

## ***OECD/CERI ICT PROGRAMME***

### **A Case Study of ICT and School Improvement at School A**

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## **1. Overview**

In 1985 the administration of the School A decided to introduce ICT in school as a means to help students to develop mental abilities and thinking skills. Soon the school started collaboration with a university research team, which undertook the responsibility to provide educational software, training to the teaching staff and support to their work in the computer lab. A new course, the investigation, was introduced in the school program. The investigation was based on the use of programmable exploratory software encouraging interdisciplinary project work, students groupwork and investigations. The introduction of ICT was considered as an innovation and the computer lab became the environment where new teaching methods were tested. However, group work, collaborative teaching methods, project work, gradually became everyday practice in the school. Sixteen years later, the teachers no longer consider the use of ICT for teaching purposes as an innovation but as a tool for supporting other innovative activities. The introduction and the continuation of the use of ICT in the school is a matter of school's policy. However, all the members of the school community recognize the importance and the contribution of ICT in teaching and learning.

School A is a private school situated in the northern outskirts of Athens and consists of three levels: Primary school, Gymnasium (low-secondary) and Lyceum (upper-secondary). The investigated school was the Primary school. The Primary school consists of six grades (1<sup>st</sup> to 6<sup>th</sup> grade) totally numbering 632 full time students, 350

boys and 382 girls. The total budget of the school sums about 3.520.000 ECU and it comes exclusively from fees. Each year 4% of the total budget is spent on ICT.

School A is considered one of the schools with specific culture and orientation among the outstanding ones in Greece. It is worth discriminating the higher social-economic level of the students attending the above school from the majority of Greek Gymnasiums. This means that although the fees are considered as the highest for the Greek school tradition, there is great demand for place booking each Academic year mainly from the part of the higher socio-economic Greek society.

There is a Headmaster and a sub-Headmaster who share the school function with 56 teachers. The academic start school date is scheduled for the 10<sup>th</sup> of September and teaching school period finishes on the 15<sup>th</sup> of June. The school weekly days are from Monday to Friday, and the fixed working periods which last about 50 minutes each are 30 per week for the lower grades and 35 for the higher grades.

## 2. The past

School A seems to be a school open to innovations. According to the Headmaster the role of the school is to help students both, acquire knowledge and develop thinking skills. In her own words, the innovations that they have introduced,

*help the students to develop skills and through the cultivation of the skills knowledge is also acquired in a pleasant manner . (Headmaster)*

In 1984 the Headmaster, who at that time was just a teacher of school A, attended in France a training seminar on the educational uses of computers. In 1985 a computer lab equipped with ten computers was established in the school and students were introduced in Logo programming. A year later a collaboration between the school and a research team from the university of Athens was initiated. The university research team provided educational software and regular training for the teachers in the use of computers for educational purposes. In 1996 the school participated in a large project involving other schools, universities, companies and the Institute of Computer Technology (a university institute). The purpose of this project was the development and the evaluation of educational software. Then, another lab was constructed, equipped with new PC s connected to Internet.

A few years after the introduction of ICT, school A, following the educational trends and in an effort to move from traditional ways of teaching to more collaborative teaching approaches, introduced various innovations. Classes were organized in small groups and students were encouraged to collaborate. Students collaborated also in larger interdisciplinary projects, which were presented to the school community at the end of the school year. Other activities such as the production of the school s newspaper, the organization of groups of students with common interests were also expressions of the new philosophy of the school.

The computer lab was the place where the collaborative teaching method was tested and produced encouraging results. According to the sub-Headmaster:

*When we started using the computers this was really an innovation. By that time we used to work in the classroom in a completely different way. The teacher was here and the students were at the other side. We did not much collaborative work...With the computers we started working in groups and what we succeed is that children show that they could collaborate with each other... The computers helped us a lot to take the decision (to change the way of teaching), since there was a domain where we could see the results (of the collaboration among the students) . (sub-Headmaster)*

Today, according to the Headmaster, ICT supports the other innovations of the school.

It is clear that the introduction of ICT was a matter of school s policy. The teachers had to accept this policy and to work for the promotion of the innovation. Speaking about the ICT implementation the Headmaster said

*All the teachers had to get into the class (the computer lab). Some of them were less pleased. Others, those who like changes and experimentation did it with more enthusiasm . (Headmaster)*

However, the administration organized the training of the staff and provided support in the form of mentoring by the university research team. Moreover, the administration gave the members of the staff the opportunity to take loans with low interest to buy themselves computers in order to help them become more familiar to the use of computers.

We do not have evidence that there were any serious problems that bothered the implementation of the ICT in the school. The teachers had to follow the policy of the school and to overcome their fears or their prejudices

about the machines. The teachers admit that there still exists some skepticism among some of them, although the majority are enthusiastic about. But still, everyone who becomes a teacher of the 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> or 6<sup>th</sup> grade has to use the computers as a tool for teaching.

### 3. The present

#### 3.1 ICT use and activities

Computers are used in school A for three purposes. They are used for administration purposes, within school curriculum to present a separate subject for learning, and as a source of information for personal use in the library. All information presented in this section comes from the interviews. The Implementation of computer based activities section is based on information collected during the class observations will be presented and discussed.

According to the Headmaster computers are used widely by the administrative personnel. We observed that all kinds of announcements, instructions etc. which were displayed in teachers rooms, corridors etc. were ICT printouts. Practically all the teachers use computers (either in the school or in their homes) to prepare material for their classes, to organize their teaching material etc.

Turning to the use of computers within the school curriculum, computers are used in a separate subject called the investigation . Third, fourth, fifth and sixth graders work in the computer lab regularly once (the 3<sup>d</sup> and 4<sup>th</sup> graders) or twice a week (the 5<sup>th</sup> and 6<sup>th</sup> graders). Two labs, each one equipped with ten computers are used for this purpose. The policy of the school is not simply to introduce the students to the Information Technology, but to use ICT as a teaching tool. This was expressed clearly by teacher A:

*The school s philosophy is that we do not want to get children involved with computers at a technological level. I mean, we do not think that the role of the school is to teach the students what is this machine, what contains, how it works. We use the computers as a machine, as a tool to make different things . (Teacher A)*

Students mainly work on Logo programming and so the impacts of Logo result directly from its use rather than from how teachers make assignments, grade etc. The purpose of this use of computers is, according to the teachers we interviewed, to help students develop thinking skills and learn how to cooperate with each other within small groups. It is believed that Logo programming activities support the development of general abilities of the students, such as to analyze and organize, not only the work in the lab, but all activities in their real life as well. In the Headmaster s own words:

*the aim is to learn to organize their thinking, to organize their mind. When I was taught Logo programming I realized the steps you do to make a rectangular. ...Then I started to realize that every work you do can be analyzed in small steps, and I find this very helpful for the children . (Headmaster)*

In the investigation course students work in small groups of two to three persons. The younger students are introduced in Logo programming. They learn to compose sets of commands to make the turtle move on the screen and draw simple geometrical shapes (e.g. squares, triangles). They also use graphics software in order to elaborate their drawings putting colors etc. During their work students keep notes about the process that they follow. At the end, each group writes a report, in which students include the outcome of their work, the program they composed, the description of the process they followed, the problems they encounter etc. (see also School B report).

As students expertise in programming develops they become able to create routines, the concepts (the concepts are geometric shapes such as a square, a triangle etc.) which they use as elements to compose more complex drawings (4<sup>th</sup> and 5<sup>th</sup> grades). The 6<sup>th</sup> graders work on small projects called the mystery . In this case the teacher introduces to the students an unknown concept (e.g. an arc) with three parameters. The students give different values to the parameters and from the outcome they try to find out what the concept is. Students make hypotheses, predictions, evaluate their predictions, modify their hypotheses, and so on. When they finally discover what the concept is they use this new concept to make more complex drawings (e.g. a bridge, a castle). The investigation class is mainly related to mathematics. However, teachers try to relate these activities to other curriculum disciplines as well. For example when in the history class they study about the ancient Greek architectural styles they use their knowledge in Logo programming to draw the columns of a temple. In another case 6<sup>th</sup> graders related their investigation concerning the arc concept to what they studied in geography

about the bridges of the big cities of the USA. In their final report they included their drawings of bridges as well as all the information they had collected about some of the most famous bridges in the USA. During the school year the students of each group work on three different projects.

Another use of ICT, which however is not frequent, involves data base construction as well as mathematics and some other disciplines. For example, as teacher A told us, the year before, during a long period the 4<sup>th</sup> graders working in small groups took measurements of meteorological variables, such as the rain height and the temperature, and introduced them in a data base. They produced graphs, made conclusions about the change of the weather value of these variables and wrote a report about their work.

Using the Internet as an information source is another application of ICT. For this purpose four computers with Internet access are available in the library. According to the school program every class visits the library regularly once in a week for one hour. There, students can have access to the Internet under the supervision of the teacher. All the teachers we interviewed said that they encourage their students to use Internet as a source of information for their projects. The computers are also available to the students during the intervals between two classes. In this case students are supervised by the library personnel.

However, teacher A believes that there are not enough computers available for this kind of use. He mentioned that although he encourages his students to incorporate in their projects information and other material from the Internet, this is possible only for those who have access to the Internet out of the school. Teacher B said that students are excited when they search for information in the Internet, but the time that the computers in the library are available is very restricted. These claims are in agreement with information taken from students interviews. Three of the students we interviewed had Internet access through their home computer and only one of them (a 4<sup>th</sup> grader) through the library computers as well. One of them, a third grader, was not even aware that there was e-mail or Internet access in the school. Another student, a 6<sup>th</sup> grader, claimed that students were not allowed to use school computers to find information in the Internet. The same student said that he uses his home PC to collect the information he needs for his projects in history or geography.

Finally, ICT is also used as a means for communication. Recently, the school participated in a university research project. In this project the students of 6<sup>th</sup> grade communicated with the students of another school through e-mail. The students of the two schools worked on the same project and exchanged data, information and ideas. However, the communication between the two schools was not continued after the end of the research project.

## 3.2 Infrastructure and support

Sixteen years after the installation of the first computer lab the technical infrastructure in school A is as follows:

- a) Administration use: There are four PCs in the Administration Office.
- b) Computer labs: There are two computer labs, one equipped with 10 Macs and the other with 10 PCs. The PCs are locally networked and provide Internet services.
- c) School library: There are four networked PCs, which provide Internet services.

The infrastructure seems to be adequate for the kind of use of ICT in the school. However, teacher A proposed that it would be better if there was also one computer in each classroom. Thus, ICT would be available all the time and he could use ICT as a teaching tool for all disciplines.

*We do not have as many computers as we would like to have. We do not use the computers in all the ways we could. It is not easy for a student to use the computers in the school, to find the information he/she needs for a project, to write an essay, to present his/her work. He/she cannot use it as a tool for everyday use . (Teacher A)*

There is no technical support provided by a special positioned person within school. The more experienced members of the staff solve small technical problems. However, the school has a regular technical support by a certain company. For the last three years, one of the company's employees is responsible for the good operation of the two computer labs. At the beginning of each school year he visits the school and checks the operation of the computers. Whenever a problem arises, during the school year, the school calls him and he undertakes the responsibility to solve it. The school technician told us that this kind of support provision is enough as far as the users respect the rules for the good use of the computers. During the lesson in the computer lab there is usually another teacher whose role is to provide educational and some times technical support to the regular teacher of the class.

Concerning the educational support, data revealed that the administration pays a lot of attention on the training of the staff in the educational uses of the ICT. Teachers have a regular support on educational matters concerning the use of ICT in the classroom. The main source of training is the university research team. The members of this team plan and realize most of the training activities. Training seminars are organized in the beginning (for the planning of the activities) and at the end of each school year (for an account of what has been accomplished during the year). Extra seminars are also organized, whenever it is considered necessary, for example, when a new kind of learning activity is planned to be introduced in the class. Specialists in the ICT educational uses are also invited to give lectures and seminars to the teachers. Teachers are also encouraged and financially supported to attend training seminars. At the time of our visit in the school a group of teachers attended an on-line course organized by the University of Harvard on the educational uses of ICT. Finally, once a week the teachers of the same grade have a meeting in order to discuss problems that arise concerning the use of the ICT and to organize their work in the computer lab. The teachers we interviewed were satisfied by the training seminars and by the support they had concerning their work in the computer lab.

### 3.3 School community's perceptions on the use of ICT

#### 3.3.1 Staff's perceptions.

Teachers' interviews reveal their perceptions on the use of ICT. The five teachers and the Headmaster have a rather positive opinion regarding the role of ICT in the classroom, although they underline some problems that the inappropriate use of ICT could cause. More specifically, the teachers seem to believe that ICT help students to develop: a) mental abilities and skills, b) social skills, they also c) provide motives for learning, d) facilitate learning, and e) can be used as a source of information.

a) *Development of mental abilities and skills.* The Headmaster and the vice-Headmaster stressed that the use of computers and especially the activities that involve logo programming help students to organize their thinking. According to the Headmaster this was the aim of the introduction of the computers in their school. Teacher A added that working with computers children *gain a lot in matters of organization*, since they are obliged to follow certain processes (as in the case they have to save their work in a file) so that the machines would continue to work properly. Teacher D mentioned her experience with the use of an educational software that helps students to organize the structure of texts, to point out that computers can help students develop different skills. Finally, the Headmaster underlined that ICT can be used to familiarize the students in the use of computers as a means for communication (e-mail, Internet), but she admitted that until now they do not have taken many steps in this direction.

b) *Development of social skills.* All the teachers interviewed underlined that the fact that students work in small groups with computers helps them to learn how to collaborate. Teacher B discriminated some particular skills that students develop through the use of computers, such as to take responsibilities, to undertake a part of a work, to be coordinated with the members of the team, to support the efforts of the other members of the team. The Headmaster argued that when students work in small projects using the computers *they take initiatives, they learn to search, they become creative and, I believe computers help students a lot to develop self-confidence and self-respect, (the feeling) that I can take out of the machine what I want.... When the children work with the computers, if they want to reach to a result, they are obliged to collaborate. And since they are very interested about, they restrict their spontaneity, get used to give to the other, they alternate roles in the group, all these are very helpful.* (Headmaster)

The sub-Headmaster, talking about the effect that the computers has on good and not good students, also referred to the self-respect from another point of view:

*When they (the not good students) are working with the computer there is no one, besides the computer, to tell them, you are not doing well, and therefore to lose their self-respect and take the role of the not good student. These students usually perform better with the computers.* (Sub-Headmaster)

c) *Provide motives for learning.* Most of the teachers mentioned that the computers do or have the potential to make learning attractive. The sub-Headmaster believed that it is very crucial for the improvement of the academic performance to give to the students motives for learning. She also believed that computers can be used as a means to trigger students' interest for learning: *it (the computer) stings your interest to get involved in other things, lets say to find information, to get into the Internet, to make your own little programs.* Teacher

D stressed that computers have the potential to present the information in an attractive way. In our question concerning how the use of ICT affects the motives of learning the teacher said that students enjoy a lot to work with the computers and she explained that:

*I think that a big part of their joy is due to the immediate response of the computer. They do something (make a program) and they see whether it works or not...When I ask them to collect material (books, posters, pictures) necessary for a project, the potential to use their computer to find information from the Internet gives them a lot of joy . (Teacher D)*

However, teacher C expressed his skepticism concerning the way computers are used in his school. He mentioned that students sometimes are not pleased by the specific use of the computers in the school lab.

*TC: Because here (in the lab) we do not play computer games, we do not search for this or the other, we do something very specific. These are objections concerning the use of this specific software.*

Int.: These activities tire them?

*TC: They would like something more live, more active. Computer games are more attractive.*

Int.: Are the children persuaded about the value of what they are doing?

*TC: It depends on the year. This year, yes. They seem to be. The year before the fifth grade did not want to enter to the lab because they felt as a compulsion to do something they did not want, something they disliked . (Teacher C)*

d) *Facilitating learning.* Teachers also believe that the use of ICT facilitates learning in various disciplines, mainly in mathematics. However they do not stress this aspect of the use of ICT. The Headmaster in responding to our question whether the use of ICT affects learning in various disciplines said:

*As a supporting tool always affects positively. ...But there is software where the children instead of writing in the notebook they write in the computer. When you use the computer directly for (the teaching of) a subject that is, in order to complete an exercise in the computer instead of writing in their notebook, there is no reason to do this, children get tired and of course we do not do this in the school . (Headmaster)*

The sub-Headmaster in responding to our question whether she believed that the ICT use affects understanding in various disciplines said:

*Yes, I can say that mainly in mathematics I see a direct effect. Yes, there is a strong effect. It (the computer) makes some things very concrete. On the condition that the teacher is very conscious of the aim of everything he/she does . (Headmaster)*

Teacher s A, although believes that the investigation is very useful, he was the one who stressed the need for using ICT to teach other disciplines.

*Students should understand that the computer is not an object situated in a locked room, where we have to go all together to work with, but that it is something we have beside us and we use it whenever we need it. The computer lab serves very many purposes but not all. We need the computer in the classroom . (Teacher A)*

The Headmaster and some of the teachers mentioned that computers helped students who had spelling difficulties to improve. Teacher B said about:

*I have seen children with spelling problems to improve. It is the only way to improve in spelling. Moreover, it is better for children with awful handwriting to use the computer to write their essays, because he/she feels that he/she succeeded and we can read his/her work . (Teacher B)*

e) *Provide information.* All the interviewed members of the staff considered that computers can be used as a valuable source of information.

Finally, all the teachers we interviewed held some provisions regarding the use of ICT in general. They thought that there were no negative effects from the use of the ICT in their school. However, they stressed that a) teachers should secure that their students work collaboratively, b) computers would not substitute experience with the real world, when this is possible, and c) students should not spend time playing computer games in their home computer. Teacher A argued that the one-sided use of computers (the investigation ) could make students to develop a wrong idea about the computers and their use (see relevant reference in previous section).

### 3.3.2 Students perceptions.

We interviewed four students from different grades. All of them declared that they liked a lot to work with computers and wished they would have more time to work with them and to have access to the Internet and to the e-mail. Two of students spontaneously mentioned that working with the computers is one of the things they

liked the most to do in the school. All the interviewed students had computers in their homes and used them. We asked the students why they like computers. Three of them answered that they like computers because by using them they learn things and they find information. The 6<sup>th</sup> grader answered that he as well as the other students have a good time in the lab:

*The kids enjoy it a lot. It is a pleasant interval. We do something different and thus we see school in a different way. We learn new things....We have a good time with our group. Someone may have done a mistake and then strange things happen: for example a rectangle appears instead of a circle .(Student D)*

Students were also asked to say whether they believe that computers help them to learn. They all agreed that computers help them a lot mainly referring to the investigation course. The 6<sup>th</sup> grader answered: *Yes, computers are interesting, I learn to use them, I learn about the variables* . The fourth grader added that working in small groups with the computers they learn to co-operate: *We learn how to co-operate with the others, how to drive the turtle and how to work with Logo* . The same student when asked whether the computers help him to learn in the different curriculum disciplines he said: *No. Apart from Internet, no* .

### 3.3.3 Parents perceptions.

Four parents were interviewed. They declared they were satisfied by the communication they have with the school. Moreover, they all thought that School A is a school that exceeds most of the other schools (private and public) because teachers put strong emphasis on the development of critical thinking and not on memorization. Some of them stressed that it is important for them that their children are taught how to co-operate, that they have the opportunity to search and discover and to take initiatives. However, it was obvious that they were not well informed about the use of ICT in the school. They thought that computers were introduced because students should acquire knowledge and skills concerning the use of computers. A father of a fourth grader (parent B), thought that children were taught the use of computers by a computers specialist. Two parents (parent B and parent C) wondered why there were no computer specialists to teach the use of computers to their children. Parent A could not think how computers could promote learning in various curriculum disciplines. Parent D claimed that computers cannot facilitate learning in mathematics or reading but can provide information. Parent B agreed that computers can help children to learn but she insisted that children should learn *how to use their mind* before being introduced to the use of computers. She argued that it is the same as with calculators, which should not be used by children before they acquire the ability to make calculations. The father of a 5<sup>th</sup> grader (parent C) was well informed about the existence of different kinds of educational software. He claimed that the school should realize the potentialities of multimedia and Internet and install a computer system in each classroom. However he thought that multimedia and Internet can be simply used as a powerful encyclopedia.

## 3.4 Implementation of computer based activities

As it was mentioned in previous sections that the use of ICT in school A aims mainly at promoting students thinking skills. It is considered that this aim can be achieved through the investigation (Logo programming) which is in the core of activities in the computer lab. The use of other software such as word processor (Microsoft word) and a graphics software (Kid pix) are complementary to Logo programming. Other skills such as communication and collaborative skills are cultivated through team working. Observational data is not enough to indicate whether these aims have been achieved, since more detailed observations and tests would be needed. However, a general view on the classroom activity and participants roles was provided.

Twelve lab sessions of 40 to 45 minutes each with students of 3<sup>d</sup> to 6<sup>th</sup> grade, were observed. In all cases students were involved in Logo programming activities (the investigation) . All the observed sessions had a similar organization, which was based on groupwork. The session usually started with a discussion at class level (5-10 minutes) during which the teacher through questions tried to make students recall and activate their prior knowledge concerning the subject of their work and also to present the aim of their activity. In the second part of the session students worked on the given task, collaborating, groupthinking and brainstorming. At times the teacher intervened usually after students request. In most sessions there was also present another teacher who assisted the teacher of the class.

Each computer was operated by a group of 2 or 3 students. Each had a notebook, which was used as a kind of diary where the students kept notes of all the processes they followed during the session. For example, when they had to make a computer program, which would result to a drawing, they usually started by making the drawing in their notebook and then they wrote the commands before they input them in the computer. They also kept notes of the output of their program and of the corrections they usually had to make to the program. Thoughts, agreements and disagreements between the members of the group were also written in the notebook. Each student had a different role in the group. One of them kept notes, another used the mouse and the third used the keyboard. The students changed their roles from time to time. The teachers emphasized that before starting their work they should first decide on the role of each member of the group, in order to have a good collaboration.

Teachers supervised and managed the whole process in the lab. Some of them tried to have full control of the process (usually this happened with the younger students), while others preferred to leave students to take initiatives. The students collaborated successfully and were productive. Most of them showed a lot of interest in their work and seemed to enjoy it.

### 3.5 Diffusion of the ICT use within the school community

School A is a private school. The introduction of ICT was decided by the administration, sixteen years ago. The teachers had to accept this decision, and therefore they were all involved in the project. According to the sub-Headmaster, in the beginning some of the teachers, those who were more experienced with the use of computers, were more involved in the project than the others. They undertook the responsibility to support the training of their less experienced colleagues. The administration, on the other hand, in collaboration to the university research team organized the teachers in school training and supported them financially to attend training courses out of the school and even to buy their own computers.

The school introduced computer-based activities as a part of the school curriculum in the 3<sup>d</sup> to 6<sup>th</sup> grades. Thus, all students in these grades were involved in computer based activities. Students of the 3<sup>d</sup> and 4<sup>th</sup> grades worked in the computer lab once a week while the students of 5<sup>th</sup> and 6<sup>th</sup> grades twice a week. Therefore, there was equal access among students within the same grades, but unequal within different grades. Concerning the use of the computers with Internet access which were installed in the library, this depended on teachers initiatives. Questionnaire data showed that 11 out of 19 teachers asked their students to collect information from the world wide web several times during the past school year and only one teacher did that several times a month (Question 19). Fewer teachers (5 and 2 respectively) asked their students to send and receive e-mails (Question 21). The most frequent computer use by students was mentioned to be word processing. Only 3 teachers out of 19 answered that they never asked their students to use a word processing program (Question 22).

All schoolteachers of the higher grades were involved in the ICT project. The teachers of the 1<sup>st</sup> and 2<sup>nd</sup> grade were asked to attend the seminars with the rest members of the teaching stuff so that they would be prepared to teach in the computer lab in the future. Questionnaire data showed that all the teachers have been preparing their teaching by using their home computer at least several times during the past school year, while 7 teachers out of 19 used their home computer for this purpose every day or several times a week (Question 36).

## 4. Main hypotheses

In what follows we will discuss the main hypotheses of the study in the light of the empirical evidence that have been presented in the preceding sections.

### 4.1 Technology is a strong catalyst for educational innovation and improvement especially when World Wide Web is involved.

We think that the information we collected from the staff s interviews, concerning the history of the introduction of ICT in their school, supports the first part of the hypothesis. According to them when ICT was introduced in the school it was considered as an innovation. Innovative teaching methods were tested in the lab.

The students were encouraged to work in groups, to solve problems and construct their knowledge, while the teachers kept for themselves the role of the coordinator of the activities. Soon, this kind of innovative approach to teaching and learning was generalized in other classroom activities. Therefore, we can claim that technology, functioned as a catalyst for educational innovation. However, sixteen years later the teachers do not consider any more the use of ICT as an innovation since group working and investigation are a part of the every day practice. They rather consider that ICT supports other innovative attempts. The use of the WWW has not been yet generalized in the school. Therefore we do not have evidence to validate the second part of the hypothesis.

## **4.2. The diffusion of the innovation/improvement (and therefore of ICT) followed the traditional diffusion pattern for innovations, as outlined by Rogers (1995).**

As we have discussed in the diffusion section, the members of the staff, since they are employees in a private school, they were expected to follow school's policy concerning the implementation of ICT. Since, there was a pressure on the members of the teaching staff to use ICT, and practically all of them were involved in the project we cannot validate the above hypothesis. However, the fact that the more experienced teachers had a more advanced role, as supporters of the other members of the staff, is in favor of the hypothesis.

## **4.3 Successful implementation of ICT depends mostly upon staff competence in the integration of ICT into instruction and learning.**

The administration of school A has put strong emphasis on the training of the staff in the use of ICT in the classroom. An academic research group has undertaken to support them in their work. Moreover, the teachers of the school are highly qualified and many of them have done graduate studies. On the other hand the implementation of ICT in the school was successful. Sixteen years after the introduction of ICT, the school continues to support this innovation and is looking forward to expand the use of new technologies. It seems that the evidence support the above hypothesis, however, we cannot claim that the successful implementation was due to staff competence unless we compare school A with other schools where no sufficient training was given to their staff.

## **4.4 Gaps in academic performance between high and low poverty students will not increase when all students have equal access to ICT.**

In school A all the students of the same grade have equal access to ICT in the site. However, we cannot test the truth of the fourth hypothesis because all the students came from predominately high-class backgrounds and therefore we cannot speak about differences in the academic performance due to differences in students financial status.

## **4.5 Successful implementation of ICT will lead to the same or higher academic standards in spite of the low quality of many ICT materials.**

Although there is an effort to relate a big portion of the computer use to the course content this has not been yet accomplished. The main aim of the introduction of ICT in the school was to help students develop their thinking skills. Therefore, we cannot relate the use of computers to the academic standards. On the other hand thinking

skills cannot be measured by the evaluation methods of academic performance used in the school. What we can say is that no one, teacher or parent, has complained that the use of computers had a negative influence on students academic performance. On the contrary, we had positive comments concerning the influence of ICT on the students. Moreover, in some cases teachers clearly stated that they had evidence that some students (mostly those who had spelling difficulties) were helped by the use of computers.

## 5. Projection to the future

Our judgments, about how likely it is that the school s accomplishments will remain, are based on different factors.

**a) How well is the innovation integrated into the workings of the site.** The implementation of ICT in the school has already a sixteen years history. Computers are used for administrative purposes. Two labs have been equipped with computers and activities with ICT have been a part of the curriculum of the four higher grades. On the other hand computers are used to support other innovative activities of the students. ICT has also been a means for the participation of the school in research programs.

Although ICT use is not strongly connected to the courses content the teachers feel that their work is facilitated by it. We asked the teachers to say whether they could do without ICT. The Headmaster answered that *school s innovations would proceed, but the computers give a lot of support* . Teacher A said that *for the present I still can do without ICT, but I don t like to do without* . Teacher D used a metaphor to answer: *yes I could do without it, as well as I could also walk all the way from my home to the school* . We think that all these evidence show that ICT has been a part of school s everyday life.

**b) What are the future plans of the school about the continuation of the ICT use.** There is no evidence that there will be no continuation of the ICT use in the school. On the contrary the school plans to expand the use of ICT. We asked the sub-Headmaster whether she believed that ICT implementation was completed. She stressed that she thought that the ICT use should be expanded, and that ICT should *become a true tool that will give support to all the courses* . She also stated:

*the continuation of the ICT use is a matter of school s policy and since the administration believes that it is an activity that offers a lot, I do not think that it risks to stop* . (Sub-Headmaster)

The Headmaster mentioned that in the future the school plans to use the ICT as a means for communication with other schools (via e-mail) and also to put emphasis in the use of Internet as a source of information.

Teachers B and D also stressed that in the future the school should use ICT as a tool for the teaching of other curriculum subjects.

**c) Whether the financial and other support to the innovation has been assured.** For the continuation and further expansion of the ICT the financial support is also a presupposition. According to the Headmaster the school provides the financial support to the ICT project. If ICT disappeared these resources would probably be used for extra training of the staff.

There is no indication that the university research team will cease to provide pedagogical support to the teachers. However, we believe that even without this support the ICT project would continue, since the teachers have received a lot of training during the long period of the implementation of ICT in the school. Concerning the technical support it seems that it is enough for the time being. However, the Headmaster thought that probably it would be better to engage a technician who would be available at any time to provide support.

**d) What do the administration, the staff, the students and parents think about the use of ICT.** As it has been extensively discussed in the Present section all the members of the school community expressed positive opinions about the ICT use. Although they had different opinions about the benefits from the use of ICT they all thought that it should be expanded.

## APPENDIX A

Consistent with the methodology described in the Workbook for Organisational Case Studies (OECD/CERI) a short-term explanatory case study has taken place in the school in order to compile a corpus of information that would allow a rich description of the ICT integration within the site. The data collection was completed in a

four-day visit of the four researchers who participate in the ICT team of the Center for Educational Research. Classroom observations were conducted in the school as well as interviews with the staff. The purpose of classroom observations was (a) to validate how ICT is used in the lessons and (b) to gather evidence for how lessons are taught. The overall time of observation was 12 sessions of 40 - 45 minutes. The scheduling of the observations in school A shown at the Table 1 - was arranged in collaboration with the head master nearly two weeks before the visit.

Teacher	Subject	Grade	Number of observations	ICT use
T4	Investigation	6c	1	Turtleworld
T1	Investigation	6a	1	Turtleworld
T2	Investigation	4a	1	Turtleworld
T3	Investigation	5b	1	Turtleworld
T5	Investigation	5a	1	Turtleworld
T6	Investigation	6d	1	Turtleworld
T7	Investigation	6b	1	Turtleworld
T8	Investigation	5c	1	Turtleworld
T9	Investigation	3c	1	Turtleworld
T10	Investigation	4c	1	Turtleworld
T11	Investigation	5d	1	Turtleworld
T12	<b>Investigation</b>	4d	1	Turtleworld

Table 1: Classroom observation plan

For the observational data collection one video-camera was used - occasionally moving to capture instances of the classroom atmosphere. Concurrently with the video-recordings, observation notes have been taken describing the overall classroom activity and focusing on potentially significant details and episodes in teacher practice, student groupwork and student communication. During our visits to the school 14 interviews were conducted: 1 with the head master, 4 with teachers (one not engaged in the ICT use), 4 with students, 4 with parents and 1 with the technical support specialist. The average time of each interview is shown at the Table 2.

Interviewee	Time (min.)
Headmaster	60
Teachers	50
Parents	40
Students	30
Technical specialist	45

Table 2: Average interview time

Background data was also collected (i.e. students written presentations of their work) that served as complementary information to the video-recordings and observation notes, which formed the main corpus of our observational data. Verbatim transcriptions of all interviews were made.

## APPENDIX B

**Table 1. Familiarisation of teachers with computer applications**

<b>How comfortable are you with using a computer to do each of the following?</b>	<b>Very comfortable</b>	<b>Comfortable</b>	<b>Somewhat comfortable</b>	<b>Not at all comfortable</b>
write a paper	15	1	3	0
search for information on the World Wide Web	8	5	4	2
create and maintain web pages	2	5	4	8
use a data base	5	7	5	1
develop a data base	3	4	6	6
send and receive an e-mail	13	0	2	4
write a program	2	5	4	7
draw a picture or a diagram	11	6	1	1

present information (e.g. use Power Point or equivalent)	7	6	3	3
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**Table 2. Importance of computer-related skills for teaching**

<b>How important is each of the following computer-related skills for your teaching?</b>	<b>Very important</b>	<b>Important</b>	<b>So-so</b>	<b>Not important at all</b>	<b>No answer</b>
write a paper with a word processor	9	5	4	0	1
search for information on the WWW	7	6	4	1	0
create web pages	2	3	8	6	0
use a data base	7	5	6	1	0

develop a data base	7	2	7	3	0
send and receive an e-mail	8	3	5	2	0
write a program	2	6	4	6	0
draw a picture or a diagram	8	7	2	1	1
present information (e.g. use Power Point or equivalent)	8	3	6	1	1

**Table 3. Frequency of use of computer applications by the students**

<b>During the past school year, how often did your students on average do the following for the work you assigned?</b>	<b>Several times each week</b>	<b>Several times each month</b>	<b>A few times a year</b>	<b>Never</b>
use the World Wide Web	0	1	11	7
create web pages	0	0	2	17
send and receive an e-mail	0	2	5	11
use a word processing program	0	5	11	3
use a computer to play games	6	1	2	10
use a spreadsheet	0	0	3	16
use a graphics program	0	1	9	9
join in an on-line forum or chat room	0	0	4	15
use a presentation program (e.g. Power Point)	0	3	2	14

use an instructional program (including simulations)	0	5	4	10
other computer uses (specify)	0	2	5	6

**Table 4. Teachers ability to use computers**

	Good	Fair	Poor
30. How would you rate your ability to use a computer	4	13	2

**Table 5a. Experiences and policies concerning the ICT use**

Answer questions 31-38 based on experiences or policies from the last school year	Yes	No
31. Was student computer use ever evaluated for grading?	1	18
33. Did you create or modify a Web site with any of the classes that you taught?	1	18
37. Did you participate as a student or instructor in a virtual course through the Internet/WWW?	4	15
38. Did you involve your students in collaborative learning over the Internet/WWW with students from other classes?	5	14

**Table 5b. Experiences and policies concerning ICT use (continued)**

Answer questions 31-38 based on experiences or policies from the last school year	No restrictions	Some restrictions	Designated sites only	No answer
32. If you assigned WWW searching, how much freedom did you allow students in locating sites to visit?	4	4	5	6

**Table 5c. Experiences and policies concerning ICT use (continued)**

Answer questions 31-38 based on experiences or policies from the last school year	All	Most	Some	Very little	No answer
34. What portion of the computer use in your classes was directly related to the course content?	1	2	8	6	2

35. What portion of the computer use that you assigned was done by students individually?	2	7	2	5	3
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**Table 5d. Experiences and policies concerning ICT use (continued)**

Answer questions 31-38 based on experiences or policies from the last school year	Almost every day	Several times a week	Several times a month	A few times a year	Never	No computer
36. If you have a computer at home, how often did you use it for preparing for teaching ?	4	3	5	3	0	3

**Table 6a. Computer use for communication**

	Yes	No
39. Are you currently using technology to collaborate with other teachers?	4	15

**Table 6b. Computer use for communication (continued)**

	More than 12	6-11	1-5	None
40. How many e-mail messages do you send each week on average?	0	1	10	8

**Table 7. Advanced uses of computer**

How many of the following have you ever done?	Yes	No
41. make changes to a computer s hardware	8	11
42. updated an application program (word processor, graphics program, etc.)	8	11
43. recovered a damaged file	6	13
44. created a web site	9	10
45. developed a data base	7	12