Innovative uses of ICT in Chilean schools

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Abstract
This paper presents some of the results of the study of seven cases of innovative pedagogical practices using ICT. The study was performed in the framework of the application of SITES M2 in Chile. The results are divided in two sections, the first presents a summary of each case, highlighting its innovative characteristics that serve as models of ‘good practice’ for Chilean teachers. The second part presents the results of the analysis of what teachers did in these cases; the impact on students; and the type of teaching and learning activities in use. Results show that these projects did not provide evidence of having impact on students’ learning achievement as defined in the national curriculum. However, they show that students participating in these projects could learn other things, had the opportunity to develop abilities defined as cross-curricular and practised ICT related skills. The analysis of the teaching and learning activities highlights some deficiencies in the way that teachers implement new teaching strategies.

Keywords: Educational Innovation, Information Technology; Teaching; Learning

Introduction
During the past decade, Chile has been implementing a major effort to substantially upgrade the quality of its school learning contexts, as well as to improve the equity of its results. Major components of this decade-long reform effort are: comprehensive investment and support programmes which combine more resources with new teaching and learning methodologies; specific programmes for the poorer schools; a new, more ambitious and contemporary curriculum aimed at developing higher-order thinking skills; an extended school-day for the whole student population; and better salaries and working conditions for teachers. In terms of national policies, education has been the nation’s top priority during the last decade (García-Huidobro, 1999).

In this context, Enlaces (links) is the information and communications technology (ICT) initiative of the Chilean Educational Reform. Its aim is to integrate these technologies as learning and teaching resources for all students and teachers in the ten thousand Chilean public schools. By the year 2002, more than 70% of primary and all
secondary schools participated in Enlaces. Each of these schools received computers; local networks; educational and productivity software and most have free and unlimited Internet access to specially created educational content relevant to the Chilean curriculum. Also, the Ministry of Education, in partnership with 24 universities all over the country, provides long-term technical and pedagogical support to each school, with more than 60% of teachers already trained in the use of ICT (see: www.redenlaces.cl; Potashnik, 1996; Laval & Hinostroza, 2002).

In 2000 the Chilean Ministry of Education decided to participate in the SITES Module 2 (IEA, 2000) initiative, in search of answers that could help to characterise innovative uses of ICT in Chilean schools and to understand their characteristics.

Literature review

The introduction and use of information technology in education is commonly associated with a process of ‘educational innovation’ (Wright, 1987; Grunberg & Summers, 1992; Fullan, 1996), either acting as a Trojan Horse (Olson, 1988), as a catalyst (Hawkridge et al. 1990; McDonald & Ingvarson, 1997) or, more recently, as a lever — a tool that must be applied purposefully to a task to be of value — (Venezky, 2002). These different categories might show the evolution of the role that ICT plays in educational innovation and also show its prevalence associated to processes of educational innovation. This has set an international scenario in which there is widespread presence of ICT in schools. Despite the present debate on the actual effectiveness of ICT as aids to improve student learning (Cuban & Kirkpatrick, 1998; Wood et al. 1999; Roshelle, Pea, Hoadley, Gordin, & Means, 2000; Cuban, 2001; Ungerleider & Burns, 2002), it must be realised that there is widespread interest and a definite need to find evidence of the impact of ICT on student attainment or at least to understand the impact that ICT can have.

Consequently many international agencies (IEA, 1998; 2000; OECD/CERI, 1999) have worked on similar initiatives aimed at finding out if and how ICT impacts educational achievements. Some qualitative studies are trying to identify the conditions and definitions of good practices with ICT (OECD/CERI, 1999; IEA, 2000) that can lead to better educational results and some that have a quantitative orientation, trying to show a correlation between the use of ICT and higher achievements (BECTa, 2001b) while others combine both methods (BECTa, 2001a).

In addition to these international studies, there have been several literature reviews that try to identify areas of impact of ICT in students’ attainment (Grunberg & Summers, 1992; Wood et al., 1999; Roshelle et al. 2000; Ungerleider & Burns, 2002). Results coincide in showing that, although there is evidence of impact in specific areas, it is difficult to generalise the methods and procedures. In summary, the vision that prevails is that computer-based technology is only one element in what must be a coordinated approach for improving curriculum, pedagogy, assessment, teacher development and other aspects of the schools’ culture (Roshelle et al. 2000). Nevertheless, if a choice is to be made, based on the current research, the strongest evidence of gains in students’ learning tends to focus on applications in science and mathematics (Roshelle et al. 2000; Ungerleider & Burns, 2002).
In this respect, the report of the OECD has pointed out that:

ICT use enriches the school curriculum in at least two fundamental ways. The first is as an enhancement across almost every subject and activity, through resource banks, simulations, learning sequences, collaborative activity and so forth. This in itself has the potential to transform the learning environment more than any innovation hitherto. The second, and yet more radical, is the pursuit of digital literacy in its own right, whereby the individual becomes empowered as a discriminating and autonomous learner. (OECD, 2001, p. 36).

It must be noted however that the OECD report, does not assess a direct impact on learning achievement, but they argue, as others do, that ICT enables key conditions for learning. A further example of these conditions is presented by Roshelle et al. (2000), describing five positive characteristics of ICT: (i) real world contexts; (ii) connections to the outside world; (iii) visualisation and analysis tools; (iv) scaffolds for problem solving; (v) opportunities for feedback, reflection and revision. Given this scenario, it appears clear that, before looking for impact on students’ achievements, there is still much to be done to identify in which way technologies can be used in real classrooms as well as the type of impact that they are having.

Methodology

As said earlier, this study was part of the SITES Module 2 (M2), an international qualitative study of innovative pedagogical practices that use ICT. Therefore, the study in Chile uses the international methodological framework (IEA, 2000).

Case selection

The selection of the cases was based on the international set of criteria (Anderson, 2002) and the national definition of an innovative pedagogical practice. A panel of experts that included policy-makers, teachers, administrators, technology experts and researchers helped the national research team to define the local concept of pedagogical innovation and to select the cases to study.

The resulting local definition of an innovative pedagogical practice considered that such a practice should have one or more of the following characteristics:

<table>
<thead>
<tr>
<th>Stage</th>
<th>Main Characteristics</th>
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<tr>
<td>Planning</td>
<td>Organising the process of lesson planning in a flexible way, incorporating other colleagues (of different disciplines) to the process or as part of a collaborative project. Using planning techniques (structured analysis) and/or ICT tools for both, the planning and the control of the implementation of the activity (for example, lesson planning software). Planning in such a way that there is a correspondence between the goals, the evaluation and the ‘criteria’ for success (i.e. measuring what they plan to achieve).</td>
</tr>
<tr>
<td>Teaching-learning process</td>
<td>As a general characteristic, it was proposed that it should be focused on the process, not on the products. Some activities considered innovative are:</td>
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<td>(a) In the classroom: Activities that allow the free circulation of students, collaborative activities, projects and expositions;</td>
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<td></td>
<td>(b) Out of the classroom: Activities that break the walls of the classroom as well as extra curricular activities in the school. To integrate the community (parents, researchers, others) into learning activities.</td>
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<td></td>
<td>(c) Student participation: That students take over the control of the lesson. To</td>
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encourage individual participation in the lesson and to promote respect of individual interests.

(d) Teaching methodology: To use a repertory of teaching methods, which can be identified to be suitable for particular situations and to promote the integration of different subject areas.

Evaluation

The use of multiple evaluation strategies (peer-evaluation, portfolios, process evaluation, project based evaluation). To evaluate using the theory available in the field for the subject.

Using the international set of criteria and these locally defined criteria, the selection process of the cases started with a collection of 240 reported uses of ICT in the classroom that were available on a web site (www.enlaces.cl). After a filtering process (including several meetings reviewing the cases) the panel of experts selected seven instances that were considered to fulfil most of the criteria. It must be said that although the selection was mainly based these criteria, issues about national representation and variety in curriculum subjects were considered as well.

Data collection and analysis

The data collection was conducted using the international set of instruments and analysis protocols as defined by SITES M2. Sources of data included surveys and interviews of administrators, teachers, and students, and, where relevant, parents and other community members; archival or historical data; materials, students’ products and where possible, classroom observations.

The data collected in the interviews was transcribed and analysed using software for qualitative analysis (QSR NudIST). The analysis followed two steps: first the data of each case was categorised using the structure provided by the international coordination of the project and which is part of the theoretical framework of the study (IEA, 2000). The broad categories were the following three: (i) the national or regional context, including national ICT policies and other national variables (ii) the local context of the school, and (iii) the characteristics of the activity developed, including data about the teacher, students and classroom factors. In Chile, data of the third category was then analysed looking for descriptive and analytic categories.

Description of the cases

International collaborative project ‘My Homeland’. This project started in 1999 and was part of the international project ‘World Links’ (www.world-links.org). The aim was to share with other schools in the world some characteristics of the province in which this secondary school is located. Students participating in the project had to research about local traditions; historical events, artistic and cultural manifestations of their communities and then share the results with other schools participating in the international project. In order to produce the material, students used productivity tools (word processor, spreadsheet, presentation tools and colleagues). The products were shared using email and presented in a web site specially created for the project (for results see: www.iie.ufro.cl/wlink/webs/ljfs/milugar/index.html).

The main innovative characteristics of this project were:

• It was interdisciplinary, involving subject areas such as arts, language, history and
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• Teachers and students changed their traditional role, engaging in research type activities and working collaboratively.
• Students developed their activities outside the classroom, collecting relevant data from the community members and several historical places. Also, they were responsible for implementing the activities planned in the international project.

Implicit teaching through educational video games. The aim of this project was to produce an impact on the learning achievements of students through the use of Gameboys (Nintendo) programmed with educational games. Students of first and second grade of primary education used these games individually for 20 minutes every day. The schedule for this activity was flexible and at each time the teacher decided which particular game the students would use, regardless of the subject of the current lesson. The subjects involved were initial reading and mathematics skills. While using the games, the teacher assumed a supportive role, assisting the various needs of the students, whether these were pedagogical (solving problems related to the game) or technical (replacing batteries).

The main innovative characteristics of this project were:
• The technology used in this project was innovative and the project depended upon it.
• Students changed their traditional role; insofar they were actively involved in their learning experience.
• The teacher changed his/her role while using the games.

Working recreationally with mathematics. The project started in 1999 and its aim was to improve fourth grade students’ problems solving skills in mathematics of a primary school. In order to do this, the teacher designed a new teaching strategy, that combined different types of self directed activities (game playing, collaborative work, visits to supermarkets, etc.) and the use of a variety of educational resources, including educational software; productivity tools (for example, they used a word processor’s ‘auto shapes’ functionality to define concepts such as the polyhedron); games such as the Chinese Tanagram and real life problems (for example, during the visit to the supermarket children calculated prices and then brought the information back to the classroom to tabulate the totals in groups). The teacher helped to develop the activity by explaining the contents of the activity to each group of students and solving technical problems with the software.

The main innovative characteristics of this project were:
• The overall activity designed by the teacher was different compared to the traditional type of lessons found in most Chilean classrooms.
• The teacher combined a repertoire of teaching strategies and a set of resources that allowed her to work simultaneously with 40 students and few ICT resources.
• Students went out of the classroom to work in an activity on a real life situation.

Composing with a virtual orchestra. The project started in 1999 and aimed to foster students’ creativity and allowed students, especially those who had a ‘limited musical
ability’, to explore and/or investigate the music composition process. Due to the lack of real musical instruments available at the secondary school, the teacher decided to use a piece of software with which the students composed music. During the lesson the teacher supported the students’ work, teaching them about music theory and solving technical problems with the software. She worked with each student individually and promoted a horizontal teacher-student relation. Students were free to work not only during the lesson, but also at home or at any other place, where computers were available. At the end of the project, students produced a CD with the piece of music produced.

The main innovative characteristics of this project were:

• The teacher changed her traditional role, she organised activities in the classroom that allowed the free circulation of students promoting a horizontal teacher-student relation.

• The project enabled students to take more responsibility for their own learning, insofar the use of ICT tools created the conditions for independent learning.

• The use of ICT did modify the contents of the lesson as prescribed in the curriculum; insofar the understanding of the music composition process is beyond the aims defined in the curriculum.

International communication project. The project started in 1999 with students in Chile and adults in Belgium. Its aims were to improve the students’ language abilities (vocabulary, spelling, composition, and oral and written comprehension) and that students learned about the local and national geography, history and culture. The project’s activities included the communication between Chilean students in primary school with adults enrolled in a Spanish course in Belgium, using email, chat and video conferencing. Chilean Students from 5th to 8th grade prepared information about the characteristics of their locality, such as typical foods, cultural traditions and tourist attractions, as well as information about the national contingencies (news). This information was sent to Belgium in Spanish. The Belgian adults responded with descriptions of their national traditions and similar issues from their own locality in Spanish. The Chilean teacher coordinated the exchange activities with a Belgium colleague.

The main innovative characteristics of this project were:

• It was interdisciplinary, involving two subject areas: language and geography.

• Teacher and students changed their traditional role, engaging in research type activities.

• Students developed their activities outside the classroom, collecting relevant data from the community members.

Collaborative learning project. The project started in 1999 as part of the participation of the secondary school in the ThinkQuest international project (www.thinkquest.org). In order to participate in this project, the teacher created an optional course called ‘Computer-Based English Workshop’. Her intention was to create favourable conditions that would enable students to learn to read and write in English. Students from the last two levels of secondary education participated in the project creating web pages in English about subjects such as art and literature, eco-tourism, sports, and cross-cultural
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studies. Students searched for information about the topics in Internet, CD Rom and the library. The information collected was then prepared using productivity tools and finally a web page was produced.

The teacher divided her lessons in two parts; the first was a ‘traditional lesson’ in which she taught the students about the English language concepts that they would apply afterwards. The second part was carried on in the computer lab and students had to work on their projects. In this latter part, the teacher supported each group of students helping them to write correctly in English; encouraging them to use dictionaries when necessary and at the beginning of the project, showing them how to create web pages. During this process the teacher developed a personalised relation with the students, encouraging them to be creative and to undertake independent research on their group’s subject.

The main innovative characteristics of this project were:
• Teacher and students changed their traditional role, engaging in research type activities and working collaboratively towards a common aim.
• Students developed their activities outside the classroom, collecting relevant data from different sources of information.

Working mathematics concepts across subjects. This project was developed during 1999 with the aims that students understood the practical applications of mathematics concepts and used these concepts in different subject areas. In order to do this, the mathematics teacher taught the concept of scientific notation during her lesson, later on, the same concept was used in the subject Earth Sciences to measure the distance between planets and then in Life Science where it was applied to the topic of viruses and bacteria. Different pieces of software were used by the students in each subject; in Mathematic they used exercise guides in a spreadsheet, in Earth Sciences they used software about the Solar System and in the subject Life Science they used an Encyclopedia. Students worked in groups developing the different types of activities following a guide prepared by the teacher. Afterwards they integrated the concepts back in the mathematics lesson.

The main innovative characteristics of this project were:
• The teacher organised activities in which the same concept was explicitly worked across three different subjects.
• Students developed their activities in groups, fostering independent learning.
• Technology was used in a variety of ways.
• Teachers of three different subject areas did collaborate and coordinate their activities.

Cross-case analysis

Results presented in this section include only those that were considered to be more relevant for the purpose of this study.

Impact on students.

This analysis is focused on the reported impacts of these projects on the participating students. It must be mentioned that the reported impacts are at a level of teachers’ and students’

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students’ perception; insofar that no formal instruments were used to evaluate any impacts (such as prepost test). In this framework, teachers and students reported two main types of impacts: learning achievements; and changes in students’ motivation.

Learning achievements. In relation to the impacts on learning, three types were reported: new contents; abilities defined as cross-curricular and ICT related skills.

The type of ‘new contents’ learned by the students can be exemplified in the following quote:

Student 1: [The project] was about us realising what we really had at hand in our province, because we had, I don’t know, [to] deeply research everything, about the natural resources, everything. For example, there were trees that we thought did not exist here, [it was] like realising what we had around; it was like opening our eyes to our surrounding.

Student 3: As well as the art craft of the Mapuches, their clothes, all this we got to know. (Students’ focus group)

They learned about topics that were not included in the curriculum, but that were relevant to them, expanding the learning aims beyond the curriculum.

It was reported that students working in interdisciplinary projects developed abilities defined as cross-curricular, for example, different levels of comprehension of the subjects:

Learn to know things so that they can apply them afterwards, they have to learn how to do it and realise that mathematics is applicable to almost all the other subjects. (Parents focus group)

These abilities are mentioned in the Chilean curriculum as a set of transversal aims that should be taught across all subjects, but in general terms teachers find it difficult to do it. In these cases, ICT seemed to facilitate (trigger) the inclusion of this type of aim in the projects.

In almost all the cases there were reports that students developed ICT related skills, learning how to use different pieces of software, the Internet and to develop web pages.

Changes in students’ motivation. Teachers’ reports coincide in arguing that one of the main changes is that students become much more motivated learners. The motivating effect of computers on students has been widely reported (Lepper & Malone, 1987; Wishart & Blease, 1999; Ungerleider & Burns, 2002), but in these cases it was also noticed that because of students’ motivation, teachers themselves became more motivated as well.

This claim can be showed in the following quote:

The first reason is that Mathematics always have been a bit difficult for the students, this is, they don’t like it very much, they find it boring, because the math books are all very serious. Then the way to call for the students’ attention … How can they like it more? I have to apply[use] the technology [ICT]. (Interview of the teacher in charge of the project)

Here, the teacher describes his subject as difficult and boring for the students, but this situation changes through the use of ICT and the subject becomes more ‘attractive’. This effect can be associated with the use of ICT as a Trojan Horse reported by Olson (1988), but it could also be interpreted as the teacher using ICT as a lever to change students’ perception of the subject (similar to the reports by Venezky, 2002).
Teaching and learning process

Results showed that the type of activities carried on in these projects were the following: Data collection, information processing and product development; communication and playful activities in the classroom.

Data collection, information processing and product development. This type of activity included visits to the schools’ library, searching the Internet, performing interviews to parents or members of the community. After this process of data collection, students used productivity tools (presentation, word processor, spreadsheet) to develop a product that was then either published in a web, sent as an E-mail: or print as a publication. Only few cases had an intermediate step of analysis of the data collected, in general terms the process involved only selecting the relevant information directly from the source.

The type of activities performed by the students is shown in the following quote:

For example, in math, in statistics we had to practice with graphs; in Spanish, we had to ‘clean up’ [re-write] the legends (different from the rough draft); in History, look for information about the Mapuches on the Internet; in Music we had to write a song, but still we had to write it on the computer. (Students’ focus group)

Although this activity is innovative compared to the ‘traditional’ type of activities Chilean teachers do, there are still opportunities to improve and take advantage of this kind of processes. For example Roshelle et al. (2000) describe one type of activity that they call ‘learning by active engagement’ in which students construct knowledge ‘from a combination of experience, interpretation and structured interaction with peers and teachers’ (p. 79 - our italics). What is missing in these cases is the interpretation and structured interaction.

Communication. The communication activities were carried on using mainly email but also some projects held videoconferences. Apart from the contents of each communication, that varied from case to case, in countries like Chile, the possibility of having an interaction with a foreigner is in itself added-value to the teaching and learning process. This is because many of the students participating in the project had never travelled outside their province or even community. One parent describes the communication of his son in this way:

Well, Diego [his son] told me that with the computer, with the Internet they sent letters to other countries, my son is communicating with a woman, she was a teacher also . . . the lady answered him. Now Diego did [write] another letter and he says that he is doing it through the computer, he says he is fascinated with it. He shows his letter to everybody, my son asked them a photo of her family and she sent him a picture of both, she and her husband. and they send from there [Belgium] . . . histories to the children, of other children that are in school, very nice stories, they tell their lives, The one that my son has, tells him that, she has three or four children . . . Diego wrote her again, I don’t know if she will respond or not, I don’t know.

(Parents focus group)

Beyond what the student can learn through this communication, an additional relevant issue is that he was having a personal communication with another family in Europe, crossing the boundaries of his community. These activities provide students with experiences that are not part of the curriculum and its impact cannot judged yet, but they certainly affect students’ understanding of the world, their social relations beyond the
school as well as parents’ perception of the school.

**Playful activities in the classroom.** Some projects developed in primary schools, used educational software with game metaphors for the students to practise specific content. These kinds of activity were generally carried on as one stage in a larger series of activities. One teacher explains:

> The issue of [students] using technology, …, that are the games they like, these are games that all [students] know, because they played with them more than once, but in a different spirit, like fighting and stuff like that, but now they [these games] are used for education, I find it fantastic.  
> (Interview of the teacher in charge of the project)

The reason for using software seems to be to provide students with playful experiences that give them direct experiences that resemble real world situations. This type of activity is similar to what teachers do in primary classrooms (Woods & Jeffrey, 1996); the computer provides the ‘playful’ dimension of the lesson.

The role of the computer as a rehearsal tool has been widely described in the literature (Olson, 1988; Sandholtz et al. 1997). Indeed, the continuing widespread use of drill and practice software (Evans-Andris, 1995; Cuban, 1997) is probably related to the ease with which such software relates to the aim of rehearsal activity.

**Teachers’ roles**

The analysis showed that teachers adopted different roles, but the one that appeared to be interesting for this study was scaffolding.

**Scaffolding.** This role can be described as helping the students while they work in groups or individually with a piece of software or other resource. In general terms teachers helped students with technical problems, explaining some concepts and the activity they should develop.

Teachers adopted this role when students were following activity guides developed by the same teacher. In this sense, the role of the ‘activity guide’ is a fundamental one; as teachers develop their teaching strategies through these guides.

One teacher argued that:

> We are performing the role that they [the authorities] expect from us, from the point of view of the collaboration in the learning [processes], but the student is the one that is learning by his/her own.  
> (Teachers focus group)

It is interesting to note that these teachers had the perception that the student is ‘learning on his/her own’ and they do not realise the relevance of the way in which the activity guide is designed. During the lesson, the guide will indeed ‘guide’ the student though his/her learning process.

**Final remarks**

The cases presented can be considered to be exemplary uses of ICT in Chilean schools and they constitute valuable evidence of what can be achieved with the available infrastructure and resources. The innovative characteristics presented for each case highlight what was considered to be not only different from the Chilean ‘teaching standard’, but also valued as good teaching and learning practice.

The analysis presented in the second section showed the impact (as perceived by the
students and their teachers) on students, the type of activities developed and the new teachers’ roles. Supporting the findings presented in the literature review, these projects did not provide evidence of having impact on students’ learning achievement as defined in the national curriculum and measured by the national students’ assessment tests. However, they show that students participating in these projects could learn other content, had the opportunity to develop abilities defined as cross-curricular and practised ICT related skills. The challenge now is to deepen the identification and definition of these impacts and opportunities, and eventually include them as part of the national assessment tests.

The analysis of the teaching and learning activities presented, highlight some deficiencies in the way that teachers implement new teaching strategies, indicating the need for training. They also show that innovative teaching practices can have an impact on students’ conception of the world, social relations beyond the school and that they can change parents’ conception of the school.

The roles of the participating teachers highlight the importance of the planning of the teaching process, if independent learning can be fostered by the use of ICT, the scaffolding role of teachers is implemented through the activity guides they prepare before the lesson takes place.

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References


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