication technologies, the prices paid one or two years ago may not reflect what is available today. Charges for services also vary in different countries.

Planners will want to investigate the various options for service provision in the increasingly competitive market. Wireless technology will be faster to deploy than new wireline access, and possibly less expensive. Satellite-based networks for Internet access or delivery to video programming have the advantage that the cost of transmission within the footprint of the satellite is the same no matter where they are sited. Geographical location is not a factor when calculating costs. Remote, rural settings have the same advantages as urban sites. There are also economies of scale since the fixed cost to use the same US$100,000-per-year channel can be shared by many sites. There is no increase in transmission costs with additional users. The more sites, the lower the cost per site for transmission costs, and the more sites to share the fixed costs of the central studio, and production and instruction costs.

As the range of costs for systems that meet the needs are examined, it is usually possible to find a less or least-cost solution. There is the usual trade-off between price and performance, but as long as essential needs are accurately assessed, there will be a basic option worth considering, at least as the pilot phase.

Multilateral development banks such as the World Bank, regional banks, United Nations agencies and bilateral aid agencies are supporting developing countries in building their distance learning programmes. The *World Development Report 1998/99*, on knowledge for development,[22] reflects a broad-based commitment to building the infrastructure of information and communication technologies for education and other sectors of development.

PLAN OF ACTION

The following guideline could be used by developing countries, perhaps through a multi-disciplinary task force, as a simple tool to evaluate their needs and the potential benefits of using telecoms for education. It

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in Action

comprises reasonable task force objectives and a list of open questions to help identify and prioritize areas of potential use of information and communication technologies to improve both the quality and the reach of education.

The mandate of the multi-disciplinary task force could be:

- to identify education problems and specific areas of education delivery which could potentially benefit from the use of such technologies;
- to assign each area a degree of priority at each educational level;
- to make an inventory of all relevant resources (physical, human and financial, in education, information and communication infrastructures and technologies) and their geographical distribution;
- to identify constraints, potential obstacles, socio-cultural factors and legal considerations to take into account before introducing new information and communication technologies;
- to coordinate a cost-benefit study of various technological options;
- to make a certain number of recommendations based on the findings of this study.
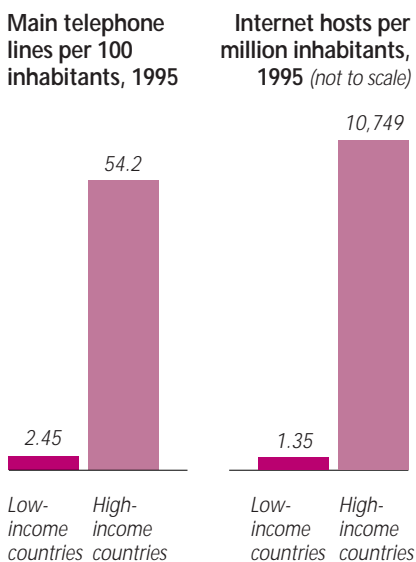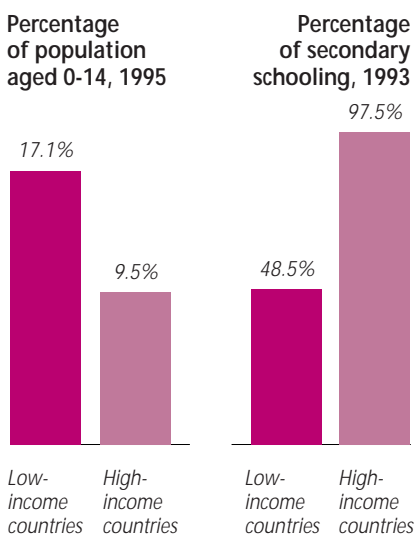
The task force could use the following questions for assessing needs:

1. Is there a comprehensive long-term education plan, and is it adequate in terms of taking into consideration the new information and communication technologies?
2. What are the most pressing education problems that need to be addressed in the country, by region and by population group?
3. What is the geographical distribution (and quality) of education resources? This could include:
   - number and quality of types of infrastructure (including schools, colleges, universities and community centres);
   - all categories of education personnel;
   - all categories of teacher training infrastructure and personnel.
4. What is the geographical distribution (and quality) of information and communication networks and technologies? Information is required on:
   - the present and projected adequate road and transportation system (in terms of time and cost for individuals to access different levels of education provision);
   - the present and projected telecommunication infrastructure and equipment of various types (real-time and delay-time access);
   - computers and peripherals in the education sector (type, capacity); availability of parts and maintenance technicians; training programmes for users; modems and connectivity;
   - the present and projected electrification coverage (all sources used to generate power for equipment, computers, lighting);
   - radio and television coverage (including cable and satellite).
5. Are there any specific geographical, climatic, cultural and political factors to be taken into consideration in integrating information and communication technologies into education?
6. What are the current uses of information and communication technologies in education?

YOUNG BUT UNSKILLED, NOT CONNECTED AND FAR FROM CYBERSPACE

Percentage of population aged 0-14, 1995

17.1%

9.5%

Low-income countries | High-income countries

Percentage of secondary schooling, 1993

97.5%

48.5%

Low-income countries | High-income countries

Main telephone lines per 100 inhabitants, 1995

54.2

2.45

Low-income countries | High-income countries

Internet hosts per million inhabitants, 1995 *(not to scale)*

10,749

1.35

Low-income countries | High-income countries

Source: World Telecommunication Indicators Database, ITU, and *World Development Report, 1996*, World Bank, in *Challenges to the Network*, ITU, Geneva, 1997

7. Has there been any evaluation of the use of information and communication technologies for education, and what were the benefits produced and problems encountered?

8. What are the present sources of education financing (national and foreign), and what is the allocation of these resources?

9. Are financial resources sufficient to cover the present education plan? Would they be sufficient to integrate information and communication technologies into education? Are there any strategies to generate new sources of financing?

10. Is there a concerted development strategy by different related sectors to share costs and resources at national and community levels?

IMPLEMENTATION – SOME WORKING MODELS

From the examples and case studies of how telecoms are currently being used to deliver education, it is possible to derive some working models to act as guides for implementation. These models start from earlier

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CORPORATE VIEW | Secure remote access

AS ACCESS to the Internet continues to grow in classrooms, at the office, in public areas and now even at home, the ability to provide users with secure remote access to messaging and the sharing of this information has become a mainstream requirement. With MessagingDirect's strong emphasis on performance, scalability, security and remote accessibility, it is a good choice for education and medical facilities.

As an example in the field of education, the company helped Samford University in the United States find the user-friendly system it needed. With more students and faculty than the limited number of computers available, the company's solution allows these users to share computers to access their e-mail from any location on any type of computer. MessagingDirect allows professors to distribute assignments, assist in homework, mail announcements and answer all sorts of questions for their students. It also allows professors to easily and confidentially share information and communicate among themselves. It provides the mobility, accessibility and security required for messaging by educational facilities.

The lack of mobility and the sluggish delivery of e-mail at Huntsville Hospital in the United States threatened the quality of service provided by the hospital. Hospital administration wanted a system that could transfer information and send announcements to staff. The hospital is now using MessagingDirect to inform staff of all changes and announcements, and physicians can use the system to archive their notes and correspondence, making that information accessible from any location within the hospital. In addition, the system works for a variety of daily activities such as transferring medical records and permitting clinical staff to order tests and procedures, as well as sending prescriptions and receiving refill requests. It has greatly enhanced administrative efficiency and provides the mobility and security required within a health care environment.

MessagingDirect is a leader in advanced messaging products for secure communications over the Internet. The system is suitable for messaging within education and health care because it allows secure remote access for convenient user mobility. It also enables direct e-commerce for such applications as bill presentation and payment as well as other secure document messaging like medical record transfers.

These leading universities, colleges and hospitals are improving on efficiency and quality by using the system: University of Notre Dame, Samford University, Duke University, Harvard Medical, University of Cape Town, Roskilde University, University of Auckland, Victoria University of Wellington, Huntsville Hospital, Shriner's Hospital for Kids, University of Toronto, University of Alberta and University of California, Berkeley.

MessagingDirect
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Website: http://www.messagingdirect.com
For further information see Annex B

technologies such as radio, television and correspondence courses, which themselves continue to serve as components of newer strategies. The new models start with the assumption of two-way communication that is interactive. Both economies of scale and economies of scope, where the same networks serve many sectors and customers, can make the Information Superhighway affordable for all countries. Two key components in the economics of distance learning are cost per student and capacity utilization. In developing the national strategy, planners need a wide-angle lens to see all the potential uses, applications and audiences on the one hand, and all the tools, networks and delivery systems available on the other. In developing the strategy, it is useful to look at what has been done to date, but it is even more useful to understand what is coming in the future, such as the exciting new role of wireless access, digital networks, the Internet and Internet protocol networks for voice, video and data.

CORPORATE VIEW | Islamic topics

HARF Information Technology of Cairo harnesses the flexibility of the Internet as a modern medium to support the Islamic heritage by having a website dedicated to Islam <http://www.harf.com>. Since its inception in 1985, Harf has continued to develop international coverage. It issues the majority of its software in at least seven languages so that developers and technical staff can regularly use the Internet with the most advanced programming languages as their working tool.

Harf has developed Islamic materials on electronic media and has gained wide-ranging experience in managing and publishing Islamic information and teachings on the Internet. Its website gives information on the company's products and technologies. There is also free access to supportive Islamic software, available to download for later study and use. Products and services include:

■ The Holy Qur'an with its famous interpretations and more than 62,000 Prophetic Hadiths, which is being developed with four different Tafsirs and will use Harf advanced search techniques. Already available in seven languages, and still developing, this site enables thematic search, full recitation of the Holy Qur'an, RealAudio, indices and dynamic pages that are created on-line at the user's request when displaying a certain verse.
■ Islamic topics directory which uses a tree structure of 14 main topics divided into 2,090 subtopics. The user can search for Qur'anic verses and Hadiths related to the main or subtopics. Recitation of Qur'anic verses can be heard and Hadiths displayed with their translation.
■ MiniPad, which allows writing in Arabic on non-Arabic Windows applications.
■ Al-Moa'zin, a programme that can adjust the timing of the five daily prayers according to any place the user chooses. Users can also listen to the prayer call and determine the direction of prayer in any place in the world.
■ Al-Bayan, which includes a variety of features to allow users access to more than 1,700 Prophetic Hadiths agreed upon by the Al-Bukhari and Muslim Imams. It is available in Arabic, English, French, German, Indonesian, Malay and Turkish.

There is also an entertainment section in Arabic, where users can enrich their knowledge about Islam while participating in an entertaining monthly competition.

Harf Information Technology has realized and utilized the global facility of the Internet to bring the teachings of Islam within the reach of all Islamic people, wherever they are in the world.

Harf Information Technology
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Website: http://www.harf.com
For further information see Annex B

telecommunications & *Education*

Transition model: from radio to the Internet

From the earlier experiences of interactive radio instruction and computer-assisted instruction a working model is being developed by the Suppes research and development team[23] at Stanford, United States, that would package a range of different tools to deliver education in mathematics, physics and other subjects at all class levels and in local languages. Radio courses would continue to deliver mass instruction at low cost, nationwide, to pupils aged 6-13 years. Where computers are available in classrooms, students can learn mathematics from the existing Education Program for Gifted Youth curriculum on CD-ROMs.

The curriculum of the radio lessons themselves can be transformed into multimedia DVDs (digital versatile disks), with video lectures, visual displays, graphically intense illustrations of particular points and video demonstrations. Small groups of students can study the lessons at a computer terminal or they can be projected to a screen in the classroom. The schools linked to the Internet would have regular communication with remote tutors and master teachers. The school teachers are provided with ongoing training and support on-line.

Using advanced techniques, audio presentations of radio-broadcast quality can be compressed so that a single DVD-ROM will hold nearly 400 hours of instruction. An entire radio mathematics curriculum for ages 9-12 years can be stored on a single DVD. The cost of a DVD-ROM drive is under US$300 and declining. An entire curriculum can be archived on the computers so that schools can adapt the pace at which students move through the curriculum classroom by classroom.

The high-quality curriculum and effective methodology tested in 20 countries over 25 years migrates to and evolves with the advanced technologies. The new tools of computers, CD-ROM, DVD, Internet, the Web and multimedia, and multisite video conferencing will deliver this curriculum to those with access. The radio will continue to reach and teach those without access, preparing them with the basic knowledge and skills so they can easily make the transition to learning with the new tools when they have access to them.

Internet-based models

Two-way communication these days generally relies on the Internet which can serve as the sole medium for carrying the multimedia content to learners and taking their responses and questions back. The video lecture can be delivered on demand by video streaming. When the major content, such as a lecture, is delivered by video or television broadcasting (wireless, cable or satellite), by video from one site to a limited number of users through VSATs (very small aperture terminals) or by video cassettes, the Internet can provide the return channel from the learner.

Telephone access to the Internet

Access to the Internet is of course fundamental. Currently users dial up through a telephone line to an Internet service provider and connect to the Internet, paying per-minute usage charges for the telephone line and a usage-based or flat fee for the service provider. Recently, cable television providers have been offering faster Internet access to those with a cable

Information and communication technologies can make education available to students in far-flung rural settings.

FAO

network. These models are wireline solutions, of copper, perhaps with ADSL (a way of combining wires within a telephone network so that they can carry high-capacity transmissions such as video) and coax cable, perhaps upgraded to hybrid fibre coax that enables telephony as well as video services.

Wireless links

Those who do not have access to telephone lines or cable television networks, or cannot afford the long-distance line charges, may seek alternative systems. Wireless solutions offer many advantages. They can be terrestrial wireless carried over microwave or digital radio networks of towers and repeaters. Recent wireless transmission techniques use complex signals that offer efficient use of the spectrum, fast deployment, wide capacity to accommodate multiple voice channels or to carry video and multisite video conferencing, as well as Internet protocol networks or Internet access. Many sites can be connected to this wireless network, for example campuses or schools within 50-70 kilometres of each other, for two-way video conferencing, and over even greater distances for Internet access.

These systems are being deployed in many developing countries. They provide immediate infrastructure that is powerful, robust and flexible. Such cost-effective networks can deliver very high-speed transmission. In areas that do not have access to networks carrying telephone traffic or data communications, such wireless networks make voice, data and video communications available to education as well as other sectors. The amount of bandwidth is sufficient to support various applications and user groups.

Satellite solutions

Breakthrough technology now promises to provide direct, two-way access to the Internet entirely by satellite so that all locations, no matter how far from the public telephone network, can have immediate, high-speed, quick-response, low-cost access. Satellite delivery of Internet, voice, data and video programming will be even more cost-effective as the number of users increases.

Thirty computers in a school could be connected on a local area network and each given direct access through a small dish on the roof. There can be fast downlink to the computers from the Internet to instantly download a website, a Web-based course, a textbook or syllabus, as well as a video streaming lecture. The uplink can be slower, but able to carry a click of the mouse, send an e-mail, effect the file transfer of an assignment or even participate in a NetMeeting or CUSeeMe multimedia video conference. A national network of up to 3,000 schools with these low-cost terminals to transmit and receive to a single transponder on a satellite, using the spectrum-efficient spread-spectrum protocols, allows educators to deliver world-class, customized education and courseware anywhere in the country.

An intranet, or virtual private network, can link all the schools with educational centres, curriculum centres, teacher training institutions, libraries and resource centres, as well as all of the global Internet and the Web. Web courses in the local language, adapted to local culture and concerns, can be conducted interactively on the intranet.

Siemens

Video conferencing is a useful tool for corporate training, linking participants who may be widely separated.

The same satellite that provides the full, two-way access to the Internet can also deliver to the same classrooms live video lectures and presentations from a central classroom or studio. A VSAT network using a digital or analogue satellite delivers the material to each designated site on the network – schools, university lecture halls, corporate training sites, offices, government agency sites and even homes. The VSAT network provides full communication of voice, image and data to and from the studio.

Watching the video on a television monitor, or even a computer screen, the students talk to the instructor by regular touch-tone telephone, if available, or by e-mail or Internet telephony with standard PC earphones and a microphone. Students throughout the virtual classroom in multiple sites hear the instructors and can even see them if there is a video link. Each classroom with computers, printers and fax machines can receive printed material and files from the instructors, and can of course transmit their responses in return.

CORPORATE VIEW | Working with broadcasters

MICROSPACE Communications delivers data and audio satellite broadcasting services to over 275,000 receiver sites in Africa, Europe and North America. Its Velocity satellite service, which transmits video and high-speed data worldwide, is used as a delivery system for many of the most advanced network applications on the market today. Offering the latest digital standards as well as a guaranteed secure programming facility, the system's conditional access feature allows businesses to control their network sites.

Caliber Learning Network, a distance learning organization based in Baltimore, United States, selected the Velocity system as the most cost-effective and reliable method of delivering distance learning material to its remote learning centres. Each centre is equipped by Caliber with a small, metre-wide antenna and an inexpensive digital receiver with smart-card technology. There is a monthly recurring charge, based on an agreed data rate, and as networks increase, the pro rata cost per site will be reduced.

Raleigh Seachange International has also selected Microspace as its satellite supplier. As multichannel television advertising takes up a large amount of space on the network, Raleigh Seachange needed a system like Velocity, which is able to distribute large, digital, multimedia files quickly and reliably.

Microspace's digital broadcast technology is being used by the National Community Pharmacists' Association to carry its distance learning and consumer information network. This provides a daily in-store television network for pharmacists and their customers offering a range of health and pharmaceutical programmes. While promoting good health practice, the service helps pharmacists keep abreast of the latest developments in the industry with a daily news item which focuses on the profession and covers legislation and regulation, niche marketing and new drug information. In this way pharmacists remain up to date, while in-store advertising directed at their customers has a positive effect on sales levels.

The American Law Network from TechNet International uses the company's digital broadcast satellite in a similar way, with a service designed to give the legal profession cost-effective access to continuing education programmes.

Microspace's Velocity system offers an efficient, secure, cost-effective route for broadcasters to deliver programmes to selected audiences around the world. Advances in satellite technology have made it possible for broadcasters to reach target audiences in remote areas, making distance learning in any discipline or at any level accessible to large numbers of people.

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For further information see Annex B

Small-scale working model

Most of the models and case studies discussed are for large-scale programmes of mass education. Different technologies and strategies should be developed for small-scale programmes, such as employee training or specialized courses for target audiences. This is a model delivery system that provides the same elements of video and visual presentation, with interactive communication with instructors and participants at other sites in real time as well as asynchronously, but on a smaller scale. The participating groups could be in different cities or towns, or in different countries and regions.

A video cassette recorder or a DVD player is required to play the video presentations on cassette or the new searchable video disks. Texts, course notes, syllabus, presentation graphics and exercises can be provided on CD-ROM, downloaded from websites, viewed or printed out from floppy disks, or even distributed as books and printed materials.

Interaction among the groups and with the instructor and experts can

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CORPORATE VIEW | Reducing travelling time

THE USE of video conferencing has revolutionized the way the world conducts its business. The use of this technology is growing in popularity as it impacts on education, medicine and legal procedures as a means of allowing individuals or groups of people in different locations around the world to interact visually and verbally.

Kozcom was established in 1989 to address the cost reductions and benefits made possible by using tools developed by the new video conferencing industry. Among other projects, the company designs, specifies, carries out training for and implements video conferencing and collaborative work systems for clients in government and industry.

An award-winning, innovative programme developed by Kozcom is duplicating the traditional courtroom environment used to hold judicial hearings. The special Three Point hearing system has made judicial time more cost-effective by reducing the amount of unnecessary travelling time.

As a result of this video conferencing system, more hearings can be conducted and cases in remote areas can easily be accessed.

While procedures are conducted in exactly the same way as a traditional courtroom hearing, it is possible for the judge and the clerk of the court to be in one physical location, the claimant in another and the lawyer in yet another. All parties see and hear one another at all times.

The system does not require a multipoint bridge to operate effectively and this reduces the complexity of the design as well as the operating costs. Two video conferencing stations are installed at the judge's location, one for the claimant and one for the lawyer. All parties are equipped with monitors and the judge is able to make direct eye contact with the person addressed. Apart from a video switch operated by the clerk to allow a wide view as the judge enters and leaves the hearing, all other controls including speaker volume and camera angles are adjusted before the hearing begins.

The package, which has far-reaching implications for use in developing countries, has been designed so that the claimant and the lawyer can be located anywhere and can use any available video conferencing or desktop system without the need for modifications of any kind. Results show that hearings by video conferencing have brought strategic, productivity and cost benefits while maintaining traditional court-room decorum.

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http://www.video-conferencing.com
For further information see Annex B

telecommunications
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Real-time video conferencing provides an important level of interaction, with the dynamics of face-to-face communication.

occur by e-mail and computer conferencing, audio conferencing (preferably with high-quality conferencing equipment) and video conferencing. The audio conference is an opportunity for a round-table discussion, seminar, case study presentations by individual student groups and general discussion. For more than three sites, a conferencing service may be provided by the national operator or a global carrier. Several systems are available for the video conferencing, all of which provide for a small video window, expandable to full screen, a shared whiteboard and shared applications. There is also a dialogue box for chat messages.

Each system operates over a desktop or even a laptop PC. It is primarily a software product together with a small camera that sits on the PC, speakers and a microphone, and modem and connection to the network, which can be either a standard telephone line, an ISDN line or an Internet/Internet protocol connection. A video card in the PC is required for some systems.

Most of these systems can connect several sites, usually six to eight, although some systems connect up to 40 sites. One system operates over the regular telephone line but only connects two sites: point-to-point multimedia video conferencing. The multisite systems can operate over the Internet, e.g. CUSeeMe or NetMeeting. This is the lowest cost alternative if the Internet is accessible and affordable. The quality of the video may be only adequate. Other more robust systems such as Intel's TeamShare operate over ISDN lines, local area networks and specialized high-speed lines. With higher speed Internet access, they are increasingly operating over Internet protocol networks at much lower cost.

It is the mix of these interactive tools that counts, and it is important to choose the right ones for the task at hand. E-mail and computer conferencing facilitate the exchange of a great deal of in-depth information very inexpensively to many sites. Because it is "store and forward", the parties do not have to be on-line at the same time. Real-time audio and video conferencing provide a different and important level of interaction. The dynamics of a dialogue brings a quality that comes from the voices and face-to-face communication. When they enhance rather than replace the more cost-effective e-mail and core lectures on tape, they too can be worthwhile.

BENEFITS

The benefits of tele-education – distance learning – come mainly from being able to develop and deploy critical, quality education resources to a wide audience of learners. Resources that would not be available at many sites, e.g. master teachers, can be accessed electronically from any site. Each model and approach will have its own unique benefits, which should be carefully assessed against its costs when the planning is under way.

Direct educational benefits[24]

■ Computer-assisted learning is geared to individual students' skills and learning speed. Simulation and exploration allow students actively to investigate situations or problems.

■ Critical thinking skills are developed, and hypotheses proposed by students can be tested experimentally. Computational tools, such as text or graphics

editors, databases, spreadsheets and presentation packages aid in processing information.

■ Lessons and lectures are enhanced by visual presentation and organization of information. Papers may be graded in electronic format, enabling teachers to insert comments easily.

■ Communication networks allow for exchanges of information and ideas, even internationally; gathering information from around the world broadens students' horizons and motivates them to sharpen important analytical skills by having to filter raw information themselves. Teachers can exchange educational ideas with colleagues around the world, as well as download a variety of materials from the Internet.

■ Administration is facilitated. Teachers can access a student database containing information on each student, allowing them to track the progress of each student individually and make decisions on which is the best approach for a particular individual.

CORPORATE VIEW	Educational packages

MIRALITE COMMUNICATIONS specializes in building networks that broadcast high-quality educational material to its customers via satellite. Miralite has installed over 2,000 steerable satellite antenna Earth stations that provide analogue and digital satellite transmissions to schools, universities and colleges. These systems deliver high-quality distance learning packages to meet the needs of today's educational strategies.

An example of a project managed by Miralite was the Satellite Educational Resources Consortium (SERC) which equipped participating high schools with a turnkey satellite Earth station. Miralite was able to deliver a cost-effective and reliable distance learning solution to around 900 high schools throughout the United States. This allowed students to receive instruction, via satellite, from leading specialists in the fields of language, mathematics and science, an opportunity that would not have been available to them without this technology.

A school in a rural area in New Jersey had never had the benefit of expert language tuition. Since the satellite service has been in operation, students are learning Chinese, Japanese and Russian from leading foreign language lecturers. Other subjects, including high-grade mathematics, have also been introduced to the curriculum in the same way. The material for these programmes is recorded in a broadcast network television station that is paid for its studio time. The recording is then transmitted via an Earth station and satellite segment for broadcast to a wide audience, including hundreds of students.

These quality programmes, which are not only restricted to students, are having a far-reaching effect on a wider audience with the technology to receive the transmissions. Distance learning is fast becoming a necessary part of any educational institution's strategy now that technology is broadening the range and scope of its own resources by providing expert tuition in areas that it is unable to cover itself. The benefits to society as a whole, brought by these new educational opportunities, are numerous.

Industry is also taking advantage of broadcast technology. Rexroth, a company which specializes in hydraulics manufacturing, uses the Miralite broadcast capability to train and update its widely scattered sales team. Company representatives are kept informed of product applications, changes in company policy and customer and marketing initiatives. Through this information channel, Rexroth is able to ensure that it is presenting a unified approach to all its customers. Transmission costs are approximately US$6,000 per broadcast or US$15 per recipient per hour, a cost-effective way of educating, training and informing large numbers of people spread over a large area.

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Website: http://www.miralite.com
For further information see Annex B
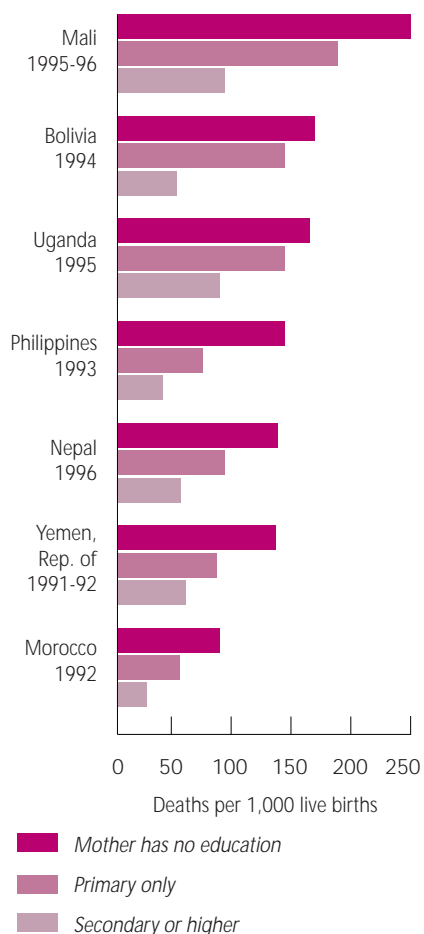
telecommunications
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■ The use of telecommunications and computers can benefit educational systems by providing individualized interactivity, which allows for both the sending and receiving of information in an expressive, visual format; and access to information without restriction, i.e. the Internet, which is both a tool and a catalyst for learning.

■ The technologies themselves acclimatize students and teachers to the tools commonly used in today's academic and business practices.

■ Using new communication technologies, such as the Internet and e-mail, in education reduces feelings of isolation in schools and communities, especially those in far-flung rural settings.

National development

The delivery of education using information and communication technologies can help in the realization of socio-economic benefits from among established national development objectives such as:

■ education of various segments or of the whole population;

■ universal educational provision, with a broader reach in rural and remote areas;

■ employment opportunities for teachers;

■ advanced technological knowledge dissemination;

■ reduction of population migration or repopulation of abandoned areas because of availability of quality education in remote areas;

■ necessary personnel recruitment (including but not limited to teachers) for remote and rural areas with a positive impact on both the local and the national economies;

■ access to educational services for adults as well as children;

■ improved literacy and numeracy rates;

■ national image improvement (this is important, for example, for attracting investment).

Summary of benefits of using telecoms for education

Benefits include:

■ cost savings where an equivalent or improved tele-education service can be delivered at a reduced cost compared with traditional delivery;

■ savings on personnel costs when distance learning provision replaces or supplements qualified staff in situ;

■ reduced travel and other expenses for students who would otherwise have to travel to receive an education;

■ savings on school or university infrastructure costs when a virtual institution replaces a real one;

■ improved teaching and learning possibilities and opportunities;

■ improved effectiveness of specialist teachers who can have an impact on far more students;

■ improved overall educational management;

■ improved availability and reduced cost of training local teachers;

■ increased support to teachers working in remote and isolated areas, resulting in increased job satisfaction.

CHILD MORTALITY FALLS AS THE EDUCATION OF MOTHERS RISES

Mali 1995-96
Bolivia 1994
Uganda 1995
Philippines 1993
Nepal 1996
Yemen, Rep. of 1991-92
Morocco 1992

0   50   100   150   200   250
Deaths per 1,000 live births

■ *Mother has no education*
■ *Primary only*
■ *Secondary or higher*

Mortality data are for children under 5

Source: Macro International, various years

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This project aims to develop the social applications of satellite capacity in Latin America through a cost-benefit analysis of pilot projects that use digital satellite technology for distance learning and Internet connectivity.

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The International Council for Open and Distance Education (ICDE) is the global membership organization of educational institutions, national and regional associations, corporations, educational authorities and agencies in the field. It is affiliated with the United Nations through UNESCO.

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The USDLA provides contacts to all companies involved in distance education. It holds two international conferences on distance learning per year: Telecon and IDLCON.

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