OECD/CERI ICT PROGRAMME

A Case Study of ICT and School Improvement at Secondary of the Superior Normal School Mexico City, Mexico.

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INTRODUCTION

This work is part of the ICT and the *Learning Quality* program of the *Education for the Future* project which the Centre for Educational Research and Innovation-CERI of the Organisation for Economic Co-operation and Development-OECD, is developing in order to obtain empirical evidence that may offer orientation as to the options concerning educational policy for the 21st Century.

The case study of the Middle School Annexed to the Superior Normal School (Escuela Secundaria Anexa a la Normal Superior - ESANS), one of the four case studies selected to represent Mexico, was elaborated according to the lineaments designed by CERI experts which, at an international level, seek to identify the conditions in which the ICT have been a catalyst for the innovation and improvement of schools.

The ESSANS being an 'annexed school' in which pedagogic innovations are traditionally applied, and the fact that for over two years it has been operating with ICT and meaningful impacts in teaching and other school procedures, make the ESANS an ideally representative school for the present study.

1. Overview
In the context of public middle schools in Mexico, the ESANS has a long established tradition of being at the forefront of educational progress, as it functions as a pedagogic laboratory for the Superior Normal School (Escuela Normal Superior - ENS) and has been the testing ground for several projects. Given these, an educational level above that

of other schools is guaranteed. Today, it has the institutional backing of the Public Education Ministry and the ILCE to develop technology related projects. It is due to its history and experience in technology related projects that the ESANS has gained its prestige, its graduates being the most highly graded public school students in the exam of admission for high school education.

Today, the ESSANS takes part in two of the most important implantation and schoolwork projects with ICT on a national level: the School Network (Red Escolar) and Project SEC21[1], which have allowed for a larger quantity of equipment, the development of teachers' and students' ICT abilities, and information exchange with other schools by means of co-operative theme-based projects. The ESANS has Computer Science, Physics, Maths and Languages labs which operate with computers connected to internet, sensors, simulators and graphic calculators. There is also a computer, a TV and a video-player per classroom and permanent teaching-staff training by means of a weekly visit of a specialist in each of the materials.

For the board of directors and teaching-staff of the ESANS the most meaningful innovation in the last years has been the exploitation of ICT by means of project SEC21. They believe that the use of the ICT has meant not only the possibility to train students and teachers as to the use of a tool or an equipment, but that it has also meant a challenge: using them as a means of learning, using the tools to communicate from teacher to students the class-contents in a clearer, faster, more permanent and significant way. The teachers participating in this project have reported not only the great importance that the training and up-dating in ICT has had for them, but also of their professional development by collaborating with specialists in the production of contents and tools for the usage of such technologies.

The students are the most enthusiastic proof of the interest and motivation regarding ICT, they all consider that these tools help them in studying and the large majority like to use computers and internet and feel sure that the school has done great efforts to innovate practices through Project SEC21.

Parents are satisfied with their children's achievements in this school, and, above all, they are conscious of the school's level and efficiency, of its kind of discipline and of the usage given to the ICT. Almost all believe that there is something important in the curriculum here given, and they associate it to the introduction of the ICT, accepting that their children's learning has improved and that the school has made an effort to improve academic programmes.

During a normal school day, students attend their curricular classes in assigned schedules (be it morning or afternoon shift) and to computer courses and workshops in 'countershift', that is to say, in the opposite shift, when they are free from their regular classes so that both teachers and students in both shifts may optimise the use of available resources. The fact that students have to move from one classroom to another does not get in the way of the working atmosphere that may be constantly perceived, and both teachers and students seem to be well-adapted and comfortable with such movement. The school headmistress plays a very important leadership role over all the school community, such leadership may be observed in the levels of organisation and control over discipline each time the students move to their classrooms or to

the laboratories, and also in the way that the teaching-staff collaborating in her team express themselves about her.

Communication and Information Technologies (ICT)

Every teacher who so wishes may make use of technology so long as he or she asks for a space in the computer room or makes use of the assigned schedules for the courses participating in Project SEC21: maths (Grade 1 to 3), history (Grades 1 to 3), introduction to physics and chemistry (Grade 1), physics (Grades 2 and 3), geography (Grades 1 and 2), biology (Grades 1 and 2). Teachers also have the possibility of playing for their students videos on particular themes, they can also work with interactive CD's or computer programmes; in the physics lab students may work with sensors and simulation programmes, in the maths lab with calculators and in the languages laboratory they may use audios and videos through which they receive an english or a french lesson.

Students too may ask for access to the computer room to do homework if they so must and if there is space available. They bring their homework in in 3.5 diskettes, they work on the internet and they take part in School Network projects for high school and other information research guided by teachers or by their own initiative. They also send and receive messages via electronic mail. A good level of abilities in the handling of equipment has been detected in both students and teachers, and the equipment is well exploited in most of the classes observed.

In general, the maths and physics labs as well as the computer room have enough computers for the students to work in pairs and for them to alternate in the use of different programmes. In the computer room, once their work is finished, they are allowed ten minutes to check their mail or make supervised searches in the internet. Given that all classrooms have a computer, a video player and a TV, teachers have the possibility to make use of this resources in their regular classes so as to emphasise contents and reflect about that which is being seen in class.

The participation in the School Network programmes for middle school seems to be a constant in this institution where students get a chance to work on free demand. Likewise, the participation in Project SEC21 has been significant for teachers and students in both the permanent training by external advisors and in the elaboration and demand of contents and specific supporting material for class contents.

In the areas assigned for administrative and managerial procedures there are several computing equipment and they are constantly made use of by the personnel. Teachers elaborate all their material (attendance lists, exams, exercise forms, etc) on a computer.

Innovation and Improvement

Given its exceptional condition as an annexed school to the Superior Normal School, the ESANS is an institution which has always stood out for being at the vanguard in that which concerns didactic aids and supporting material; in particular, it has a long history in the use of technologies, history which goes back to the projection of films in 8 millimetre format. This is why teachers are used to handling innovative technology and require the use of such media.

Specifically, the participation in Project SEC21 stands out as it has generated significant changes and innovations in both infrastructure and in the community's organisation and

partaking in the project. The installation of equipment and reconditioning of the laboratories has required such a level of organisation that this very organisation, in its turn, has allowed for the later readaptation and / or remodelling of physical spaces which has been possible thanks to the economic contributions of the Parents' Association, the ILCE and some funds which the SEP gives its schools. Likewise, the reelaboration of schedules has played an important role in this innovation, as it has provided the students with enough school-time to cover the requirements set by the project according to the official schedule for technological usage. Regarding the teachers' participation in the project, it turns out that they themselves have felt the need to receive training in the use and appliance of such educational technology; it was not easy at first for everyone, but presently they show a good disposition and attend the courses. The managerial organisation as well as its procedures in relationship to both parents and educational authorities have been a significant factor.

2. The Past

The ESANS has had technological support for its educational practice since it began; from an 8mm projector to show images in a history class, to the modern simulators and sensors to discover the properties of materials with which pupils nowadays study the contents of physics.

Specifically regarding ICT, since 1992 the Parents' Association donated some computers which allowed both students and teachers to have a first contact with this kind of technology, particularly, the maths teachers were the ones involved in the Logo R. project. Afterwards with the participation in the RedEdusat (Satellite Education Network) they installed a parabolic aerial with a codifier that permitted satellite connection, situation which the teaching staff made the most of by taking part in a diplomat of the Virtual University of the Technological Institute of Superior Studies of Monterrey (Universidad Virtual del Instituto Tecnológico de Estudios Superiores Monterrey - UV ITESM). The diplomat was called "Updating of Teaching Abilities" and functioned as an integrating factor of the diverse synergies which moved some teachers and the managerial personnel towards the use of the ICT and to establish links with another project: School Network.

"This was around 1992 or 1994, ... the parents bought us IBM PC's, but they were of the oldest kind, 386 or something of the kind, with those, the computer science teachers created a Logo to work on them ?afterwards, we worked with the collaboration of the Edusat on the SEP's behalf, which downloads satellite information so that teachers may see clips or videos that may result useful for their teaching. Later we worked with School Network in joint projects." (E/.Subdir.P. p.1)

"We had the fortune of receiving, through the Parents' Association, some computers which were then of a very high quality, this was in 1993? we were impressed by the potential of such media, then we decided that as soon as we got the chance we would re-enhance the usage of technology, and above all, one that was more adequately updated." (E/Dir. pp. 1)

This initial connectiveness, in which Java equipment was acquired, did not give them adequate access to co-operative projects developed by School Network on a Windows for PC's platform. So, they had to change their equipment to consolidate the technological platform and initiate

the school's 'start off' with ICT. The above mentioned connectiveness and equipment allowed the school to be able to take part in Project SEC21 which is considered to be the most important innovation in these last years.

"?disgracefully, we are a 'school by the brand' we had the Java station and we were not able to profit from it? we were never able to handle that technology, we lost information, we were not able to get access? we had it exchanged for Compaq and since then the start-off began, results were seen and then we entered SEC21." (E/Subdir.Pp.1)

Educational Innovations

The ESANS has been in constant contact with change and innovation, not only due to it's staff's interest but also because of its close contact with the Superior School for Teachers (Escuela Superior de Maestros - ESM), whose students, during their formative years must attend the ESANS for supervised practices. This situation gives the ESANS a unique quality, as it represents a 'pedagogic laboratory' where it is normal for innovations to take place. Such experimentation is a constant search for alternatives to improve educational quality to keep up a permanent up-dating and giving the ESANS the possibility to choose among the best ESM students those which may be incorporated into their teaching staff.

In this school, transformation and improvement are an every-day reference, in contrast to the either scarce or non-existent information provided in relationship to the latest programmatic reforms institutionally decreed for high school education[2]. Thanks to the skilful conduct of the managerial team, students and teachers take part in a large amount of events and contests in which they usually play a distinguished role. The workshops, in which kids are taught several sports, musical instruments, arts and computer studies in **countershift** (situation which permits the optimisation of available equipment, as morning students attend workshops in the afternoon and *viceversa*), also include yearly exhibitions and have been one of the best accepted innovations in the school community, despite the schedule adjustments that they imply. The 'French as a foreign language' programme in collaboration with the french embassy has also been widely accepted for, besides the teaching, the possibility of teacher and student exchange with french schools was opened.

The idea that introduction of technology has been the most important innovation in the school community in these last years is shared by the large majority. The arrival of computer equipment was not an abrupt change for the school; even when they had to adapt to space availability and teachers had to be trained. The openness to change was a constant which allowed transformation to take place.

"We have had the idea that we are a pilot school in constant change, so I started to work here and found novelty and joined research work to which we were invited. We have seen our own change in time, we are not backward in the technological field? I have seen change take place

and I know that we are a school that's always seeking to move ahead." (E/MaS. Geography. p. 1)

Both teachers and managerial staff find that there is not one only person responsible for innovation and particularly for the incorporation of ICT through Project SEC21. They are conscious of the generalised compromise and participation, though they do distinguish the relevance of the good headship to co-ordinate all efforts and keep the ESSANS at the leading position as a high school in Mexico City.

3. The Present
3.1. Organisation of Evidence
3.1.1. **Promotion Patterns**
Regarding the course of events, we may observe that, though it was the parents who gave the ESANS its first computers, the headmistress's knowledge of and participation in Project SEC21 was a detonating factor for the completion of the equipment, and most importantly, for the use and application of ICT in daily educational activities. These decisive and important leadership on her behalf obtained support from external agents' interest in a well-planned and concrete ICT related project. Such an external agent was the directive team of the ILCE, that is, the SEP's institution responsible for equipping public schools.

"...we believed, and we still do, that technologies contribute a lot to the development of new means of communication with our children and with other schools? we knew that it would be good for the school? to get the project started, we talked to our personnel and made them see the benefits we saw in the possibility, they agreed to participate in the project." (E/Dir. pp. 3)

Their main problem was economic, but it was solved by the APF and other institutions. In general, teachers eventually adapted themselves to the project, even though some expressed rejection towards the project at the beginning, the great majority finally concluded that being a part of it meant an opportunity to update and refreshen their knowledge.

The teacher's adoption of ICT was gradual, first the teachers in the maths department, then the social sciences and natural sciences teachers, then the spanish teachers and finally the ones in technological areas.

"...the maths teachers did a very conscientious work on Logo R. We were impressed by the potential of such media ." (E/Dir. Pp. 1)

"...the teachers were the ones who got involved at once, they have always been really enthusiastic, always looking for alternatives, for new didactic material to work with the kids. Those of us who are fixed to certain norms or structures took longer and had difficulties adapting. " (E/ Tec.pp. 7)

"...teachers were confronted with their need to update their knowledge, to enter an intellectual renovation and go beyond established programs. I feel we have progressed, that though we still stick to the programs we do it in a deeper way and with better procedures which obviously give better results."

(E/Dir pp.4)

(the adoption of the initiative) "...was through collages, they got organised and the first computers that we had, here at school, were for teachers, not students. First it was the maths department, and then us - natural sciences, then the spanish department and lastly the technological areas." (E/Sma Cs.Ns. p. 4)

3.1.2. **Personnel Development**
The managerial personnel that characterises the type of teachers to be found at the ESANS is formed by a group of dynamic teachers committed not only with their students' learning, but also with their own development as educators; the courses most of them have taken and the effort they show in the preparation of their classes prove the point.

"The ESANS has been distinguished, since its foundation, for being an institution integrated by very enthusiastic teachers who innovate in their practice and that always look for the best means, alternatives, procedures and techniques for their students' development." (E/Dir. pp. 2)

"...as they (the teachers) got to know the possibilities the new technology offered them, they became leaders in the field." (E/Esp pp. 2)

Owing to the scarce mobility of the teachers and the compromise they acquire with the institution, a large part of the personnel has several years' experience (the average is over 12 years seniority in the ESANS). Nonetheless, this has not been a handicap for technological usage. Each one, at his or her own rhythm, has adapted to the school's changes and has witnessed and been an agent in the benefits that the changes have brought, always working towards a common goal. This school's work team knows that the goal has not been reached, that though they have achieved much, there is still a long way to go, and that it is by the way of teacher training and up-dating facilitated by inter-institutional collaboration that the quality of teaching may be elevated.

Some teachers decided to take computer courses on their own, but most have taken the Saturday courses offered by the SEP and the ILCE. These courses lasted several months and were directed at the usage of the new tools. They still receive a weekly visit from a specialist in each department, to supervise technological usage related to Project SEC21.

"A couple of years ago I took a course in a private school, the rest I have learnt here at school (meaning the ILCE courses)? Permanently we have the ILCE professor coming in two hours a week."
(E/MaS Physics. p.5)

"...we came to the Saturday courses from September through to December. The course was from 9 to 13 hours, but we wouldn't go until 14 or 15 hrs., there was always someone who got hooked up and wouldn't leave, we stayed and planned the course for the students. That's how it started." (E/ Tec pp. 7)

Though most of the school staff is conscious that part of the project's success depends on the number of computers available, on the programs and on the way these are used in order to give the students the opportunity to work in a closer and deeper contact with technology, it is generally assumed that all of these are not enough. They say that it is not enough to know how to use the tools, but that it is also necessary to know how to use them in such a way that it benefits the learning of students and teachers. This necessarily implies a teacher-mediated process.

"...it is very important to be able to exploit technological uses and the access to information in the classroom, that is to say, to have a headship and teachers who can take the technology and use it in an effective manner." (E/ Esp pp. 1)

(innovation) "...is a step that has allowed us to enter into a close contact with additional tools, different from those we were used to? students are learning that technology has other uses besides playing, they are used to seeing it as part of their daily existence, but a part that was distant from them, without any awareness of its real possibilities and appliances that can be learnt. That is something that they can now see." (E/Ma Concepción pp. 1).

Another important factor regarding the teacher's education is that they are clear of the need to keep on training, learning and up-dating their knowledge in their own fields as well as in the use of TIC's. They have had ILCE training, but it seems that in some cases there is the need for a greater amount of work with their equals so that they may share their experiences in teaching with TIC's , and it might even be necessary to implement this same process elsewhere. The case of a physics teacher exemplifies this:

"?the teacher who comes in (meaning the SEC21 trainer) who has knowledge in physics, but at another level, lacks something to connect himself with us. He says, for example ' I'll tell you what the program is like, but don't ask me how you're supposed to teach it', but that's not the point. We need to work with people like ourselves. I don't know if I'm doing things right, we've had a lot of observers watching us. Am I doing things right? Wrong? Terribly wrong? Or, how do others do it? Comparison is important. Though we are told that we are the first school, how would others do it? (E/MaS. Physics p. 6)

Among the strategies that are considered most adequate or that have turned out to be most effective is found the direct personal assessment regarding the usage of a tool and its applications in teaching a lesson; department sessions in which experiences are shared are also mentioned in this group.

3.1.3. **Leadership Role**
All though support from parents and other institutions has always been present, the school headship has been the one that promotes and co-ordinates all the efforts. From the operation of projects to the selection of the personnel to be incorporated into the teaching body, the headship has been the guiding image in which diverse interests and perspectives coincide.

"There is a school culture, but obviously the headmistress's' leadership capabilities have been

fundamental in this process? Without the leadership there would be no structures to canalise forces to work in the same direction, the headmistress's' staff help her in this respect, while teachers and academies also work in the same direction? It's a team-work's leadership. It seeks to add up personal experiences with information received by other means." (E/Esp. pp 2)

"...having the headship is a kind of statement to unify, to avoid, there will always be differences between people, there will always be a certain situation among all of us who work here, but the closer they are, the more benefits there will be, then the headship, the head, means a lot." (E/Sub pp. 9)

The headmistress is distinguished for her constant seeking of ways to improve the education of her pupils and of the personal development of the academic staff, without disregarding the opinions and feelings of the school community. In this respect a feeling of unity, belonging and team work may be perceived. That is how the headship contacted ILCE, with the intention of taking part in it's projects, giving each teacher the time to adapt to the changes while simultaneously seeking for new ways of training them, bringing the instructors into the school for that very purpose.

"Ms. Carreño (the headmistress) told us, in the teacher's room: 'teachers: we are invited to work here ¿What do you think?' and we all said 'yes'." (E/Tec. pp.7)

The responsibility in the transformation is assumed by all the personnel as a team. With a clear and well organised headship, each one knows his or her role and can respond effectively. The headmistress herself does not consider her presence to be indispensable, as in her absence the school continues to function and functions well. What she does consider to be fundamental is the ICT training for all teachers.

"The administration is so well consolidated that I can go on vacation knowing that all will be perfectly well, that teachers, students and workers know what they must do. It has taken a lot of effort, but it has been done and I am very proud to say it. We have managed to become the school to which my children wish to get into." (E/Dir pp.17)

"Something that's worthwhile saying is that we must unite our efforts, because when institutions sail on their own it is more difficult for projects to be accomplished. I think that the teacher's career should put an emphasis on computer training which is nowadays unavoidable, whether there is or not a SEC21 project in their school, training in the computer area is fundamental." (E/Dir. pp. 11)

3.1.4. **ICT - Innovation Connections**
In the school community there is a generalised idea that associates technology with being at a leading role and with improving the learning level. However, teachers don't feel dependent towards it nor pressured to use it, and express, in a large majority, that despite its being a valuable aid, they could continue teaching without this tool.

Computers have brought change not only to classrooms but also to the managerial area. Teachers search for information when planning their classes on the web. Exam designing, file

organisation, etc. are also done on a computer.

In this matter, some teacher's comments are relevant. They feel that there is the need to have a flexible curriculum so that it can be possible to apply technology and at the same time count upon pedagogic elements that may allow them to use the tool in a better way each time.

"...modifications to previous structures are needed, not only regarding furniture, but also schedules and teachers. It took a lot of changes? but the prime incentive is to see the work yielding more than before." (E / Ma C.D. pp.3)

The handling of the contents of the academic program issued by the central administration has been reorganised to include the technological factor. Regular contents are covered but new and diverse material is added. Since SEC21 the objective is to establish a link between the production of contents and material aids for the use of those technologies. This means that specialists and teachers employ time in designing and producing contents and material:

"The innovation is in how to develop contents and processes including technology." (E/Esp pp.1)

Teachers and managerial staff express that this tool does not substitute the teacher nor the books, that it doesn't change the program, but that it is a new way to relate to it.

"...All that there was before must be readapted to make use of technology, but we must not loose sight of what we are after. A computer gives us the option of including new material but with the same themes established in the program." (E/ Ma C. D. p. 2)

(Computers) "... are a complement, I believe they are much more than a text book, that they aid the teacher in guiding the student step by step? Its an aid in transmitting knowledge." (E/Dir pp. 7).

3.2 Results

1. **ICT Infrastructure**

In relationship to the average equipment in schools of elementary education nation-wide (5 web connected computers average per equipped school) the ESANS has a major technological equipment, both human and material. Project SEC21 includes an installation of 50 local area web connected computers, which allows for the school's access to two technological platforms of wide coverage at a national level: EduSat Satellite Web and School Network computer web. The incorporation into diverse technologies such as digital format video, internet access, graphic calculators for maths teaching and specialised software for physics teaching are also included. This means an integration of different platforms for school use as a fundamental requisite as well as a good conectiveness (64 kb/s wide band).

Specifically, the two media rooms have 20 computers each, they are connected to internet and fashioned in a U shape along the room. The computers installed in the physics lab have a specialised software including simulators and sensors to measure and experiment with phenomena related to the state of matter. The maths lab has 100 graphic calculators, 15 computers and a screen with a PC screen projector for the teacher's use. The languages lab has a master console table, 20 tape recorders and 40 earphones. As has been mentioned previously, for the other subjects participating in project SEC21, there is equipment (a computer, a TV and a video player) installed in the classroom so that teachers may choose from the multimedia video collection or ask for the acquisition of new video material. The present student - computer relationship is 14.8 computers per pupil.

The school has its own server, a parabolic aerial, and is connected to internet. Also, and most importantly, there is a four person team in charge of the media area, they give computer classes and keep the equipment in a good state. However, the headmistress of this institution finds that their best technology-related resource is the teachers' enthusiasm.

There is a generalised opinion, among teachers and managerial staff, that more equipment is needed. They also feel that a greater number of computers are required so that the children's work may be individualised, and so that children who do not have computers at home, may be able to do their homework at school.

An equipment expansion is considered necessary, there are teacher's petitions to be able to have more computers in their own classrooms. There are also petitions for other academic subjects which have not yet benefited from these resources to be integrated to the program. However, the greatest demand is on behalf of the students who hope to have a computer each and more accessing time to use it freely.

(The computers) "...aren't enough for everyone, one is shared among three, the seat is long and one can't see, you must come in early to get a seat." (E/Ao Alma Díaz p. 3)

As far as the maintenance of the existing equipment goes, there is a need to keep the up-dating of the machines on, and to keep on looking for new strategies towards a good maintenance.

"Now equipment has a guarantee, but, latter on, the school will have to see how to give it maintenance (how to obtain the budget) we get some money from the SEP, but it's very little.." (E/Subdir pp.7)

"We have planned a specific maintenance program which includes computer cleansing. The technicians who work here have been taught how to do it, and when we have had a special case we have asked the Parents' Association for help." (E/Dir pp. 11)

While part of the teaching personnel says more computers are needed, most of them, together with the managerial team, consider that that the most important thing is to have constant teacher training to optimise the resources. It is important to point out that over half the teachers interviewed qualify well in their computer usage abilities (specifically, 12 out of 22 - see Appendix "B" - Practice Assessment).

Regarding team financing, most has been given by the ILCE, the same as with teacher training. The SEP backing has also been used within School Network project. The Parents' Association has become a fundamental support in the process of incorporating technology in school. With their approval, enthusiasm and above all with their economic help, the buying of new material and up-keeping of the old has been possible.

3.2.2 Effectiveness

Participating in project Sec21 has encouraged changes in all the school community. The common use of technology by directives in the management of the school has made their administration easier. It has also generated innovations such as reinventing the way of elaborating schedules (counter-shifts); as well as the forms of negotiating with teachers, parents and central authorities.

Teachers recognise that the use of ICT allows them to be up to date constantly in harmony with world events, and have access to an unlimited amount of information. They also see as an incentive finding the students motivated by the use of the machines as well as noticing a change in the learning rate of their pupils.

"...the subject I teach (history) becomes friendlier, not so tedious. I can also take them to the precise moment of the historic event. " (I / Ma E.E. p. 1)

Students affirm (with teachers as witnesses) that classes became more interesting, motivating and attractive; they even express their wish to have further computing lessons and more free time to browse the web.

Parents are also aware of the innovations applied at school, and are pleased with the development of the latter and with the results they see in the development of their sons: "They look forward to attending school, and share at home what they have learned with the computers. They don't have needs concerning technology; they are satisfied with the equipment supplied at school."

The abilities they develop using a computer as a didactic tool are many. Among these there can be found: team work, whether the students in their group work in pairs or interact with pupils of other schools over the web. The ability to research can also be spotted out, though in this sphere it is emphasised that pupils do not just download the information; they have to know what to do with it and how to use it, in this respect it is the teacher who sets the rules. It is also important that professors know how to use and integrate technology to the syllabus.

"When I said that we have renewed ourselves I mean it because we have understood that there is plenty of information we lack that can be accessed by these means. This gives us a better knowledge and a wider scope of materials to prepare our class." (E/Dir p p. 8)

Technology in the classroom offers the opportunity to "see" things, to experience with

phenomena; the pupil has a closer contact with reality. He can observe the images with movement and sound, thus stimulating more senses and therefore contributing to a better learning.

"...advantages, at least in physics, are numerous. We are working with sensors and simulations. Simulations, specially for physics, are extremely important because they give us the opportunity to show students examples which could not be done in the lab; situations where we can change physical laws? one of the objectives in physics is that pupils use the knowledge obtained to explain their surroundings, and the computer's simulations offer this." (I / Ma G.H. p.1)

All this is translated into a generalised enthusiasm with respect to the use of computers in class. With them the work is done better, easier and faster due to the fact that pupils prefer this method, pay closer attention and are able to see things that they hardly would otherwise. Therefore their learning is improved.

"?students point out that, for them, it is more objective to remember things from the personal experience they obtain from the use of this equipment than from what the teacher traditionally exposes." (E/Ma GH pp.2)

The economy of time is another important aspect to be considered. Professors, for instance, assure that the use of computers save them time in activities like elaboration of lists, tests, class presentations or when directly applied in the classroom for projecting a video, as a calculator or as a source of information with the aid of the web. On the other hand, there is consciousness of the need for professors to be trained on the use of the equipment, and to adapt their lecture to the needs and capabilities of the resource. Students also have to adapt to the use of the equipment as a new process of learning. This is translated into a greater inversion of time (well spent) due to the fact that the teacher has to constantly adjust his work plan to accomplish the

syllabus.

Professors point out that there are certain aspects of technology that must be supervised. One of these is the existence of information of all types between which 'non apt' materials for students can be found. Another aspect is the sole use of information from this medium leaving out other important materials exposed in class. A third possible misunderstanding is the centring of the class in the medium itself thus leaving out the important role of the teacher; this can lead to losing site of the principal objective. Taking this into consideration, the school has created procedures of control and supervision in order to avoid abuses or damage to the equipment.

"If it is true that cases have existed, the percentage (of internet abuses); I would count them as minimum? Here we have rules and a visual monitoring of the pupil's activities." (E/Dir p. 13)

When an evaluation of the most benefited students from the use of computers in class was done, teachers proved to have different opinions. Some affirm that high performance pupils make the most of the machines due to the fact that they are the ones who naturally are looking forward to learn more and produce better quality work. Other professors point out that all students are affected in the same way. There is also a third group which assures that this tool allows low performance students to 'catch up' by allowing them to understand concepts which they had failed to grasp, while the advanced students only review the contents.

"For high performance pupils, it can be an interesting form of covering contents, while the less advanced can understand things easier, thus increasing their achievement." (I / Ma G.H. p. 2).

3.2.3 Academic Rigor

The school directives express that since SEC21 the indicators of academic success have been improved. If these have always been elevated, they have been improved by the project.

"?we have a didactic model which is centred on the pupil, this has allowed us to obtain and maintain the first place among public schools which take part in the "National Centre of Evaluation" (Centro Nacional de Evaluación CENEVAL), enabling our students in their first options when they enter medium-superior education. It has also allowed to have the first place in the examinations made to students to evaluate teachers who take part on a Magisterial Degree. We have also been able to have students who obtain excellency scholarships by The Technological Institute of Superior Studies of Monterrey (Instituto Tecnológico y de Estudios Superiores de Monterey Campus Ciudad de México ITESM-CCM); scholarships in The Franco-Mexican Lyceum and another one in The University of Educational Sciences." (Postulation forms, p. 4; No. 24)

3.2.4 Equity

For some teachers, pupils are more skilled in the use of computers; for others there is no difference.

It is also a fact recognised by various teachers that some girls/boys handle computers far better than they do. A teacher has even pointed out that she relies on some of the more advanced students when she has a technological problem she can not solve.

For most of the staff the fact that all students have the same opportunities to access the equipment represents a guarantee of equity in the access and learning opportunities.

3.3 Projections

3.3.1 Sustentability and Growth Capability

Putting into practice an innovation project which represents the introduction of a model including technology, which incorporates various platforms, has meant permanent work for this institution. The academic community has been forced to transform itself as well as didactic contents, budget strategies and human resources; all this with the intention to take advantage of the benefits technology has to offer.

With the mentioned adjustments, it is possible to observe how, gradually, everyday activity is transforming to become a new alternative to traditional schools by incorporating the advantages offered by ICT into education. This benefits however, require the maintenance of certain conditions essential to continue, or to apply the project in other institutions:

-a flexible management with advanced skills in resource administration
-a constant formation / actualisation of teachers which includes the elaboration of materials
-the existence of a vast team for full time technical support
-parents' support as well as an adjustment in the type of organisation that allows the supervision and control of situations which are contrary to educational interests.

The possibilities of growth and expansion of technological devices within the school are seen as a logical step within the consolidation of Project SEC21. It is considered that the next step should be to incorporate the subjects which are not yet developed as well as the possibility that, by technological means, communities organised by academic areas can be created to enhance communication and collaboration between the different schools. This would result in a more productive work and better results for students.

"I believe that a relationship between different areas could be created. We planned this for physics, geography and mathematics; but we hadn't thought of bringing them together? (we could) bring the areas were they intersect. Take, for instance, physics where we work with simulators and graphics; there we have mathematics. It would be very important and we could use it all." (I / Ma C. D. p.5)

On the other side, in a wider level, the school community through parents and teachers expressed their desire to implement this technological resource to all elementary schools throughout the country. However the director of the school points out that the experience of the ESANS is hard to repeat because this institution has a quite particular history and special support from other institutions since the technology was introduced.

"I'm delighted working with all this in the classrooms. I'm still in the project and while I have the technology it will continue to be used. I only wish this could be the case for all public and private schools at all levels." (E/Ma L.P. pp. 7)

"If we want to improve the whole country we should start from kindergarten. I know it is extremely expensive, but it is something like a dream." (E/Mm M.H. pp. 5)

"I think it is hard to have a model identical to ESANS's because we have had a lot of support from ILCE, from the parents' society and ourselves who have sought the ways for self-sponsoring to go on."

Another element to take into account is the impact this technology would have in the contents of education and in world educational standards. To have computers in the class room takes you to a special type of class handling, didactic treatment evaluation student interaction, etc. which would eventually result in a reformulation of objectives and didactic programs.

"This (the computer) together with a world wide network will allow a heavy increase in counties' interaction which implies a huge challenge to pedagogic procedures" (E/Esp p.4)

Finally referring to the possibilities to repeat this experience,

"SEC21 is simply a step which is handled based in computing, satellite video or internet for mathematics physics, etc. But we will soon have Internet 2 in this school; we will know what is happening in a telescope on Hawaii or a microscope in a computing centre in San Diego." (E/Esp.S p. 4)

We know that the initial experience at ESANS with Project21 constituted a pilot plan in order to be able to validate a model of integration of technology and pedagogy in a secondary school; we consider that ESANS does not represent the general prototype of secondary schools due to its special characteristics. We however, have obtained empirical evidence of a project that in its particular case has been successful.

4 Hypotheses
4.2 Hypothesis 1
Technology is a powerful catalyst for educational innovation and improvement when the web is involved Vs. when the real improvement in education is achieved, technology is only useful as an additional resource and not as a catalyst in itself.

Evidence backs up both hypotheses. On one hand it has been proved that the inclusion of ICT has collaborated in educational improvement, given the better results obtained in the admission exams to high-school educatíon of ESANS students for the period 200-2001 according to the data obtained from the CENEVAL. It is important to note however, that the later evidence is not clearly isolated from structural, pedagogical and organisational characteristics that constitute an undeniable 'know how' that implies years of work. If it is true that a successful experienced was observed with the implementation of ICT, its also undeniable that this school is traditionally an academically successful institution due to its condition of 'experimental'

school even without technological devices. It is also important to note that according to some specialists, a two year experience is too little to note the improvement. Thus it would be desirable to have new data compilation and its respective comparison with other schools to obtain more concluding results.

4.3 Hypothesis 2
The diffusion of innovation / improvement (and therefore of the ICT) emerged from the pattern of promotion of innovations as indicated by Rogers Vs. Technology functions in a different manner from traditional innovations and therefore different patterns of promotion should be applied.

The promotion of innovations related to ICT in ESANS followed the traditional Rogers 'sensu' pattern:
- There was a first agent of change introduced which convinced parents and teachers to get involved in SEC21
- Institutional and comprehensive non formal means of communication existed when the director exposed information in professors' meetings.
A group of teachers -the mathematics department- adopted the project in an early stage, and there was another group which, though they did not integrate in an early stage, was not against the project.

4.4 Hypothesis 3
The successful installation of the ICT depends particularly on the capability of the personnel in the integration of it to teaching and learning. It assumes that professors should apply the ICT and for it to be successful, their academic value is positively related with the competency of the teacher Vs. Technological and didactic infrastructure and the student's capability in using ICT determine the results of the implantation of the program and not the competency of teachers.

With respect to this point, there are elements which support the investigative hypothesis favourably. However, we consider that it is important to debate further on the effects other factors have on this success because we agree that the successful implementation of ICT not only depends on infrastructure. As pointed out before, most professors of ESANS proved to be skilled in the didactic handling of the ICT and mediated between the computer, contents and pupils. This would prove the hypothesis that supports the efficiency of teachers. It is not to be forgotten that we have testified that the force that has directed and improved the situation have been the actors in the institution and not technology by itself. Here we should point out that ESANS teachers are outstanding ex-pupils from the ENS and have plenty of pedagogical elements to give their classes, with an open attitude and disposition to keep up to date, and in this school computers are just an additional resource.

However, we also count with empirical evidence that demonstrates the importance of pupils' ability to handle ICT for this tool to become a successful tool to the degree that some professors rely on the students to operate the technological devices. ESANS has as pupils those who achieve better grades in the exam for access to secondary schools, this, together with counting on a high level of connectivity, enough computers for informative lessons, adequate software, simulators, technical support, wide band amplitude, internet 2, etc.; can make us

suppose that they also contribute significantly to make this a successful experience.

4.5 Hypothesis 4

The gaps between low and high economic resource students will not be increased when all students have access to the ICT Vs. The equal access to ICT will contribute to increasing the gap between more and less economically privileged students.

We count with empirical evidence that supports the first hypothesis: for some parents and pupils, the fact that some students have more contact with ICT at home is fundamental, as well as being good students. However, we consider that the instruments we possess are not enough to obtain enough information to support or reject any of the hypothesis. The different levels of poverty in the student population can not be evaluated with the applied instruments or with the socio-economic profile of the school; the used device does not allow to evaluate in a rigorous manner the academic level of pupils before or after the implementation of the ICT. This would imply another kind of research. However we can assure that due to the organisation of the school, all pupils have the same access to ICT, independent of their economic status or academic performance although there are differences in the skills they possess to handle the equipment, and in their use of it in or outside classes (at home for instance).

4.6 Hypothesis 5

The successful implementation of ICT will lead to the same, or higher academic standards, independent of the low quality of many of the ICT materials. Academic standards are a function of the teacher's and school's expectations and not of the quality of text books, ICT materials or others Vs. The use of ICT will contribute to a reduction of academic standards because the pupils spend more time in queries which are marginally beneficial and in reviewing low quality contents in the web and didactic programs of low quality..

Affirmations made by professors with respect to the fact that the use of ICT allow them to go deeper into the contents. As well as those made by pupils who say they get further understanding of subjects when they are exposed with the aid of technology, would support the investigation's hypothesis. However, we also found evidence that supports the alternate hypothesis. Such as the fact that the use of ICT in class require more time than that available for the teacher to give her/hiss subject; as well as the time pupils need to make web searches and make use of the didactic software.

5 Appendix A /

Methodology

The team who obtained this information consisted of three participants and took place during five days with approximately four hours of work each day. Thirty five interviews were carried out; ten made to pupils of different grades, ten to professors of different subjects and grades, eleven to parents (including the president of the parents society) and four to directives. Each

interview spanned between ten and forty-five minutes. Materials related to the use of ICT were supplied by the school such as schedules, syllabi, evaluations, etc..

A methodology of low term explicative cases was proposed. This under the consideration that such modality gives an appropriate design to make evaluations of a project in which, apart from containing important explicative variables, the limits between the program and its context are not easily distinguishable. (Yin, 1993).

Other significant methodological characteristics are: :
-The recollection of data is derived from a theory with established questions or subjects as previously defined hypothesises
-The contrary or rival hypothesises are also defined before hand.
-Data recollection is focused on that which is relevant to prove the principal hypothesises defined beforehand (CERI/OCDE, 2000-june)

The convergent evidence was derived from:

1-Interviws and questionnaires applied to teachers, administrative, students, parents, and technical personnel.
2-Observation of classes and of the school
3-Recolection of work from students and teachers, school publications, plans, etc.
4-Monitoring of teachers' practices with ICT
5-Evaluation of diverse electronic devices
6-Interviews with recognised personalities independent from the school, such as: inspectors, providers, members of the community, etc.

Data recollection in each school took place based in a chronogram of five days previously scheduled with the director of each school in a previous meeting where the subjects to be interviewed were also selected.

-Instruments.

1-Interview for the director
2- Interview for students
3- Interview for teachers
4- Interview for technical specialist
5- Interview for parents
6-Monitoring of teachers' practices
7-Class observation
8-Observation outside classes
9-Cuestionary for teachers, pupils and parents

The methodological proposal of the OECD included the liberty to select the number of

students, parents and professors to be interviewed. It was decided to include a questionnaire that was elaborated taking as a guide the results of the interviews so that there was a greater amount of data to document the case and to support the asseverations with respect to the hypothesises.

A relevant issue to be mentioned is that both subjects that manifested themselves actively in favour or against the innovation were included. This due to the fact that this selection allowed us to have a wider vision of the evolution and evaluation of the project.

Sample Selection
The election of ESANS as an integrand of the four schools reported for the Mexican case was due to the consideration of it being a public school of secondary level, which, has worked successfully has worked for more than two years with ICT and whose innovation has represented improvement in scholar procedures as well as in teaching and in the use of ICT.

6 APENDIX "B"

ASSESSEMENT OF ICT PRACTICES

Annexed High School

Diagram 1: Teacher's feeling towards ICT

How well do you feel using computers in each of the following activities?	Very well	Well	More or less	Not well	Does not do it
Writing an essay	6	11	2	0	3
Seeking information in www	6	14	1	0	1
Creating and maintaining web pages	1	4	4	1	12
Using a data base	5	14	2	0	1
Sending and receiving electronic mail	11	8	1	0	2
Programming	1	9	5	1	6
Making a drawing or diagram	6	12	2	0	2
Presenting information (Power point)	10	7	4	0	1

Based on the answers of 22 teachers

Diagram 2: Average frequency with which teachers set ICT work

Last year, how often did your students do the following tasks for the work you set?	Very Frequent-ly	Frequent-ly	Once in a while	Scarcely	Never
Use of the internet	3	8	9	1	1
Create web pages	0	1	3	11	7
Send or receive e-mail messages	1	10	6	3	2
Use of a word processor program	4	6	6	4	2
Use of a computer to play games	0	3	9	8	2
Use of a calculus sheet	1	2	10	6	3
Use of a program for graphics	2	2	11	6	1
Join an on-line forum or chat	2	3	8	7	2
Use a program for presentations (power point)	4	6	7	4	1
Use an instruction program (simulator)	2	3	4	8	6
Others (specify)	3	4	1	5	10

Based on the answers of 22 teachers

Diagram 3: Teacher's ICT abilities

	Good	Sufficient	Poor	Did not answer
How would you grade your computer abilities?	3	12	6	1

Based on the answer of 22 teachers

Diagram 4: Experiences or policies in which teachers have applied the usage of ICT during the last school year.

Evaluation of the student's abilities in using ICT	yy	NO
Have the student's computer abilities been formally evaluated ?	8	15

Restrictions in www searches	No restrictions	Some restrictions	Only assigned sites	Did not answer
If you set web searches, how free were your students to visit different sites?	5	5	7	5

Creation or modification or web sites		NO
Did you create or modify a web site during some of the classes you taught ?	1	21

Computer use proportion in relationship to class contents	All of it	Most	Some	A bit	None
What proportion of computer use in your class is directly related to the course ?	5	7	7	2	1

Proportion of student's individual computer use	All of it	Most	Some	A bit	None
In what proportion was the computer use in your class carried out by students individually ?	1	6	7	4	4

Frequency of computer usage at home to prepare classes	Several times a week	Several times a month	Some times	Never	I don't have a computer
How often do you use your computer at home to prepare your classes?	3	7	9	2	1

Partaking in virtual courses via www		NO
Have you taken part, either as a student or an instruction in a virtual course in internet?	4	18

Involvement of students in collaborative learning via www		NO
Did you get your students involved in collaborative learning processes through the internet, with students from other classes ?	9	13

Participation on forums or professional chats on-line		NO
Are you currently participating on a forum or chat on-line to collaborate with other teachers?	5	17

Frequency of messages sent and received via electronic mail	Over 12	From 6 to 11	From 1 to 5	None
On average, how many electronic mails do you send each week?	1	2	12	7

Diagram 5 : Tasks directly related to ICT programming and installation (on a 0 to 5 range)

Which of the following have you done?	0	1	2	3	4	5	Did not answer
Make hardware changes	18	0	1	0	0	0	3
Actualisation of an appliance (word processor, graphics program)	9	4	3	2	1	1	2
Recovering of a damaged file	14	4	2	0	0	0	2
Creating a web site	15	3	1	0	0	0	3
Developing a data base	7	3	3	4	2	2	1

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[1] "SEC" stands for "Secundaria" which is equivalent to the first three years of high school. *(Translator's note)*

[2] The integration of a basic cycle including kindergarten, grade school and the first three years

of high school was established at a central level in 1992. This meant the transformation of the programmatic contents grouped by areas which was the previous organisation of high schools. This grouping was disintegrated into subjects so as to facilitate the inclusion of grade schools into the program. The before mentioned meant a change in plans and programs and also a change in the teaching and learning activities.