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A Case Study of ICT and School Improvement at *Escola Secundária da Póvoa do Lanhoso* Póvoa do Lanhoso, Portugal

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1. SUMMARY

The *Escola Secundária da Póvoa do Lanhoso* is a public school situated in a small town, Póvoa do Lanhoso, with 19,000 inhabitants, and is the chief town. It has a school population of 1150 students (of the 7th and 12th grades) mainly aged between fourteen and nineteen, in day school, and between eighteen and thirty, in night school.
Given the characteristics of the surroundings, situated on the outskirts in relation to the large centres and most of the students coming from a rural environment, the school serves a large number of students with poor expectations in relation to schooling, which tends to be reflected in the number of students leaving school before completing the basic education. In a joint effort to curb this movement and to simultaneously promote a greater connection between the students and school life, a set of initiatives have been developed within the scope of the reform and the educational innovation with ICT in order to encourage the involvement and integration of the students in the school.
Among these initiatives is the creation of an alternative education syllabus for the 3rd cycle of the basic education and the involvement of the school in the Nónio XXI Century and Internet in School Programmes, which acted as a support to the implementation of the reform and as a means of generalising it.
The innovative effort to introduce the new curricular approaches and teaching and learning methodologies based on ICT reflects the initiative of the management body and the involvement of most of the teachers in the development of the change process.
Within the scope of the changes introduced in the school during this process, the one which probably had the greatest impact on school life and the school organisation was the change in the philosophy of managing the space in the Library, made possible thanks to the approval of a project in the scope of the National Network of School Libraries and the Institute of Educational Innovation, in articulation with the Nónio XXI Century Programme. Within the scope of this restructuring, the Library acquired a central place in the school and in the students' daily activities, providing access to information, be it in the form of daily newspapers or via the Internet during school hours, as well as reference bibliography, videos and CD-ROMs. For this a new Nónio room was created with access to computers where students can do the tasks assigned to them, consult information, use the email and log on to the Internet.
This restructuring of the model for using ICT was extended to the school's internal communication system and a telecommunications network was created linking all the computer rooms and the Nónio room, as well as the staff room and administrative departments. From here it was possible to create a logic of sharing among these different rooms, strengthened by the adherence of the teachers to the new access capabilities and the sharing of information and to their importance in building learning, both in terms of the curricular integration of ICT in teaching and learning and in administrative terms, namely through the computerisation of school management procedures.
Besides their teaching activities, the teachers are integrated in two school organisations: the educational support group and the project follow-up and development group. The former is directed at developing activities to help students with greater learning difficulties, namely by providing assistance to the alternative education class, and the latter concentrates on the implementation and follow-up of projects in course in the school. All the teachers form part of at least one of the two groups thus making it easier for them to acquire more in-depth knowledge of school life and of the students. Resulting from this procedure the alternative education project was created. This project is strongly directed towards the use of ICT and towards preparing students to enter the working world. Through it, it was possible to integrate students with learning and adaptation difficulties in the educational project.
Further projects and activities were developed to occupy the students' free time in the school and School Clubs were started. A special room was set aside for free-time activities where the students can watch videos and play didactic games. The clubs were also given the conditions necessary that would make it possible for the students' free time to be as effectively occupied as possible. In this respect, special mention should be made of the Mathematics, Computer and Science clubs which now have computer resources enabling

students to better occupy their free time.
In parallel to the investment made to improve the teaching conditions and means, the school has also tried to invest in the quality of the teaching process, namely through the promotion of experimental teaching in sciences, particularly through the support obtained within the scope of the Ciência Viva (Live Science) III and IV Projects. These projects have enabled an effective development of the experimental teaching activities.
This initiative of developing school activities also includes the promotion of art education, be it in the form of theatre (several activities have been developed in this area) or painting, in the context of which a series of workshops have been held.
On promoting reflection on the Library space and its functions, the school started a process of joint involvement, sharing and (re)creation of the school's space and functions, identifying needs and problems and attempting to find solutions to the school community's activities by making available new media to assist the learning process and by supporting training in the use of these media.
This project of reflection and internal inter-pair training undoubtedly provided the supporting motivation and progressive involvement of the community of teachers in the use and integration of the new media in teaching. This process of change also provided the support of the wider community of parents, especially when the school extends training in ICT to the students' parents in free summer courses.

2. THE PAST

The need to introduce the reform and educational innovation involving ICT arose as a natural process to overcome the cultural and socio-economic problems of a school population from a region with pronounced needs, allowing the school to be transformed into the ideal centre to acquire and develop new vocational skills and simultaneously contribute to a better integration of the students in the local community.
In order to understand the characteristics of the school population, it is important to think, even briefly, about certain aspects related to the socio-economic origin of the students' parents. According to the data collected by the school during the 1998/1999 school year, the overwhelming majority of parents were employed in the industrial, agricultural or commercial sectors. The progressive emergence of a significant number of parents who are self-employed is worth noting. However, this fact is not a positive factor for the inversion of the situation in general.
In both cases it should be stressed that most of the jobs are connected to activities that do not require skilled labour. This is a factor which is strongly associated to the low schooling level of the students' parents.
We are also confronted by a school population that tends to be homogenous, with a strong articulation with the local community. There are however a significant number of students who come from France, Switzerland and Germany (as a result of the massive wave of emigration during the 60s and 70s). In some cases these students initially experience integration difficulties which leads them to relate mainly with students in an identical situation. This is why occasionally French and German are spoken in the school corridors. Nevertheless, after analysing the data concerning students changing to other schools, in the vast majority of the cases, these students end up integrating themselves in the school community. The principal of the school considers the factor of changing schools to be residual and this occurs only when the family moves to another house (one or two cases/year), when a student is transferred to the local Vocational School (10 students/year) or when a student is transferred to private teaching institutions at the end of high school (12^{th} grade).
It is in this context that the process of introducing the reform starts, through the creation of an alternative education class and the innovation with ICT in the school. The major objectives of this project are to create conditions for the effective development of the quality of teaching and learning, to gain new skills for the students' vocational future and to promote their full integration in active society.
In the initial phase, however, the reform/innovation with ICT project met with some resistance, essentially in relation to doubts on the effectiveness in the educational development of alternative education and the lack of sensitivity and command of ICT of the teachers (partly due to the fact that they do not have initial training in this area). Added to this last aspect are factors such as lack of knowledge as to the educational uses of ICT and of the change processes in educational practices, namely in the curricular integration of ICT.

We would like to stress that since the beginning the school's management body has tried to integrate all the administrative services of the school in this innovation process by providing training for its staff and by computerising the respective services, such as editing student evaluations electronically.
The external resistance of the parents was overcome by involving them in the project, namely by offering them ICT summer courses. Besides contributing towards the enrichment of adult education, this strategy strongly and decisively led to a closer relationship between the school and the parents, permitting and encouraging better mutual knowledge and greater ties not only between the school and the parents but also between the educational project and the external community. This factor has revealed itself positively by raising the awareness of local companies to the need to create vocational placements for students from alternative education and technological courses.

3. THE PRESENT

ICT Infrastructure

This school currently has 32 classrooms in operation, a population of 1150 students, 98 teachers, 26 auxiliary and educational support staff and 10 administrative workers.
In 1997 the school joined the Nónio XXI Century Programme and the Internet in School Programme. Over the last three years it has had projects approved by the National Library Network, by the National Commission for the Commemoration of the Discoveries, by the Institute of Educational Innovation and by the Ciência Viva III and IV projects.
As a result of the activities of the various projects in course and of the investments made within the scope of these projects, the school has 73 computers, 14 of which are reserved for administrative and management activities (2 for the Executive Board, 1 for the management of documents in the library, 2 in the staff room, 1 in the class directors' room, 5 in the administration services, 1 in the SASE and 2 servers).
The students have access to 59 computers spread out in the different rooms and laboratories, with a ratio of 19 students to one computer.
A total of nine classrooms and laboratories three normal classrooms, the Nónio room which is integrated in the library, the Multimedia Production Centre, the Biology laboratory, the Physics laboratory and the rooms used by the Mathematics and Computer Clubs are equipped with computers.
The library/Nónio room is equipped with video recorders where students can watch audiovisual material and also has a vast collection of educational videos and software (CD-ROMs). Students also have access to the Internet in the Nónio room where they can do their assignments on the 12 available computers.
From all these rooms, the computers which have access to the Internet (connected to the net via a RDIS line) are those found in the three classrooms, in the Nónio room and in the staff room.
The classrooms equipped with computers are networked and those which can be used freely by the students are the Nónio room and those used by the Mathematics and Computer Clubs. These are available to students during school hours, during the holidays and two nights during the week for students and members of the community.
A teacher, the Installations Director, is responsible for the supervision of this equipment. As the school does not have technicians as part of its staff to carry out maintenance services on the communications systems and the equipment, these services are outsourced to a company specialised in this area. As regards the maintenance of the computers, these services are being carried out by the teachers themselves, with all the limitations associated to this accumulation of functions.

Effectiveness

The issue of effectiveness should be assessed by the school's capacity to develop the educational project, particularly in the resolution of cases of failure and of the integration of students in the school community. Within the scope of the reform initiated in this school effectiveness means assessing the initial situation, which presented problems of repeated failure and the risk of leaving school before completing the compulsory basic education, and developing the process of creating and implementing alternative education, namely in adapting the syllabus to the training needs of the students, in following the learning processes, in

integrating students in the school community and, finally, in assessing the levels of motivation and involvement of the students in this project. The implementation of alternative education has decisively contributed to these students regaining their place in the school both through the importance which the school acknowledges them and through the new situation of social and academic integration, which in effect means greater personal commitment.
As the teacher who teaches this class Mathematics and Computer Sciences says, *"The kids in alternative education did not have great expectations in relation to school; now they have made great discoveries which lead to other discoveries and their reaction is quite positive".*
The impact of ICT in the development of the students in the learning processes is summed up by the same teacher in the following manner: *"...for some it is merely a tool, for these (alternative education) it is a discovery".*
This impact is extended to the teachers' practices both in the preparation of the teaching and learning materials and in the approaches guiding their own activity, progressively integrating the new media as tools for the construction of learning and facilitating the development of a perspective directed towards *teaching to learn.*
In addition, the introduction of alternative education has led to a reduction in the differences in access to technologies and to knowledge and has encouraged democratisation in access to information and education.

1. MAIN HYPOTHESES

The main hypotheses of this study comprehend the aspects identified with the development of Educational Reforms and Information and Communication Technologies in Education, especially as regards the impact of communication systems mediated by computer in the implementation of the educational innovation processes, namely: dissemination patterns, upgrading and involvement of teaching staff, role of leadership, ICT-Reform connections, academic rigour and equity.
According to the methodology and instruments used by the study, data were collected, catalogued and processed, enabling the creation of an empirical base which we used to present each of the aspects and the discussion of the hypotheses under study.

Dissemination patterns

This school started the process of introducing the reform and innovation with ICT through the creation of an alternative education class comprising ten students who were considered to be in the risk of leaving school before completing the compulsory basic education.
The introduction of alternative education in the school was the institution's response to the problems associated to motivation, inadaptability and failure in school, and the risk of leaving school before completing the compulsory schooling. The implementation of the reform arose within the scope of the legal framework which regulates the autonomy of schools, allowing them to propose the creation of alternative education projects through which it is possible to bring the school reality closer to the educational needs and interests of students with integration difficulties.
Besides the adapted scientific component, the alternative education being developed in this school includes a strong practical component of a vocational or pre-vocational nature in the area of Information and Communication Technologies, the main objective being the successful integration of the students in active life.
The dissemination of the reform and educational innovation with ICT is closely related to the project creating alternative education. The proposal and coming into being of alternative education in the school coincides with the innovation programme with ICT in 1997, through which the process of using computer tools in the teaching and learning practices was started. In this sense, the introduction of alternative education acted as a continuing experiment of ICT and simultaneously as a means of assessing the results of

this integration for the teachers.
Adapting the syllabus to the educational needs of the group gives preference to using ICT as a support for the new approaches both in the construction of learning and in gearing this learning to the working world.
The innovation in this project no doubt implied a considerable amount of uncertainties and implementation difficulties both in promoting the dialogue between the discipline areas involved and in the development of new educational approaches to the contextualisation of learning.
However, in this school the dissemination of the use of ICT is not limited to the activities related to the reform/innovation project with the alternative education class. On the contrary, in fact; in the community there is a generalised awareness of the uses of ICT in the teaching and learning processes to which the initial effort of the management body and the group that oriented the launch of the first projects made a decisive contribution. A result of this effort today is the perception that the project belongs to the community of teachers.

Upgrading and involvement of the teaching staff
The upgrading and involvement of the teachers in this school is supported by a continued process of internal reflection which led to the implementation of the reform and made the teachers aware of educational innovation with ICT.
The development of this movement is not new for some of the teachers in this school who previously participated in the Minerva Project (1985-1994), which was for many their first contact with the problems surrounding educational innovation with ICT. This became apparent on analysing their length of service 50% of the teachers in this school have between 11 and 20 years of service. Most of the teachers (55%) are women and 72.5% of the teachers are aged between 32 and 42.
The upgrading process was initially set in motion by the management body and by a small team of teachers with previous experience in the Minvera Project, which progressively promoted the recognition of the importance of the school being open to the integration of the educational innovation projects as instruments for the development of the school itself and of its role in the social and cognitive construction of learning.
If ICT are perceived as being the horizontal upgrading for the development of teaching and learning activities, on the one hand, the need to carry out a new phase of work directed more towards their pedagogical use in the various discipline fields arises, on the other. In this sense, the specialist teacher claims that *it is necessary to promote more pedagogical training, directed towards the classroom,* through which teachers acquire more autonomy in integrating ICT in the syllabus.
The effort made to upgrade the teachers in this school has followed a model of inter-pair training, oriented by the needs and objectives of their colleagues. Through this process, the community has acquired some autonomy which can be seen by the involvement of the vast majority of the teachers in the innovation projects in course.
Nevertheless, the continuity of this development depends partly on a group of skills for using ICT individually and in classroom activities with the students.
The degree of familiarity and capacity to use ICT in teaching practices is presented by means of the Survey on Teachers' Practices which includes different sections that are described and commented on below.
The first section is about the use of the computer as a personal work tool. *Writing an article* is a task with which 73.8% of the teachers interviewed said they felt comfortable. The tasks related to *sending electronic mail* messages (35.7%), *searching for information on the* web (31.0%) and *drawing a picture* are also included on this level.
For the activity related to *creating and maintaining web pages* 64.3% said they did not feel at all comfortable. Other activities on this same level were the activities related to *using a database* (31.7%), *creating a database* (54.8%), *writing a programme* (73.8%) and *presenting information using PowerPoint* (31.7%).
As regards the importance of using computers for the teaching activity, 61.9% said they felt *writing an article using a word processor* was very important. Of equal importance are the activities *drawing a picture* (42.9%) and *presenting information* (39.0%). *Searching for information on the Internet* is referred as an important activity (45.2%). More or less important are the activities related to *creating web pages* (38.1%), *using a database* (36.6%), *creating a database* (42.9%) and *sending and receiving email messages* (35.7%).

The activity related to *writing a programme* (52.5%) is referred as not at all important.
The analysis on the frequency with which students were involved in activities related to the computer in the classroom presents the activity on *the educational use of the Web* with 43.9% sometimes. On the same level sometimes 51.2% of the students *use word processing programmes.*
The activity related to *creating web pages* reveals 85.7% in the never column. The following activities also appear in this same column (never): *sending and receiving email messages* (70.0%), *using the computer to play games* (61.0%), *using a spreadsheet* (63.4%), *using a graphics programmes* (68.3%), *joining a discussion forum* (85.4%) and *using a presentations programme* (63.2%).
It is obvious from these data on the frequency with which students use the computer that the process of integrating ICT in the classroom is still carried out by a small group of teachers.
65.9% of those interviewed answered negatively to the question on *whether the students use of the computer had ever been considered in the evaluation.*
As regards the *degree of liberty given to students to surf the web* during teaching activities, 44.4% stated that they had indicated some restrictions and 32.0% stated that they had carried out the activities without restrictions.
Only 7.5% of those interviewed *created or modified web pages with some of their classes*. 56.1% of the teachers use the computer several times a week to *prepare lessons* and only 19.1% have ever *participated in a virtual training course.*
All those interviewed confessed that they had never involved their students in *collaborative learning* via the Internet. In relation to these data, the development of collaborative activities has been done within the scope of activities carried out in the school area.
As regards the collaboration with other teachers via technology (email, chat, forums), 28.5% use these means of communication. In relation to the weekly frequency of sending emails, 9.5% send more than 11 messages per day, 4.8% sends between 6 and 11 messages per day, 38.1% send 1 to 5 messages per day and 47.6% do not send any messages.
As regards the number of email messages received per day by the teachers, 4.2% receive more than 11 messages per day, 48.2% receive between 1 and 5 messages per day and 47.6% do not receive any messages.
Despite the effort to promote the educational use of ICT, results show the need to carry out a training model that favours the development of skills in using them in the classroom as well as the generalisation of integrating ICT in teaching activities directed towards the development of learning.

The role of leadership

The start of the reform/innovation with ICT project is based on the following aspects: the awareness of the management body to this field of issues; the fact that the school runs technological courses in the computer and communication area; and the integration in the body of teaching staff teachers specialised in the area of the educational use of ICT which made it possible to form the initial team of innovation projects.
The commitment of the management body in the development of the innovation is a factor that is clearly present in the initial phase, namely in the organisation of the reflection processes on the development of library and school activities, as referred in the previous section, or in the implementation of the processes to computerise administrative procedures. Furthermore, the creation of work teams within the scope of the Nónio XXI Century and Internet in School Programmes contributed decisively as an incentive to the development of the reform/innovation.
According to the words of the school's vice-principal, *we prefer a team and not an isolated person,* namely due to the fact that the integration of new teachers with training in the area of the educational use of ICT has permitted inter-pair training and has set in motion *a snowball effect.* This opinion is corroborated by the teacher responsible for the Nónio project in the school: *there is no leader... the project is autonomous.*
The self-sustenance of the project is based on the internal learning process of the community of teachers in the school which made it possible to broaden the concept of team to the community of teachers and not to restrict it to the size of a small group of specialists.
In this sense, the training carried out by the local co-ordinator of the Nónio project was decisive for the innovation process, as was the existence of a Teacher Training Centre. This system that made it possible to replicate the training over time within the community and in an informal manner, whenever necessary,

facilitating the progressive familiarisation of the teachers with ICT, namely in using email and the web, among others, and raising their awareness to their integration in the syllabus.
The process of introducing the innovation led to the development of a learning organisation whose path can be followed in the progressive involvement and accountability of the teachers in the conduction of the change process itself in the school, namely in the self-organisation capacity for the internal dynamisation of the projects to be developed, or in the elaboration and presentation of projects to national funding agencies in the sense of supporting the various lines of development of innovation activities improvement of the school.
Throughout this path, which started with the launching of the first challenges in the form of internal reflection and continued with the awareness-raising and training processes for the use of ICT in an educational perspective and which went on to the involvement of all the teachers in the groups that dynamised the projects, the sense of developing a learning organisation which supports and follows the innovation in the school is obvious. It was through the activity of the teaching community as a learning organization that the innovation project was able to overcome the internal resistance to the community itself, transforming it into the driving force of its own development by starting the inter-pair training actions in accordance with the needs, expectations and objectives of the educational project.

ICT-Reform connections
Information and Communication Technologies play a central role not only within the scope of the implementation of alternative education, but also, in a less incisive manner, in the remaining teaching and learning activities in the school.
If, on the one hand, alternative education is a catalyst of ICT integration experiences, mainly for the group of teachers directly involved in them, then these experiences are disseminated through the teaching and learning activities of the remaining teachers, on the other. For example's sake, we mention, besides the activities connected to the computer technological courses, which are based on ICT, the strong usage rate of the Nónio room for teaching activities by the other classes in the school. Added to this is the fact that ICT are an incentive to the development of the processes of integrating students in school life through the School Clubs.
The strong adherence and use of the new media as tools for the building of knowledge, both in formal classroom situations and in informal situations of individual work, such as doing school assignments and searching for information, is revealed in the high rate of frequency with which students use the computers in the clubs and the library.
It is therefore through the adherence with no restrictions that students show to the new work environments that the success of the implementation of alternative education can be seen. As the students involved in the alternative education project state, *they have email, send email messages to their peers and also to the teachers, work with their peers through the Internet,* and they feel that the school is providing them with the means to build learning, namely when they refer to the library as *the most important improvement.*
The role of ICT in the organisation of alternative education arises as a condition of success for the learning processes.
In this sense, the perception which these students have of the importance of environments based on ICT for their educational development (within the scope of alternative education) no doubt lies in the affirmation by a student *that without computers they would not know what they know today.*
This affirmation summarises the impact of ICT in the implementation of alternative education. Furthermore, the impact is not limited to the alternative education project as, within the general scope of the school, the remaining students corroborate the importance of the library, namely when they affirm that *they have everything in the school and do not need to go to the municipal library* and that *they can have access to the Internet in the Nónio room.* They make special reference to the importance of this aspect to them *because not all students have computer subjects and that (having access to the Internet) is important to everyone.*

Academic rigour
The issue of academic rigour arises traditionally through the type of use of ICT and of their impact in the quality and practices of the teaching and learning processes. Academic rigour, however, does not depend exclusively on the materials but on the attitudes, skills and strategies of the teachers for the use of ICT in education.

The use of ICT implies greater involvement and participation by the teacher in planning and managing activities and in following them both in the classroom, as a means of developing student learning, and from a distance, in the practices already established by some teachers in using email to send suggestions for assignments or to answer students' doubts, in this way performing a new type of follow-up to learning.
Practices using ICT in the classroom have encouraged the development of the quality of learning both through collaborative processes which are set in motion and through the growing autonomy and accountability of the student in performing tasks, especially in searching for information and in preparing class or community presentations.
The development of the project *Young Environment Reporters* within the scope of activities in the school area is an example of the accountability and autonomy of students who have to search the Internet for information, carry out collaborative activities and publish information on the Internet.
This practice is a form of developing individual criteria for selecting information and on its quality and relevance to the task being carried out. In this sense, the vice-principal affirms *that the Internet may potentially develop the critical process of students as what exists on the Internet may not be correct.* The remaining teachers who are more directly involved in the educational use of ICT in the classroom are of the same opinion and further stress the importance of the social dimension of the work group in which the student is involved as *a means of developing critical thinking.* In addition, the pressure of the group acts as a natural way of reducing the marginal use of ICT while carrying out school assignments.
The use of ICT arises as a means of promoting the quality of learning, their integration in the syllabus being a fundamental issue, especially when the teaching and learning process is developed in a perspective focused on the student and on the development of his/her autonomy. In this sense, reflection on the follow-up strategies of learning in the new environments is vital. For this, teachers need to develop new attitudes and skills, as recommended by the specialist teacher, who states that it is essential to offer teachers pedagogical training in the use of ICT.

Equity
The Nónio room and the Library, in conjunction with the rooms used by the School Clubs, play the most important role in creating conditions for access to ICT by the members of the school community.
The existence in this school of computer and communication technological courses, as well as the alternative education class, immediately presents a differentiated condition in the forms of accessing the computer media; the former is a natural condition of the course itself and the latter is a means of overcoming this group's learning difficulties, based on an approach focused on greater access to ICT and their use as tools for the learning processes. For these students, the privileged access is a form of reducing the differences with which they arrive at school.
Nevertheless, the school shows a strong awareness of the problems resulting from the general conditions of accessing ICT, attempting to create conditions of equal opportunities in using information technologies.
Without a doubt, the model of access to ICT in the Nónio room as well as in the rooms used by the school clubs (Mathematics, Computer and Science) unmistakably contributes not only to promoting their informal use but also to their use integrated in the school's regular teaching systems. It is in this perspective that the opening of the Nónio Room to the community has been encouraged, particularly through the summer courses directed not only at the students but also at the community.
The promotion of access conditions to information and communication technologies is a central perspective in the educational project in the school, namely through the room for occupying students' free time, which is equipped with computer resources, and in the bid project for the creation of a new computer laboratory dedicated to basic education students which will be networked to the already existing rooms. Still within the scope of this project, the possibility of placing a terminal with access to the network in each room in the school is being considered.
As regards the differences in usage between the richer and the poorer students, the opinions of the teachers refer the differentiation factor in familiarisation with the technologies by the richer students, which is expressed in a higher performance in an initial work phase. However, this difference tends to become more balanced with the continuity within the scope of the regular programmes of use. On the other hand, some teachers mention that the difference between the two groups of students is evident in their academic

performance, namely because they have a computer at home and have more time for assignments. They refer in particular that the fact that these students do not have any limitations as regards use reflects an advantage in the use of the technologies, counter-arguing that the poorer students *have less opportunities and that this limits them and acts as a barrier.*
As regards the difference in use in relation to gender, the opinion of the teachers is divided on the perception of undifferentiated use between boys and girls, on the one hand, and on the perception that boys tend to adopt a more exploring attitude when using ICT.

DISCUSSION OF THE HYPOTHESES

Hypothesis 1
Technology is an important catalyst of educational reforms, especially when these involve the Internet. The alternative hypotheses is that when a true reform is in progress, technology serves merely as an additional resource and not as a catalyst, i.e. the driving forces behind the reform also encourage the application of the technology to resolve specific educational problems.

Analysis of the data gathered indicates that the main hypothesis should be accepted and not the alternative hypothesis. In this case study, technology is the support for the development of the reform through the creation of alternative education essentially supported by information technologies.
The data in favour are: i) raising the awareness of the school's management body that encouraged the creation of alternative education to the educational use of technologies; ii) the existence of a small group of specialist teachers who ensure the initiative's support; iii) the creation of a syllabus directed towards the contextualisation of learning through the intensive use of technology; and iv) recognition by the wider community of teachers of the impact of technology in the development of learning processes, promoting the dissemination in the school of practices using the technology.

Hypothesis 2
The dissemination of the reform (and consequently of ICT) follows the traditional dissemination pattern of the reforms and innovations described by Roger (1995). The alternative hypothesis is that technology operates differently from the traditional reforms and innovations and that its dissemination pattern therefore has distinct characteristics.

Analysis of the data gathered indicates that the main hypothesis should be accepted and not the alternative hypothesis. The dissemination of the reform (and of ICT) in this school follows the dissemination pattern put forward by Roger (1995), namely *innovation, uncertainty, dissemination, adoption/rejection.*
Findings in favour of this hypothesis are based on the following facts: i) the adoption and dissemination of the reform/innovation are a result of the initiative and wish of the school; ii) the existence of a group that initially developed the project, positively influencing the community and acting on its uncertainties and insecurities in relation to the level of complexity of the projects (alternative education and innovation with ICT); and iii) the development of communication channels within the community through which it was possible to encourage dialogue and the development of the consistency of individual representations on the dimensions and impacts of the projects in course on educational practices.
The creation of alternative education is strongly associated, in this school, to the development of the educational innovation with ICT. In this sense, the orientation model for the creation of alternative education is also a project of educational innovation with ICT.
The adherence of the community to the implementation process of the reform and ICT is jointly developed, both in terms of involving the community members in the reflection process on the integration of ICT in

education and in terms of the training necessary in order to be able to use ICT in the classroom. We would like to stress however that this development is a result of the performance of the early adopters (the management body and the group of specialist teachers) in adopting the reform/innovation and in the inter-personal communication channels and process through which it was possible to create a community of adopters in the school.

Hypothesis 3
The effective implementation of ICT depends essentially on the skills of the teaching staff in integrating ICT in learning. This hypothesis assumes that the effectiveness of ICT is associated to the mediation of teachers and that their academic value is positively related to the teacher s skills. The alternative hypothesis is that the school s technological infrastructure and the skills of the students, and not the skills of the teaching staff, in ICT determines the results of implementing ICT.

Analysis of the data gathered indicates that the main hypothesis should be accepted and not the alternative hypothesis. The motive that lead to the acceptance of this hypothesis is the fact that the composition of the alternative education class essentially depended on the existence of teachers with the necessary skills to develop ICT integration in the development of learning.
From the very beginning the creation of alternative education and its implementation presented a strong innovation component in educational approaches through the use of technology. The integration of ICT in learning is a vital issue, especially when the teaching and learning process is carried out with the student in mind.
In this sense, mastering the skills for using and integrating technologies in the teaching and learning processes is essential for the implementation of ICT.

Hypothesis 4
If all the students have identical access to ICT, the difference in academic performance between the poorer students and the less poor should not increase. The alternative hypothesis is that if all students have equal access to ICT, students who are less poor will tend to increase the difference in academic performance in relation to poorer students.

Analysis of the data gathered indicates that the main hypothesis should be accepted with reserve, not excluding the alternative hypothesis. This because the perceptions of the teachers as regards the hypotheses under discussion are not unanimous. In fact, findings suggest controversial aspects which we present below.
On the one hand, the opinions gathered suggest that there are no differences in performance between the two groups under analysis in a situation where both have equal access to ICT. Nevertheless, access in identical conditions in the school, for both groups, presents according to the opinion of some teachers very different usage rates in the beginning which tend to lessen and become more uniform as the activities are developed. According to this perspective we could validate the main hypothesis if we take into consideration the fact that at the end of the activity programme there is no difference in performance.
On the other hand, the teachers also mention that, in spite of equal access in school, the students bring with them to school a wide set of experiences which, for the field under analysis, clearly reflect the advantage of having a computer at home with access to the Internet. For these students (the richest), their experience is an advantage in using computers at school, even when there is equal access for all.
In this sense, and according to the opinions gathered, we cannot exclude the alternative hypothesis in the sense that today's small difference will be a big advantage tomorrow, in spite of the fact that at school this difference tends to be reduced, especially when the school is committed to the building of educational innovation with ICT and the creation of equal access conditions.

Hypothesis 5

An effective implementation of ICT will cause academic standards to remain the same or to increase in spite of the poor quality of many ICT materials. Academic standards depend on the expectations of the teachers and of the school and not on the level of manuals, of ICT materials and others. The alternative hypothesis is that the use of ICT will lead to a reduction in academic standards insofar as the students will spend more time on research with marginal benefits and on surfing Internet sites or curricular materials of low-quality.

Analysis of the data gathered indicates that the main hypothesis should be accepted and not the alternative hypothesis. Findings show that the increase in academic standards is directly connected to the ICT implementation models, particularly through the following aspects: i) the attitudes of the teachers in relation to the innovation; ii) the skills of the teachers in using and integrating ICT in the classroom; iii) the development of strategies for using ICT in teaching and learning; and iv) the development of critical thinking in the students in using ICT as a tool for building learning.
The alternative education project is supported by a totally new approach in the conception, planning, management and follow-up of learning situations involving ICT and the success of this project depends not on the existence of the media but rather on the strategies for using them.
From this point of view, it is not the materials but rather the learning situations which the teachers promote with the materials that play a positive role in the development of quality standards in teaching.

5. PROJECTIONS

Sustainability

The sustainability of the educational reform/innovation with ICT in this school essentially depends on the continuity of the involvement and sharing processes between the members of the community of teachers and on the joint reflection on the innovation, its representations and its implications for the development of education.
We also feel that sustainability depends on specific factors in the implementation plan of the reform, such as: the availability of the teachers to continue a project of innovative work that demands a high level of participation and involvement by the teacher, both in the individual follow-up of the students and in the processes of integrating the students from alternative education in the school community; and the capacity to articulate the project's different phases of development with the expectations of the community of parents.
In terms of educational innovation with ICT, sustainability comprehends the specific dimensions of training and raising the awareness of a learning organisation directed towards the opening to innovation cycles, towards change and towards the evaluation of its performance.
In this sense, it should be stressed that the sustainability of the project in this school lies mainly in the development of an organization that presents a high capacity of internal training through a continued process of reflection, awareness-raising and development of skills for the use and integration of ICT in the educational practices and processes according to the needs and objectives of its members. In this way this project is strongly articulated to the educational needs of the students and of the community in which the school is integrated, encouraging the distribution of the responsibility for continuing the change among all its members.

Dissemination

The possibility of transferring the processes of change and educational development is deeply related to the type of involvement and participation of the actors in bringing about this change, as we have tried to present throughout this study, insofar as we are dealing with the development of attitudes and not only with the acquisition of skills for the use of ICT. The diversity of factors which characterise this scenario does not make it possible to define a dissemination model but rather indicators that may contribute to this end and which are based on the good practices achieved by this community of teachers.
Besides the aspects related to the regulation of the reform's implementation, its dissemination implies the mobilisation of the teachers to become aware of the social function of the school in promoting equal access

to education and knowledge.
In this sense, the dissemination of the educational innovation with ICT will imply, as this school did, reflection on the importance of space and time in learning for the student as he/she attempts to place the learning processes in the new space for the mediation of knowledge which are offered by ICT.

6. ANNEX A

The methodology used in this case study followed the recommendations of the OECD as to the way in which the study should be carried out.
The research team was made up of five researchers, members of the Competence Centre of the University of Minho.
The school was chosen according to the criteria defined in the research manual and a preliminary visit to the school was made to introduce the members of the research team and the objectives of the study, to familiarise them with the school's environment and to organise the work plan in co-ordination with the executive board.
The field work was carried out in the beginning of January 2001 and data were collected through semi-structured interviews with the school's management, teachers, students and parents, and through a questionnaire completed by the teachers and observations outside the classrooms.
Documents on the students' work were also collected and photographs were taken of student activities inside the classrooms, laboratories and outside the school. The data collected were catalogued, classified and organised according to the matrix contained in the OECD research manual.
A representative of the school's management, two experts in technologies, six teachers, eight students and two parents were interviewed, 40 teacher questionnaires were collected and four classes of the interviewed teachers were observed.
The interviews with the teachers and the management representative were held individually, with an average duration of 1h30, this duration varying between one and two hours. The interviews with the students lasted for an average of 45 minutes and the average duration of the interviews with the parents was one hour each. All the interviews were filmed on video and notes on the interviews were typed up using a portable computer.
The complementary materials of the school and the students' work were catalogued and are available on the Internet at: http://minerva.uevora.pt/ocde/povoalanhoso/

7. ANNEX B

Summary of the teacher questionnaires

To what degree do you feel comfortable/capable of carrying out the following activities on the computer?
(% of teachers)

	Very Comfortable	Fairly Comfortable	Not at all Comfortable	
1. Writing an article	73.8	19.0	7.2	0.0
2. Searching for information on the World Wide Web	31.0	28.6	23.8	16.6
3. Creating and maintaining web pages	9.5	14.3	11.9	64.3
4. Using a database	19.5	17.1	31.7	31.7
5. Creating a database	9.5	9.5	26.2	54.8
6. Sending and receiving email messages	35.7	23.8	16.7	23.8
7. Writing a programme	7.1	7.2	11.9	73.8
8. Drawing a picture or diagram	31.0	21.4	23.8	23.8
9. Presenting information (e.g.: using PowerPoint or equivalent)	22.0	17.0	29.3	31.7

How important are each of the following skills related to the use of the computer for your teaching?

(% of teachers)

	Very Important	+/- Important	Not at all Important	importante
10. Writing an article with a word processor	61.9	28.6	7.1	2.4
11. Searching for information on the Internet	38.1	45.2	14.3	2.4
12. Creating web pages	7.1	26.2	38.1	28.6
13. Using a database	14.6	31.7	36.6	17.1
14. Creating a database	9.5	28.6	42.9	19.0
15. Sending and receiving email messages	9.6	33.3	35.7	21.4
16. Writing a programme	7.5	17.5	22.5	52.5
17. Drawing a picture or diagram with design/graphics software	42.9	33.3	14.3	9.5
18. Presenting information (e.g.: using PowerPoint or equivalent)	39.0	31.7	24.4	4.9

On average, how often were your students involved in the following activities as part of the work assigned to them over the last school year?

(% of teachers)

	Several times a week	Several times a month	Sometimes	Never
19. Using the World Wide Web	9.7	4.9	43.9	41.5
20. Creating web pages	0.0	2.4	11.9	85.7
21. Sending and receiving email messages	2.5	7.5	20.0	70.0
22. Using a word processing programme	17.1	14.6	51.2	17.1
23. Using a computer to play games	0.0	2.4	36.6	61.0
24. Using a spreadsheet	4.9	7.3	24.4	63.4
25. Using a graphics programme	0.0	7.3	24.4	68.3
26. Joining a discussion forum or chat room	0.0	4.8	9.8	85.4
27. Using a presentation programme (e.g. PowerPoint)	2.5	5.0	25.0	67.5
28. Using an educational programme (including simulations)	0.0	0.0	36.8	63.2
29. Using the computer for other purposes (specify)	17.4	4.3	8.7	69.6

% of teachers

	Good	Fair	Weak
How would you grade your capacity to use computers?	0	0	0

	Yes	No
31. Have you ever considered the students use of the computer in your evaluation?	34.1	65.9

	No restrictions	Some restrictions	Only those indicated
32. If you asked your students to search the World Wide Web, what degree of freedom did you give them to surf on the Internet?	32.0	44.0	24.0

	Yes	No

33. Did you create or modify a web page with some of your classes?	7.5	92.5

	All of it	Most of it	Some of it	Very little
34. What part of using the computer in your classes was directly related to the course content	17.6	14.8	32.4	35.2
35. What part of using the computer for tasks assigned to the students was done individually?	12.2	21.3	39.3	27.2

	Several times a week	Several times a month	Sometimes	Never
36. How often did you use the computer at home to prepare your lessons?	56.1	26.8	17.1	0

	Yes	No
37. Have you ever participated as a student or trainer in a virtual course via the Internet/World Wide Web?	19.1	80.9
38. Have you ever involved your students in collaborative learning via the Internet/World Wide Web with students from other classes?	0	100
39. Do you currently use technology to collaborate with other teachers (vocational chat rooms, forums or others)?	28.5	71.5

	% of teachers			
40. How many email messages do you	> 11	6_11	1_5	0
send on average per week?	9.5	4.8	38.1	47.6
receive per day?	4.2		48.2	47.6

	Number of times					
	1-10	11_20	21_30	31_40	41_50	>50
41. Have you ever changed the hardware of a computer?	6	1				2
42 Have you ever upgraded a computer?	7	1				3
43. Have you ever recovered a damaged file?	9	1	1			3
44. Have you ever created a web page?	13		1			1
45. Have you ever created a database?	6					4

8. ANNEX C

Complementary information on alternative education, materials gathered during this research, documents on the school s Educational Project and the school's Nónio project, and a link to the School s web page are available on the Internet at the following address: http://www.minerva.uevora.pt/ocde/povoalanhoso/