Learning from the pioneers: Best practices as exemplified in the TELAR network

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Introduction

Since the 1960s, continuous progress in microelectronics, information technologies, computers and telecommunications has brought about a deep and all-embracing transformation that has culminated at the beginning of the 21st century in a new global economic, social and political system (Castells 2000). Today, the gap that has always existed between developed and developing countries and between rich people and the poor has been accentuated by inequalities in access to this new global system, for which the new information and communication technologies (ICTs) provide the gateway. The 1999 UNDP *Human development report* shows that in 1998 only 0.8 percent of Latin Americans had access to the Internet, and the overwhelming majority (90 percent) of those who did were members of a small and wealthy elite.

The problem as it exists in Latin American societies is not limited to the scarcity of computers and Internet connections: it is much more complicated. The resources needed to access this new technological world not only require people to have the technology and the technical training but also the intellectual skills to use that technology and turn it to their own purposes (Wilhelm 2000). ICTs are not simple tools, but rather processes that must be developed – processes of communication, information or production. In these processes, thanks to the facilities ("user-friendly" programs, digital productions) that the new technologies offer, the distinction between users and creators is disappearing, and those who were once merely users of ICTs can now be creators as well. But to reach the point where they can create things for themselves, users must have the necessary intellectual and technical preparation (Castells 2000: 31).

Bonilla (2000) argues as follows: "Cyberspace, virtual communities and networks represent new fields of play that are reproducing and extending the existing unequal social and cultural distribution of material and symbolic capital in the Western world; nevertheless, they also constitute an arena that offers the potential for empowering excluded social groups and helping them

to improve their living standards through strategic use of these new tools, while encouraging the processes of reinforcing identity and building citizenship."

The fast-moving changes that new technologies have brought about have exerted tremendous pressure on governments, schools and other educational institutions to find ways of integrating technology into education. While many government projects start out with good intentions, they soon run into barriers that prevent their effective and successful implementation. Schools are complex institutions that are difficult to mobilize. Technology projects often fail for lack of proper planning. The task of transforming a school is daunting indeed, and failure in this respect is no surprise. Yet the fact is that we know very little about what it takes to integrate technologies successfully into Latin American schools.

In an early effort to bridge the growing divide, the government of Argentina in 1994 introduced the Social Education Plan, as part of the wide-ranging education reform inaugurated by the 1993 Federal Education Act, Law 24,195. One of the objectives of this plan was to promote the integration of technology as a means of improving the quality and equity of public education. In cooperation with IEARN (International Education and Resource Network) Argentina, which has been in existence since 1989, the TELAR network was established. TELAR (the Spanish acronym for *Todos en la red*, or roughly "Everybody into the Net")[1] is a network of schools, teachers and students in Argentina, run by Fundación Evolución. Between 1994 and 1998 it was supported and financed by Programme 1 of the Social Education Plan[2] of the Argentine Ministry of Culture and Education. TELAR is associated with IEARN,[3] an international education network that allows students to participate in international cooperation projects, and TELAR now functions in fact as the Argentine chapter of IEARN. In Argentina this education network is known as TELAR–IEARN.

Programme 1 of the Social Education Plan, "Better Education for All", provided support to teachers experimenting with new teaching methods, and in particular with the use of technology. As part of Programme 1, schools were supplied with computers for both information processing and telecommunications uses. Fundación Evolución,[4] in cooperation with the Ministry of Culture and Education of Argentina, was in charge of providing initial training for 1,000 teachers in schools participating in the Social Education Plan. With this training, teachers were able to take advantage of e-mail for communicating with their peers in other parts of the country and the world in order to associate classroom activities with the theories of constructivist pedagogy, critical thinking, problem resolution and transformational practices. Although the Social Education Plan was terminated in 1999, Fundación Evolución has continued its efforts to bring ICTs to Argentina's neediest schools. Through its national network of provincial facilitators, it is today working in close cooperation with the Ministry of

Education, the educational portal "Educ.ar" and other non-governmental organizations.

In schools that received training under the Social Education Plan, success in adopting ICTs varied from nil or very limited in the great majority of schools, to massive adoption in a few institutions (Lafontaine 1999). Our research set out to examine the reasons why use of this technology had such an outstanding impact on the education community in two public schools that were operating under very unfavourable conditions, within low-income communities in isolated zones where there were few resources available. To this end, we conducted an exhaustive study of the Provincial Secondary Education Centre No. 3 (CPEM 3) in Zapala, province of Neuquén, and the Provincial Secondary Education Institute No. 84 (IPEM 84) "Jorge Vocos Lescano" in Tanti, province of Córdoba. In both of these schools, ICTs were successfully adopted and integrated beyond all expectations, to the point where they became national and international models of success.[5]

"Learning from the pioneers" is an investigation into the best practices used in the TELAR–IEARN network, with a focus on the process that led to the integration of technology into school life.

By documenting the process of integrating ICTs in the two schools, we were able to identify the key elements that made these experiments successful, despite the difficulties posed by poverty and remoteness from major urban centres. The results of this research will allow Fundación Evolución to use the schools as models for further efforts to develop and improve its activities and for making recommendations to education ministries and other education authorities on the factors that must be taken into account in programmes for promoting the integration of ICTs into schools.

Theoretical framework

In the more industrialized countries of North America and Europe, there is a growing literature on the key factors essential for the design of a model technology project (Ely 1990; Read 1994: 34–41; Fullan 1991; Hawkins et al. 1996; Honey and Henriquez 1993). Although this literature relates to factors and circumstances that are very different from those prevailing in Latin America, we took those models as the starting point for our research into the conditions and factors for success in the TELAR–IEARN schools. This paper is a first step towards developing a model that is more appropriate to the Latin American context.

Research in the United States has shown that there are a number of constant aspects or factors in any successful technology project. The exact number of significant factors varies from one study to the next, but there is a minimum core group of factors that show up on all lists. As our analytical framework for examining the data from surveys and interviews with teachers

in those two schools, we have selected for our research the seven most commonly cited factors. They are as follows:

1. Goal

One factor that appears important from the literature is a clearly defined purpose or goal for integrating technology. Moreover, such goals are clearly and significantly related to broader educational objectives. In most cases these were clearly understood by teachers, parents and the local community, in very concrete ways: improving reading and writing, enhancing technological skills or involving the community in projects, for example. Goals might vary between different technology projects, but a constant element in all of them was that the technology was associated directly with the students and their experiences.

2. Leadership

Leadership at various levels is important if an innovative project is to take root and grow. In our study we focused particularly on leadership within the school, which is divided between the principal and the project coordinators. If a project is to succeed, there must be a person who takes the initiative for directing it. More specifically, there are several aspects of leadership that are important in a technology project.

(a) Pedagogical vision. Leadership requires a pedagogical vision that recognizes what sound education is and what the role of technology should be. The literature suggests that in many successful projects technology is used as a means for improving the educational experience, but it is never the final objective.
(b) A long-term commitment to integrating technology. Another feature of successful experiments is that the schools approach change from a long-term perspective. A complicated project requires an ambitious vision because it implies great changes, yet at the same time it demands a patient approach, taking modest steps each year. The successful schools are those that are prepared to foster and promote change over a horizon of three to five years.
(c) Recognizing the extent and depth of the problem. According to the literature, successful leaders and coordinators recognize that the challenge of integrating technology has many facets and is closely linked to all other aspects of school direction and management (financing, teaching, teacher training, assignment of classrooms, timetables, etc.). By recognizing that the integration process is complex, the school's management and the project's coordinators are ready to resolve any problems that might arise.

3. Professional development

Training is one of the most important elements. Teacher training, in both technical and pedagogical terms, is consistently cited in the literature. This allows teachers to acquire new skills and introduce new practices and teaching strategies. In the best case, training is designed to provide direct support to a project's specific activities. Moreover, a successful project will sometimes adopt training strategies based on local experience within the school and the community.

4. Learning and experimentation

Another strategy that appears in the literature on successful integration projects is to begin on a small scale and experiment. Every small step provides an opportunity to examine and assess progress, appreciating positive elements and revising negative ones.

5. Time

Another key factor, and a multidimensional one, is time. Achieving such a great change takes time. Time needs to be viewed in different dimensions, as it relates to professional development, pedagogical vision and the commitment of the school's management. In the area of professional development, sufficient time must be programmed so that teachers can learn to integrate new technologies into their curriculum. Consistent with a constructivist and active pedagogical vision, time must be allowed for students to carry out their technological projects. The school timetable, divided into classes of 40–50 minutes, makes it difficult for students to concentrate and come to grips with a complex project. And, finally, the school's principal must be patient and allow time for the school to adjust to the complex process of integrating tools as powerful as ICTs.

6. Infrastructure

Infrastructure is of great importance for the long-term success of any project that implies transforming an institution. We may divide it chronologically between preexisting infrastructure and the infrastructure that will be developed with the project in order to meet new needs. There are several important elements of infrastructure:

(a) Specialists and technical support. The support of experts and specialists is crucial for the long-term success of any technology project. The kind of support needed goes beyond mere technical know-how. Pedagogical and curricular support is indispensable. Coordinators must start by instructing teachers in how to make significant use of the technology.

(b) Physical space. In North America there is no one model for distributing computers that stands out as more effective than the others. Schools have succeeded with centralized computer laboratories as well as with the placement of computers in individual classrooms. The only important factor is that the computers must be located in a place reserved for their use so that students will have the equipment available when they need it. The placement of computers corresponded in all cases to the pedagogical needs of the project.

(c) Support from the professional community. The literature indicates that schools with successful technology programmes have enjoyed support from the teaching community. Its role is to provide collective support for teachers participating in the project as they struggle to cope with innovation, analyze emerging problems and seek advice.

7. Financing

Financing is a continuing challenge, but a project's success will depend on whether it can adopt a long-term sustainable development strategy. Successful projects accept the fact that technology is not a one-time investment but a continuing cost that must be accepted as part of an institution's ongoing expenses.

Methodology

For this project, we employed a mixed methodology and working approach based on documenting teaching experiments in the classroom. We included a quantitative methodology to supplement our qualitative research. The central methodology consisted of two case studies of successful schools in the TELAR–IEARN network. Each school represents a world with its own social system, which is, in turn, situated within a broader context. The case study approach allows researchers to approximate experience as it is lived in each school and, in this way, to identify the particular features in each case that allowed TELAR–IEARN to grow, to put down roots and to have the observed impact.

The two schools included in our research, CPEM 3 in Zapala and IPEM 84 in Tanti, were selected on the basis of three criteria: we looked for schools that had been participating in TELAR–IEARN for a long time, those whose students had participated steadily in TELAR–IEARN projects, and those where the coordinators had demonstrated their commitment to the TELAR–IEARN national network. These factors, we felt, should indicate solid support for the educational technology and the school's connectivity to the national network. We began by advising four selected schools of our interest, and two of them were prepared to cooperate with us. Although the schools were in different regions and reflected differing situations in terms of their socioeconomic characteristics and degree of urban influence, we recognized

that a study on such a reduced scale could not hope to represent the diversity of contexts among schools of the TELAR–IEARN network.

In each school, the research team conducted a series of interviews and observations over a period of one week. They interviewed the following groups of people:

- The original coordinators of TELAR–IEARN
- The current coordinators, if there had been change
- The current principals
- The former principals, when possible
- Teachers who had participated in TELAR–IEARN
- Teachers who had not participated in TELAR–IEARN
- Students participating in TELAR–IEARN projects
- Former students who had participated in TELAR-IEARN, where this was possible

We sat in on classes and participated in them, and we observed computer and telematic laboratories, recess periods, the teachers' room, extracurricular activities of students and TELAR–IEARN activities.

To round out our qualitative data on the two schools, the research team conducted a survey using a questionnaire developed by the Center for Innovative Learning Technologies of Stanford Research Institute and the University of California at Berkeley. This survey covered factors that were considered key for integrating technology in schools, as noted in our theoretical framework, and allowed us to measure the extent to which these factors applied in a given school. The questionnaire was translated and amended to fit the Argentine context and was administered to teachers in each school in the hope of obtaining an overall view of their teaching philosophy and activities, their previous training and their use of technology, as well as their relationship with the students so that we could then attempt to correlate those factors with the success of TELAR–IEARN.

Introduction to the case studies

Characterization of the schools

CENTRO PROVINCIAL DE ENSEÑANZA MEDIA NO. 3

CPEM 3 is a secondary school located in Zapala, at the approximate geographic centre of the province of Neuquén in northwestern Patagonia. Its immediate surroundings present an arid landscape of mountains and tablelands, in contrast to the southwest of the province where there are forests and abundant vegetation and the climate is cold and humid. Zapala has a

population of some 33,000. Its geographic isolation places it at a disadvantage in comparison with other cities of Neuquén. The nearest city is Cutral Co, 80 kilometres away. The capital city is 180 kilometres away. Another feature of the city is its cultural isolation. For example, the one movie theatre in town operates only sporadically. Income levels are low, and the city's youths have few if any spaces for social interaction. Even sporting facilities are scarce because of the lack of enclosed spaces and the harshness of the climate.

CPEM 3 opened on April 19, 1960, and since that time has awarded the diploma of *Perito Mercantil* (Commerce Specialist), to which it has now added *Auxiliar en Computación* (Computer Assistant). The school has an enrolment of 1,150 students, divided into three shifts, and a teaching staff of 140. CPEM 3 was one of the first five pilot schools to take part in the IEARN programme, and it is the only one in that group that remains involved with TELAR–IEARN today, 10 years later.

Instituto Provincial de Ensañanzas Medias No. 84 "Jorge Vocos Lescano"

IPEM 84 is the only public educational institution in Tanti (Department of Punilla), a town located 47 kilometres from the provincial capital, the City of Córdoba, and 750 kilometres from the federal capital in Buenos Aires.

The area is bordered by high mountain ranges to the west and the land slopes gradually lower to the east. It is an area of many rivers that empty into the Lago San Roque, which is a major point of attraction for the city of Carlos Paz, a tourist centre located only 18 kilometres from Tanti. The economy relies primarily on tourism and on the output of regional products.

Tanti has a population of some 5,000 inhabitants. Despite its proximity to the city of Carlos Paz, it is not a "must see" on the tourist circuit. The road leading to Tanti, which branches from the main highway from Córdoba to Cosquin, ends in the mountains, and only visitors interested in adventure tourism are likely to take it.

IPEM 84 was created in 1987 by a group of parents determined to establish a public secondary school in the town. The school offers EGB 3 (grades 7 to 9) and Polimodal (grades 10 to 12), with a focus on electricity and electronics. The school's infrastructure is in poor condition, the classrooms need roof repairs, there is no heating and winter is a difficult time for students. All are therefore looking forward eagerly to the new school building that is now being built a few metres away. The school's student enrolment in 2000 was 286, and it has a very loyal teaching staff of 41 teachers, many of whom have been with the school since it was founded. Very few students leaving the school go on to university, for lack of money. For this same reason, many students have never been to the capital city of the province, although it is only 47 kilometres away.

Demographic profile of the schools

We conducted a questionnaire survey to obtain a more accurate description of each school. The survey was designed to provide greater detail on the general context of the school, covering areas such as school culture and support, educational philosophy, teaching practices, use of technology and professional development.

The questionnaire was distributed to 90 teachers in the two schools. These teachers had been with the school for more than one year and were teaching more than one class. The response rate to the survey was 50 percent (45 responses), 36 from CPEM 3 and 9 from IPEM 84.

Responses were received from 2 principals, 37 teachers, 4 assistant teachers and one educational adviser. Eighty percent of the teachers are women. The teachers had an average of 13 years, professional experience (see Table 1), and more than 50 percent of them had been teaching for at least 10 years.

Table 1. Years in teaching

Years in teaching	*% of teachers*
1 year	9
2 to 5 years	5
6 to 10 years	28
11 to 20 years	33
More than 20 years	25

The questionnaire asked teachers whether they were using the technology with their students and how they were using it. Of the 45 teachers responding, 47 percent (21) were using computers with the students ("users") and 53 percent (24) were not ("non-users") (see Table 2).

Table 2. Ways in which teachers use the technology for teaching practices

	Use with students	*Do not use with students*
I assign tasks and supervise students in using the computer	15	
I assign computer use to students but they are supervised by another teacher	6	
I use computers in the school but not with my students		6
I do not use computers in the school but I do use them elsewhere		13
I have never used computers for teaching or any other purpose		5
Total	21	24

The teaching profession in Argentina is governed by factors such as the number of teaching hours and the number of students in each class. In contrast to developed countries, Argentine teachers are allowed no specific time to prepare their classes. Only classroom hours qualify as paid working time. The sample of teachers covered by the survey worked an average of 23.5 classroom hours a week (see Table 3). Since teachers in Argentina commonly hold down several jobs or teach in several schools, however, we asked them how many hours they worked in total. We found that the teachers were working an average of 32 hours a week and that "user" teachers spend more time in class in the school in question.

Table 3. Average teaching hours in the target school and total hours worked per week

	Teaching hours in the school (per week)	*Total hours worked (per week)*
Users	27.2	34.9
Non-users	20.0	29.3
All teachers (*n* = 45)	23.5	32.0

Another aspect that is important in understanding the context of their work is the number of students per class and the frequency with which each class is taught. Since these data tend to vary from class to class, we asked teachers to report on the class with which they estimated they did most of their work (see Table 4). The teachers had an average of 28 students per class. Forty percent of them met with their class only once a week, while the remaining 60 percent met with their class at least twice. Eighty percent of the user teachers met with their students twice a week or more. There is a correlation, then, between use of the technology with students and spending more time in the same school and meeting more often with students.

Table 4. Number of students per class and frequency of class instruction

	Average no. of student	*Weekly class frequency (average)*	*Teachers who meet their class only once a week*	*Teachers who meet their class twice or more per week*
Users	28.1	2.25	20%	80%
Non-users	23.3	1.50	57%	43%
All teachers	28.0	1.90	40%	60%

Case study: CPEM 3, Zapala, province of Neuquén

Decision to participate in the project

IEARN (which subsequently came to be called the Red TELAR-Centro IEARN Argentina) reached CPEM 3 in 1990 when the principal of the Escuela de la Costa school on the Patagonia Coast, Daniel Reyes, made contact with IEARN in the United States with the idea of bringing the project to Argentina. At that time it was decided to create a pilot project with a school in each province of Patagonia. In Neuquén, the Board of Education offered the project to CPEM 3 because, at that time, it was the only school in the province that had a computer room. The main conditions for participation that the Board of Education demanded were to have a computer, to have a telephone line and to secure the commitment of the heads of the computer science and English departments. When the IEARN project was launched in Argentina, English and computer science were the two subjects that were essential for success with the project.

1. Goal

The department heads of CPEM 3 met to discuss the proposal. After debating all the pros and cons, they finally decided unanimously to become involved in the project.

In 1990, the Internet was little known in the world at large, and even less so in an isolated place like Zapala. Considerations were not based, therefore, on any prior experience with the technology, but rather on the possible teaching impact that teachers could foresee from the little they knew about the project. This lack of knowledge was considered a negative point in terms of participating in the project. Teachers were uneasy about this unknown technology and feared that they would not be able to use it property, and they were on the point of rejecting the proposal. Fear of the technology went hand-in-hand with the concern that it might represent a waste of money. There was also debate over the cultural impact of a cooperative project proposed by the United States and Russia. Concern focused on the risk that teaching would have to follow US curricular guidelines and would therefore no longer meet the needs of Argentine students, and that it would tend to expand the already heavy influence of US culture and values. A further negative factor was resistance to the changes that would be needed in teaching methods in order to carry out the cooperative projects.

Pros	*Cons*
More resources for students	Unknown technology
Curricular support for teaching computer science and English	Waste of money
Cooperation with other schools	Foreign cultural influence
Professional development for teachers	Changes in teaching methods
Overcoming Zapala's isolation	

The points in favour of participating in IEARN that were debated at that time could be divided into the potential impact for students and that for teachers. Among the factors that might affect students, the most attractive from the teachers' viewpoint, was that the project would mean more resources for students in a cash-strapped school. Whether or not the experiment was successful, it represented the only way of giving the students access to this technology. Moreover, it was unheard-of for a public school to have such access, and so the project was looked upon as an opportunity to give substance to the notion of equity, which was one of the key concepts behind the Argentine education reform. The second point in favour was the linkage that the project implied between technology and subject matter. For the computer science and English departments in particular, IEARN represented an excellent curricular resource. The two department heads immediately saw the benefits that the experiment could bring, if it were successful. In effect, it represented an opportunity to improve the quality of education, which was the second guiding principle of the education reform.

In the case of the English department, teachers reported that as soon as the first English-language messages began arriving from students in the United States the local students became very enthusiastic about the subject. For the first time, students could see that this foreign language had real meaning for them. The teachers quickly realized that this technology had a potential that they had never imagined. The English department thus became a solid pillar of support for participating in international projects.

The project's most positive impact on teachers was the professional experience that it represented. At that time, the two female teachers responsible for the project were feeling frustrated in their professional career. They put in their teaching time and they liked the work, but they felt bogged down in routines. IEARN offered a change, the chance to experiment and learn something new. Not only were cooperative projects something innovative in themselves, but the Internet held out the promise of global connectivity, which would put them in contact with teachers all over the world. It offered continuous professional training in the teaching practices of many countries.

A final factor that attracted teachers to IEARN was the hope that they could thereby break down the school's isolation, recognizing that this could have a profound impact on the education community. It is important to remember that Zapala lies alone on the North Patagonian plain and that the nearest town – no bigger than Zapala itself – is 80 kilometres away. Professors and students alike live in isolation from the world, a fact that will become clear when we explain how the teachers of Zapala received their training. The new technology promised to connect them to the globe, through a virtual world where geographic distance would lose all meaning.

Although at this stage IEARN worked primarily in English, the first project in which the school became involved was in Spanish, with the Escuela de la Costa. This project dealt with an oil spill in the waters near Puerto Madryn,

during which thousands of penguins became fouled and were facing death. Students of the Escuela de la Costa were able to share with CPEM 3 classes the efforts they were making to rescue the penguins. Teachers and students both considered this first project a success, but the coordinators still faced the problem of enlisting greater participation. It was now easy to motivate the students – the penguin project had aroused great interest and they were keen to take on further projects. This motivation was indeed an important factor in encouraging more teachers to participate.

2. Leadership

The coordinators provided leadership for the project and they developed strategies to help promote it among the teachers. They planned and designed training courses to demonstrate the pedagogical utility of IEARN and created easy and clear ways to foster participation in IEARN. In order to enhance technological skills, the coordinators organized and conducted an e-mail workshop and discussion groups with their colleagues. The workshop helped teachers to overcome their initial misgivings about the technology and bolstered their confidence and their ability to introduce the technology in the classroom.

The coordinators also pursued a strategy to demonstrate the use and impact of ICTs and IEARN. The first projects at CPEM 3 included a highly public component so that other teachers, students and the general community could see the impact that these projects were having. Perhaps the best example came when the school participated in a videoconference with the Argentine Ambassador to the United States. During our interviews in CPEM 3, many teachers recalled that moment, which had revealed for them the real potential of this technology.

A third strategy that the coordinators pursued in practice was to create small activities that the teachers could incorporate into the classes. In history and geography classes, for example, teachers asked the students to pose some very simple questions relating to the course of study. These questions were sent to several schools around the world by e-mail. As the responses came in, the students were able to learn through genuine communication about the similarities and differences between people. The geography and history teachers overcame their initial doubts about the technology and realized that it could be of great service in helping their students to learn.

A fourth strategy followed by the coordinators as participation grew was to identify specific IEARN projects that would appeal to specific teachers, to create a concrete activities plan and help teachers carry it out.

Although the school principal was not involved in the project on a daily basis, his leadership was also decisive. From the outset, the CPEM 3 principal gave the project his full support. The school changed principal several times during the 10 years of its involvement with IEARN, but each incoming

principal threw his support to the project. This support made itself felt in many ways. At the outset of the project, the principal set aside a small room for the telematics club. His support was also essential in granting permission for the coordinators to excuse themselves from school for training sessions.

The principal's most important contribution was to promote and undertake all the changes needed to the school's infrastructure and for its use, and to approve the expenditures to keep the project going. When IEARN arrived, CPEM 3 had only one telephone line. With the principal's consent, that line was shared with the telematics club. Later, another principal sought help from the Provincial Board of Education to provide another telephone line for the project. Because it did not have its own budget, the school could shoulder only part of the costs associated with the project, and the principal had to negotiate with the Board on several occasions to cover the balance.

Another aspect of CPEM 3 that was noted by the teachers who launched the IEARN project was that the teaching body in the school was fully behind it. The teachers knew each other and cooperated and shared with each other very well. This strong collegial spirit did much to popularize the project among the other teachers.

A final factor that was fundamental in institutionalizing the technology in CPEM 3 was the principal's establishment of a Department of Telematics. The Provincial Board of Education created the necessary time slots, which institutions were allowed to allocate as they deemed necessary. The Department of Telematics is the only one in the province (if not in all of Argentina). It is interdisciplinary in the sense that it uses its resources to promote and support cooperative projects using technology in all areas of the curriculum.

3. Professional development

Initial training for the coordinators was complicated by the fact that the participating schools were widely scattered, with one in each province. It was therefore not possible to bring all the coordinators together on a regular basis at the Puerto Madryn school, which functioned as the IEARN-Argentine headquarters. As well, the Puerto Madryn school itself had little experience with the project, although it did have a telematics expert on the staff. The people with the greatest experience were in the United States. Nevertheless, the coordinators were able to make occasional trips to Puerto Madryn to attend technology workshops. IEARN provided manuals and printed material so that the schools could in effect do their own training.

In Zapala the coordinators made use of other training means, beyond those programmed. At their own initiative they asked the Provincial Board to fund more trips to Puerto Madryn to work with the expert there. Essentially, however, the coordinators trained themselves in telematics aspects (configuration, software, wiring, etc.) via short-wave radio links. At 10 pm

each night they met at a ham radio operator's home to listen to technical instructions from the expert in Puerto Madryn. They took notes and then tried out their new knowledge at school the next day. If it did not work, they went back for another radio session the following night. Beyond the tremendous dedication that the two coordinators showed, we must note that they started from a solid basis of knowledge in computer sciences and English. The only technological aspect that was new to them was telecommunications. The head of the computer science department was already fully familiar with the computer science aspect. Not all schools invited to participate in the TELAR network had this kind of expertise available.

4. Learning and experimentation

The fact that the project was launched at the same time in the United States, Russia and Argentina meant that the local principals, coordinators and teachers, as well as the international coordinators, were all finding their way and coping with the same problems. This provided a sense of security to the initial participants since they were all facing a common challenge. The first successes were as modest as exchanging messages between students at Puerto Madryn and their twinned school in the United States.

5. Time

One of the conditions for participation that the Board of Education asked of the first school was that the heads of the computer science and English departments should be fully committed. At this time in the province of Neuquén, department heads were allotted 12 hours a week to spend on administrative duties associated with their position. This meant that in CPEM 3 the two coordinators had some time free from classroom responsibilities to devote to the project. Obviously, they spent far more time than this on the project, but those free hours allowed them time to coordinate with other teachers and students.

6. Infrastructure

There were several factors within CPEM 3 that helped the launching of the TELAR–IEARN project and to keep it running successfully. Some of those factors were already in place before the project began, and others were incorporated during the course of the project.

The coordinators were faced with problems in integrating an inter-disciplinary project into a conventional curriculum, without much help from other teachers at the outset. Moreover, in 1997 the coordinators lost much of

their available school time for the project because of new budget programming demands on the part of the province. They therefore decided to establish a special club to promote and pursue the projects. Thus was born the CPEM 3 Telematics Club. The club was responsible for selecting projects, finding interested teachers and coordinating students' efforts to use the technology. Generally speaking, students and teachers in the club reviewed all projects submitted through TELAR–IEARN and selected the ones they found most interesting. If there was no one in the club who could help coordinate a project, another teacher was asked to take this on. Sometimes the project was integrated into the curriculum of some class, and sometimes it would be treated as an extracurricular activity.

As the project grew, it gave rise to specific needs. The principal decided to earmark specific resources to meet these needs. This led to the creation of a dedicated telematics room, which did much to enhance the coordination of activities under TELAR–IEARN.

When the need to translate messages into English exceeded the capacity of the English department, someone came up with the idea of creating the Translators Club to enlist students who had had private English instruction and whose facility in the language therefore exceeded the requirements of the official course of study. Those students helped greatly in translating international project proposals.

7. Financing

Financing has been a weak point of TELAR–IEARN in every school. It depends heavily on the support and the bureaucratic skills of the principal. In Zapala, the Provincial Board of Education initially refused to recognize expenditures associated with the project. For example, the project initially had to share the principal's telephone line. As expenses grew, the Board demanded adjustments. The principal refused to yield. The argument ran on for several months until the Board finally agreed to cover a portion of the costs. Later, official approval was received for a second telephone line, the costs of which were paid by the Provincial Board.

The TELAR–IEARN project enjoyed the support of the Zapala community. The local Internet service provider subsidized a portion of the subscription fee and several local firms covered the rest, as well as paying for paper, supplies and other inputs. To keep the telematics club going, many youngsters lined up sponsors among local businesses and neighbours, who paid a small monthly quota. When it came time to replace the equipment, students held raffles and other fund-raising activities. If it had not been for these additional contributions from the community, the project would never have survived.

Case study. IPEM 84, Tanti, province of Córdoba

Decision to participate in the project

IPEM 84 "Jorge Vocos Lescano" has been part of the TELAR network since 1994. It became a member as part of the Argentine government's Social Education Plan. IPEM 84 was one of 20 schools participating in the Social Education Plan in Córdoba. The principal of the school passed on to one of his computer science teachers an invitation he had received from the Provincial Ministry of Education to attend a teacher training session that was to take place in Puerto Madryn, in Chubut province. The principal had very little information about the event, other than that it had to do with computers. Thus, without knowing what it was all about, this teacher attended the first international IEARN session organized by the TELAR–IEARN Argentina network, together with another teacher from Córdoba whom she met at the airport. The Social Education Plan was to link 500 schools that year, but only two teachers from each province attended the training session. The two teachers from Córdoba in fact represented the only schools of that province in the Social Education Plan that are actively involved today in the TELAR network.

At the Puerto Madryn meeting, teachers spent seven days learning how to work with the projects offered by this organization. The computer science teacher felt that this meeting was very important, not only because of the training provided but also because it was a chance to meet and compare notes with other teachers involved in project implementation.

Before IPEM 84 became a member of the TELAR network, the pressures of globalization had led the Ministry of Culture and Education to introduce ICTs in the classroom. As noted earlier, concerns over fairness and accessibility meant that this was done initially in the neediest schools, under the so-called Social Education Plan. This was how IPEM 84 came by its four computers. The computer science teacher, who was at that time setting up computer laboratories in Córdoba, was put in charge of finding a place for these new computers and getting them up and running. Thus, when she came back to school from the training session in Puerto Madryn, she found that in addition to her new technical and teaching know-how she now had the resources – computers and a telephone line – needed to begin participating in TELAR.

1. Goal

Tanti is part of an urban community that is isolated by poverty and socially marginalized. The school leadership recognized the potential of this opportunity to participate in TELAR and promoted the project from the outset as a unique chance for the school, and for the Tanti community, given its

scarce resources, to interact with other educational establishments in Argentina and around the world.

In describing the pedagogical vision of the TELAR network, the Tanti coordinators stressed the importance of the first meeting of IEARN. At that meeting she met the teachers from Zapala and many other places, including countries that already had many years of experience. As the Tanti coordinator put it, "I learned there what TELAR is all about, I saw what these projects could mean for my students." Speaking of other teachers in Córdoba who had declined to attend the meeting, she said, "The others never came to understand what TELAR could really do."

For this school coordinator, with her strong social commitment, to be part of the TELAR network represented an opportunity for her own professional development and that of her fellow teachers, and more importantly a chance for personal enrichment for all her students. Her goal was to give all her students access to new technologies and new opportunities. As she said, "My students are just as good as the others, and they should be given the same chance."

The following projects in which teachers and students participated provide examples of the embodiment of this vision. In 1997 several students took part in a project that had a pronounced impact on the community. Under United Nations supervision, they joined the Student Movement Atlas project, in which they replanted areas ravaged by forest fires. At the outset of the project their objective was to study the soil, in light of the frequent fires that swept through the zone every season. On the basis of their research, they made contact through the TELAR network with a school some 300 kilometres away that was also working on a reforestation project. The students of IPEM 84 researched the kinds of trees that were needed and asked for them. As those trees grew, the two schools were able to work together on replanting areas that had been burned. Many students look back fondly on this activity, recalling the contribution that they were able to make to preserving the environment, the widespread recognition they earned for it, and the chance it gave them to engage in real fieldwork.

Thanks to the TELAR network, many of the teachers were also able to participate with their students in different competitions: the Geography Olympiad, coordinated by Fundación Evolución, sponsored and financed by the Ministry of Culture and Education and supported by the National Geographic Society, the purpose of which is to promote geographic knowledge and understanding; the Invention, Science and Technology Olympiad; and the Argentine Health Olympiad, held as part of a national health education programme. According to participants, these activities gave them the chance to:

- share their daily activities and be recognized for them
- rethink their role as teachers and the way they would structure their class for the next year, based on the methodology they had used with their students in conducting the required research and on what they had learned from the Olympiad

- acquire new knowledge in their own discipline
- encourage their students to take a more responsible approach to their own learning and to become involved in actual and meaningful experiments

2. Leadership

The computer science teacher, who had a technical degree and several years of teaching experience, led and coordinated the process of integrating TELAR into the school. She had the time to do this because, although no extra teaching hours were allocated, she had complete flexibility for incorporating projects into her computer class, and she could take advantage of the projects to teach the use of computers. When TELAR began in Tanti, the computer science teacher, who was also teaching in another school in Carlos Paz, decided to transfer her assigned teaching hours to Tanti so that she could spend more time in that school and work more closely on the project. The importance of this time consolidation aspect is borne out in the results of the survey, which show that one of the most important factors for integrating ICTs is to have a high concentration of working hours in the same school (see Table 3).

With all this enthusiasm, all this drive and the excellent relations she had with her colleagues, she found two strategies for integrating the TELAR projects into the school and promoting their integration into the curriculum. The first was to identify an appropriate project and then show it to a teacher who might be interested (for example, because it was related to the course he or she was teaching) and encourage that teacher to take it on, while offering constant pedagogical and technical support, for which she was well equipped. The second was to inspire the students by first showing them a project and then having them interest their teachers in it.

Projects in Spanish were generally favoured in the school, given the English-language barrier and the fact that there was no English teacher available who had time for projects.

The principal also played an important role in launching and running the project over the years. The principal's support was decisive in selecting the coordinator and also in giving her sufficient responsibility to establish the project. More important yet was the principal's support for financing the project and its required infrastructure. The principal played a key role in negotiating with the parents' association and the telephone cooperative. At one point, when some equipment was stolen, the principal's intervention saved the day. During the years of the Social Education Plan, the principal had left a portion of the subsidy untouched because the school already had computers. When the theft occurred, he was able to draw on this small reserve fund to buy a new machine.

3. Professional development

The Social Education Plan offered very few workshops on computers and telematics. Teachers from Tanti recalled that only two workshops were held, apart from the event in Puerto Madryn, where the pedagogical vision of the TELAR network was transmitted but which was attended by representatives of only two schools. Those two workshops were the only preparation given to the schools that were to be integrated into TELAR–IEARN under the Social Education Plan.

There were other opportunities for professional development, however; for example when TELAR worked together with the Health Ministry on the Health Olympiad. In connection with this Olympiad, a course was offered on how to use research projects as a basis for teaching.

Tanti represented a special case, since the computer science teacher already had a systems analyst diploma and another one in educational technology, in addition to her teaching certificate. Within the school, therefore, she was able to organize and conduct preparatory courses for teachers and principals.

The collegial atmosphere within the Tanti school created a professional culture in which teachers shared and discussed new practices, new teaching strategies and new activities. This created a propitious setting for continuous training and experimentation. This feature of Tanti stands out in the results of the survey, which show that one of the most common forms of professional development was to learn from a colleague.

4. Learning and experimentation

The leeway allowed for experimentation in Tanti produced solutions to obstacles in other areas: the lack of sufficient time for students and teachers to work on projects during the school day and the need for greater technical support. In the case of Tanti, the ability to adapt the computer class curriculum to incorporate ICTs was decisive. With this experiment, the coordinator was able to resolve the two problems: on one hand, she was able to find sufficient time for students to work on the TELAR projects, while on the other hand she established a technical support group among students to help with maintenance of the equipment.

5. Time

Before it joined TELAR, the school already offered computer science classes, but once telematics and the concept of project-based work were introduced changes had to be made to the curriculum. The principal at the time encouraged the coordinator to modify the computer science programme to include telematics and to familiarize herself with project-based teaching. In effect, the coordinator created her own course of study. The project-based

approach allowed students to learn about computers by writing a term paper, designing a web page or analyzing data from a spreadsheet as part of interdisciplinary activities such as environmental studies or local history.

6. Infrastructure

The principal provided solid support from the outset; and because IPEM 84 is a technical school, most of its members looked upon the integration of TELAR as a logical step forward, and one to which they would have to adapt. Similarly, the community was very cooperative and rallied quickly behind the project, particularly since the school had in fact been founded by local parents and teachers. Thanks to this community support, the computer laboratory was fully equipped and at the time of our study had nine computers connected to the Internet.

The school coordinator was responsible for technical support, but since the school was in fact a technical institution she decided to train her students to perform technical servicing themselves. The students had access to the computer room whenever it was not being used. Since the telephone line used for Internet access was connected to a cooperative, and communication was very difficult to establish, the students sometimes had to take turns waiting and pestering for a connection. When a connection was made, they would alert all the others so that they could read any incoming messages about the projects they were working on.

7. Financing

The community played an important role in financing the connection. The parents' association paid for the telephone line. The telephone cooperative, which runs the telephone service for the town and is the only Internet service provider, allowed the school free connection to the Internet.

Students also contributed by holding raffles to buy new equipment, since the school had no other source of funds for the project.

Benefits of the TELAR network and telematics

During our field research at the two schools, the teachers involved in TELAR told us of the many changes that they had observed in the school and among the student body. Those changes go well beyond technical know-how. There have been changes in classroom activities, in student motivation, and in the level of autonomy and responsibility with which students conduct themselves. In the two schools visited, students in the telematics club and the technology support team play a key role in keeping activities going at the school. The students look after the equipment and make repairs, they select and promote projects and enlist teachers to work with the TELAR–IEARN network. The

projects have served to extend students' learning well beyond the classroom. One important aspect is that, in order to communicate through the network, the students are learning more about many aspects of their own community.

The results of the survey confirmed the comments made by the teachers we interviewed. The questionnaire included an item on benefits observed among the students in two global dimensions: psychosocial development and knowledge acquisition. In their responses to the questionnaire, teachers indicated that students had benefited in several dimensions (see Table 5). In the area of psychosocial development, 91 percent of the teachers found greater self-confidence, 86 percent pointed to improved abilities to work independently of the teacher, and 86 percent thought that students were making a greater effort. In the area of intellectual development and learning, 76 percent of teachers reported greater comprehension, and 67 percent believed that the increase in skills applied to the student body as a whole, and not only to a group of specially endowed learners. As well, 62 percent of teachers indicated that their students were delving into more complex information.

Table 5. Teachers' views of benefits to their students from the use of the technology (percentage of teachers' responses)

Students feel more confident in their own abilities	91%
Students work harder on their own, without teacher supervision	86%
Students work harder at tasks when using computers	86%
Students have a more thorough understanding of the concepts they encounter	76%
Skills improvements are more evenly spread and not limited to a few outstanding students	67%
Students search out and interpret more complex information in a more thoughtful way	62%
The quality of students' writing is better when they use a word processor	48%

These observations have encouraged teachers to integrate TELAR and ICTs into their teaching as a tool for enhancing students' commitment and deepening their knowledge in different subject areas. One item on the questionnaire asked teachers to select the three most important objectives for using the technology, from a list of nine options that ranged from improving technological knowledge to learning other subjects. Responses varied, but there was a clear preference for objectives that make use of technology to deepen and extend student learning into other areas (Table 6). Most of the teachers cited the use of technology to seek information (57 percent) and to reinforce what students had already learned (52 percent). Next came its use as an analytical tool (43 percent) and to facilitate cooperative

work (48 percent). Only 29 percent of teachers considered computer literacy itself to be the principal objective of using the technology.

Table 6. Objectives most frequently cited by teachers for student use of computers

Seeking new ideas and information	57%
Making knowledge and skills "sink in"	52%
Learning to work collaboratively	48%
Analyzing information	43%
Communicating electronically with others	33%
Improving their knowledge of computers	29%
Self-expression through writing	19%
Presenting information to an audience	5%

The projects that were undertaken in the schools, the interviews, and the results of the survey on benefits observed among the student body all suggest that learning is active and constructive. As well, 100 percent of the teachers using the technology declared that they had learned new teaching approaches from it, and 63 percent defined their teaching role primarily as that of a "facilitator".

Conclusion

The successful outcome of the experiment in the two schools studied is consistent with the theoretical framework on which we based our research. In varying ways, the education community in both institutions was able to overcome difficulties that prevented other schools from implementing the programme and integrating ICTs into school life.

1. Goal

IEARN International and the Argentine Ministry of Culture and Education each had their own objectives in implementing these programmes: improving the quality of life for the planet and its inhabitants on one hand, and improving secondary education on the other. In addition to these two goals, the project succeeded in both schools because the school community adapted it to its own needs (overcoming isolation and marginalization, providing basic content in computer science and English, promoting professional development, education reform and social equity).

2. Leadership

Constant support from the principals of both schools made it possible to bring about the institutional changes required for integrating the technology into the school so as to participate in TELAR–IEARN. Extension of the project in each school was due to the efforts of the coordinators, their clear vision of the potential offered by ICTs as a means for professional and educational development for the entire school community, and their efforts at generating small-scale activities to this end.

3. Professional development

Interviews at both schools revealed the difficulties that teachers faced in overcoming the shortcomings of the programme described by Lafontaine (1999) and in achieving their own professional training. In the absence of other resources, TELAR itself became for them a source of professional development. As well, both schools succeeded in overcoming obstacles because they had a computer science teacher with the technical know-how to move into telematics. In the case of CPEM 3, there was an English teacher whose command of the language made it possible to participate in IEARN at a time when very few projects were being conducted in Spanish.

4. Learning and experimentation

Flexibility to experiment and adapt the programme to each school's circumstances was important. In both cases, they began with simple exchanges and experimented with concrete activities that allowed them to reorganize the institution, test out the equipment and inspire enthusiasm among students and teachers, and ultimately to achieve massive participation by the education community.

5. Time

In both schools the coordinators had non-teaching time available, which they could devote to the project. This free time was generated by the schools themselves. Nevertheless, most of the time spent on the project was voluntarily contributed by the coordinators.

6. Infrastructure

The experience and strategies used in both schools confirmed that computers are not the only infrastructure needed to ensure success in projects of this kind. Equally important are access to a dedicated telephone line, a secure connection to the Internet, adequate teaching and technical support, and physical space where students can use the equipment.

7. Financing

Interviews in both schools revealed the difficulties that teachers confronted in overcoming the lack of funding, a crucial aspect for the sustainability of efforts to integrate ICTs. With no outside support, both schools had to develop their own strategies. The project was sustainable thanks to the support and the bureaucratic skills of the principals and coordinators, as well as the enthusiasm and creativity of the teachers, the students and the community in general.

Finally, our research also points to the fact that teachers in a school can play a decisive role in overcoming the digital divide. Many teachers demonstrated a strong social commitment to achieving equity and securing greater resources for their students, in a context of economic hardship.

> I want my kids to have the same access as other kids – they're just as good as other kids and they should have the same opportunities. Today my school has access, but I worry about all the other ones. (TELAR–IEARN coordinator in Tanti)

Recommendations

During our research we learned a good deal about the difficulties facing schools in Argentina in their efforts to integrate technology, and these findings are quite likely applicable to schools in similar contexts throughout Latin America. The two case studies highlighted the individual challenges that each school and its education community faced and the way that they overcame these barriers to improve the education they offered their students.

On the basis of this research, we have prepared a series of recommendations to guide future attempts at creating and developing other projects for integrating educational technology.

- Establish clear goals for the programme, based on real life. Those goals must be flexible enough that schools can adapt the programme to their own institutional aims, their needs and those of their education community, as well as to the interests of their students.
- Plan to start out on a small scale and expand the programme over time, monitoring progress carefully and making changes and improvements as experience dictates.
- Select schools through competitions or calls for proposals, in which the school must demonstrate an institutional commitment to the use of ICTs in order to ensure that it has the willingness to undertake the work required.
- Plan for sufficient and ongoing technical and pedagogical training, either through attendance at courses or via the Internet. Such training should include instruction in computer maintenance for selected personnel.

- Create a programme based on the mother tongue or the most commonly used language of the students.
- Ensure that each school has the minimum resources needed to start working on the project and, if possible, a dedicated telephone line for the programme.
- Enlist the support of the school principal.
- Within the school setting, encourage the selection of teachers who have the leadership potential to coordinate the programme and be the first to receive training. As leaders, they will have to be trained to have a clear vision of the educational potential of the technology for their school, an overall vision of the process of integrating ICTs and of the changes that will promote that integration, so that they can select the appropriate strategy in each case.
- Develop a strategy to free up sufficient time for teachers and students. For teachers, this time must be available during the school day, while for students the approach may call for implementation either during class time or as an extracurricular extension of learning activity.
- Give teachers participating in the programme the flexibility to adapt the curriculum and experiment with it.
- Include activities to foster a supportive relationship between the school and the community.
- Provide sufficient financing at the outset and help the school, or some other local educational body, to develop strategies for self-financing and to promote public policies that will encourage cooperation from the private sector.
- Ensure continual monitoring of the schools participating in the project so as to learn from their experience and revise aspects of the programme if necessary.

One interesting fact with respect to these two schools is that in August 2000 they both applied to join the GEMS programme (Global Education Model Schools), an alliance between IEARN and the Schools Online organization, the purpose of which is to supply equipment to needy schools. Our two schools were awarded a laboratory with 10 latest-generation computers complete with Internet connections. These laboratories were installed during March 2001.

It would be interesting to monitor these schools and the other five schools in Argentina that received the same equipment in order to compare the impact of having more and better access to this technology.

Notes

1. TELAR <http://www.telar.org>. In 1989 Daniel Reyes, principal of the Escuela de la Costa school in Puerto Madryn, province of Chubut, made contact with Peter Copen, president of the Copen Family Foundation (CFF) in New York, who at that time was supporting an initiative to link 10 US schools with 10 schools in Russia in order to improve the quality of education and promote understanding among students of the two countries. That experience was so successful that CFF decided to invite other countries to join the programme, under the motto "Connecting youth: Making a difference in the world". Daniel Reyes jumped to this challenge and became the creator and guiding spirit of the TELAR national network and a founding member of the international IEARN network. During 1993 and 1994 the Ministry of Culture and Education helped to extend IEARN and TELAR to nearly 500 schools under the Social Education Plan.
2. In 1993 Argentina adopted the Federal Education Act, aimed at reforming the education system to reduce bureaucracy, decentralize management to the provinces, and improve the quality, equity and efficiency of education in Argentina. A key aspect of this reform was to improve the level of education in poor and remote areas, where equipment was lacking, facilities were inadequate, teachers were unmotivated, and school dropout and failure rates were high. This portion of the Act was known as the Social Education Plan. It consisted of three principal programmes: (1) Better Education for All, (2) Better School Infrastructure, (3) Student Bursaries. By 1998 the Social Education Plan covered 12,000 schools and 3.5 million students at the primary and secondary levels.
3. IEARN <http://www.iearn.org>. IEARN was founded in the United States in 1990 by Peter Copen and started with a pilot project for connection and interchange between schools in Russia and the United States. The main objective of IEARN is to foster responsible, humane and spiritual growth and thereby enhance the welfare of regions, countries and the planet through telecommunications. IEARN has now linked schools, teachers and students in more than 90 countries. Through this network, schools can give their students and teachers the opportunity to get involved in cooperative projects in nearly all disciplines. These projects, which are proposed by teachers and students all over the world, can readily be integrated into the school curriculum.
4. Fundación Evolución was created in 1991 to provide a legal framework for the activities of the TELAR–IEARN network and the education programmes associated with them. Since that time, Fundación Evolución has coordinated, supported and promoted participation by Argentine schools in the TELAR–IEARN network. It also coordinates education programmes and interacts closely with schools in the network.
5. The fieldwork in these two schools was conducted in August 2000.

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