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The contribution of ICT to education.

Comparative findings from international surveys and some innovative practice

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Content

Introduction

The Agnelli Foundation has asked European Schoolnet to investigate the relationship between ICT and education within a comparative approach positioning Italy in the European landscape.

Within this view, European Schoolnet has proposed to compare and cross-analyse results of the concerned countries in international surveys, mostly PISA and SITES, both in their 2006 edition. In addition to this, a literature review of most recent articles and studies has been planned to better contextualise the findings of the analysis.

TIMMS 2007 has initially also been considered as an interesting possible source of knowledge. Nevertheless, at a certain point in time, the Agnelli Foundation did express its interest in getting some insights about innovative and inspiring practices of innovative teaching and learning processes using ICT, throughout Europe. Some reorientation in the course of the work did then take place and, due to time and resources limits, TIMMS 2007 analysis has been abandoned in favour of collecting information on inspiring innovative practices and national initiatives in the field concerned throughout European countries.

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1. Italian 15-year-olds and ICT – Comparative analysis of data from the PISA 2006 survey

Main findings

At the present time, with almost universal access to computers throughout Italy, one still observes a certain split by gender in the frequency and type of use made of these technologies. A socioeconomic fracture also persists: young people from more advantaged backgrounds use the Internet more than the disadvantaged.

Nonetheless, compared to other Europeans, the average young Italian is not a great user of the Internet; he or she downloads music less often and, in particular, communicates less through the Internet (chat and email). In this respect young Italians are akin to young Greeks, who also communicate less in this way.

Within the context of school, several elements suggest that the provision of computers is more problematic than Internet access, since it can be seen that some regions are much less well equipped than others in terms of computers per student, but that, once the computers are provided, Internet access is almost always available.

The use of computers in teaching is not optimal in Italy, which lags somewhat behind other European countries in this respect. Nor is this entirely due to the lack of equipment in some regions. The example of Portugal shows clearly that a country may be less well equipped but can still manage its resources so as to give a maximum number of students the opportunity to use school computers.

Young Italians seem nonetheless better prepared than the average European school student to use ICT for learning. According to what they say in the survey, the use of educational software and the writing of computer programs are more widespread in Italy than in other countries. This is an asset that should no doubt be built on to further develop this type of “intelligent” use of ICT.

One ground for concern is the lack of confidence that young Italians show in their competence as regards use of the computer and especially the Internet. Schools no doubt have a major role to play in helping young Italians feel technically at ease with tasks that are demanded in more and more occupations, even relatively unskilled ones. The communications of industrial and commercial companies and many other sectors of activity increasingly involve exchanges for which one needs to know how to attach a file, find information on the Internet or download documents. Young Italians are less at ease with these activities and also perform them less often.

In Italy, as elsewhere in Europe, the educational use of ICT is associated with a scientific attitude and behaviour that are in no way reserved for those with aptitudes for high-level science. The analyses above have shown that science teaching methodologies have a significant role to play in this area. This “revelation” should serve to support the arguments for high-quality science teaching that will train young people who enjoy science, who have acquired scientific knowledge and competences, but who also adopt a scientific attitude vis-à-vis the computer and use it as more than just a tool for entertainment.

NB: A synthesis of analysis by region is provided in annex 3

Introduction

PISA (Programme for International Student Assessment of 15-year olds) is run by the OECD (Organisation for Economic Cooperation and Development). It is a cyclical programme designed to assess reading, mathematical literacy and scientific literacy. The main aim of the survey is to assess the extent to which young people at the end of their obligatory full-time schooling are prepared for entry into adult life, which implies mastery of certain knowledge, skills and competences that are essential for them as future citizens and future workers.

The survey is conducted every three years; the first was in 2000. In 2006, 57 countries took part in the test – the 30 members of the OECD and 27 partner countries. Each cycle assesses the three areas simultaneously, with the emphasis on one particular area each time: reading in 2000, mathematical literacy in 2003 and scientific literacy in 2006.

The students take a two-hour cognitive test. After the cognitive test, they spend half an hour answering a contextual questionnaire which is designed to collect socio-demographic data (gender, economic and social status, etc.) and also information on attitudes towards the area being assessed. (Do they enjoy reading? How often do they read? etc.).

The countries taking part also have the option of giving the students a short questionnaire relating to their degree of familiarity with the Information and Communication Technologies (ICT). In 2006, 25 OECD countries – including Italy – and 14 partner countries opted to do so. The information gathered related to the students' access to computers, the use they make of them and their degree of confidence in handling these technologies.

Finally, school principals are also invited to submit information about their institution by completing a 30-minute questionnaire. This addresses numerous aspects of the organisation of the school: the student body, the forms of teaching that are organised, human and material resources, the school environment, etc. Some questions concern ICT: computer facilities and Internet connections, and the extent to which they are used in teaching.

The analysis that follows focuses on ICT and the information that can be derived from the PISA 2006 survey. Are 15-year-old Italians familiarised with ICT? Do they often use a computer at home, and at school? What kinds of use do they make of it? How do they perceive their capacity to perform various ICT-related tasks? Is there a link between frequency and types of ICT use and performances in the test? These questions will be addressed in four sections. The first examines access to ICT and frequency of use at home and at school. The second section analyses two major types of computer use, and the factors determining each of them are identified and commented on. The third section examines the students' perception of their skills in various ICT-related activities. Section 4 considers the impact of frequency of computer use on performances in the PISA test, and is followed by a brief conclusion.

The scores of the young Italians are compared with those of 15-year-olds in other Mediterranean countries – Spain, Portugal and Greece – and three northern European countries – Denmark, Finland and Norway – and finally with the average scores for the European Union.[1] France didn't took the optional ICT familiarity survey, this country is consequently not covered by the comparison.

In PISA, the scores for Italy are presented for the country as a whole and also separately for 13 of the 20 Italian regions: Bolzano, Basilicata, Campania, Emilia-Romagna, Friuli-Venezia Giulia, Liguria, Lombardy, Piedmont, Puglia, Sardinia, Sicily, Trento, Veneto. Where important differences emerge, they are underlined and the scores are also presented by region.

It was not possible to report on the seven remaining regions separately, since these regions, which did not wish to be assessed separately, tested too few students for it to be possible to calculate sufficiently reliable indices.

[1] The weighted averages for the European Union are calculated on the basis of 20 of the 27 member countries. Cyprus and Malta did not take in the PISA surveys, and Estonia, France, Luxembourg, Romania and the UK did not collect information relating to ICT.

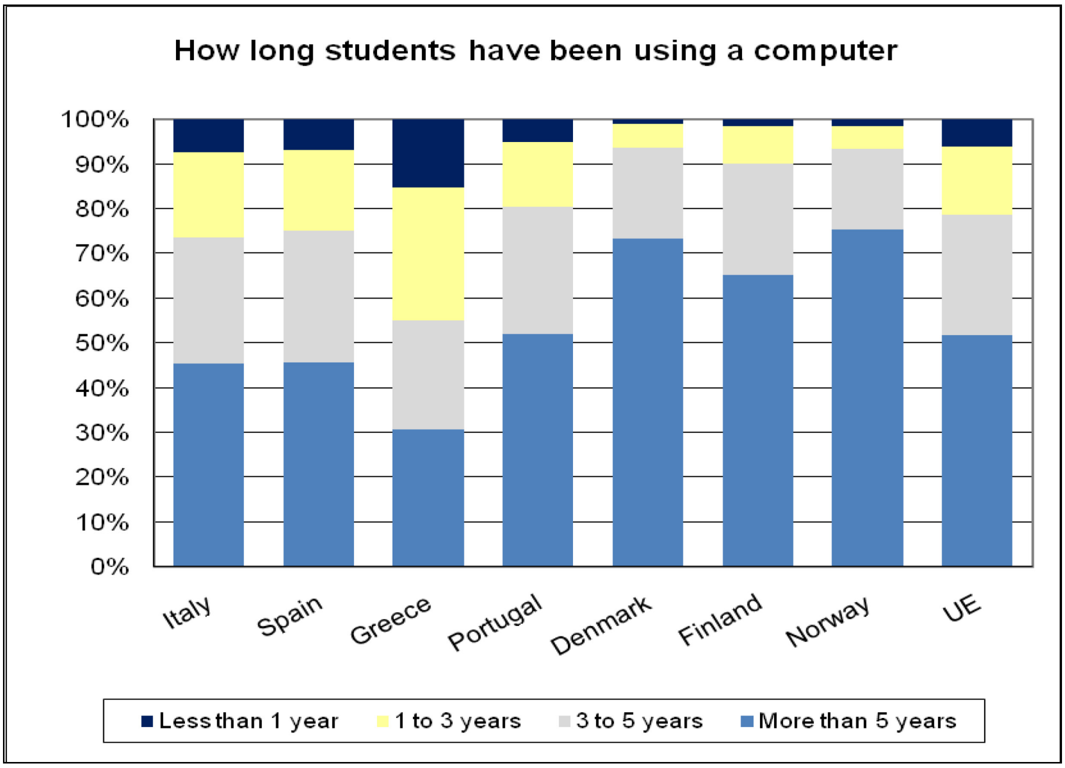
1.1 Access to ICT resources

In 2006, almost all 15-year-olds had already used a computer. On average, in the European Union, only 10% of the students had never been in contact with a computer. In Italy, this proportion is slightly higher than the international level, with 1.7% saying they have never used one.

Over the European Union in general and in Italy in particular, no differences are observed between boys and girls in access to computers.[2] Even more surprisingly, the economic and social status of the family is also not decisive: in Italy, the gap between the 25% most disadvantaged students and the 25% most advantaged was about 4%. The lack of difference in terms of gender and socio-economic status in an area that until a few years ago was reserved for boys and the best-off families reflects the astonishingly rapid spread of computer use in the industrialised countries. Having said this, one may still suspect that the generalisation of IT has not happened at the same pace and at the same time throughout the whole of the European Union.

The data from PISA 2006 confirm this intuition: while almost all young people are using computers by the age of 15, this is a relatively recent experience for some and a well-established one for others. It is reasonable to suppose that relatively early computer use (at primary school) is a factor favouring the development of “digital skills” and self-confidence in relation to these technologies. Figure 1 shows the disparities between students and between countries as regards first use of a computer.

Figure 1: How long students have been using a computer



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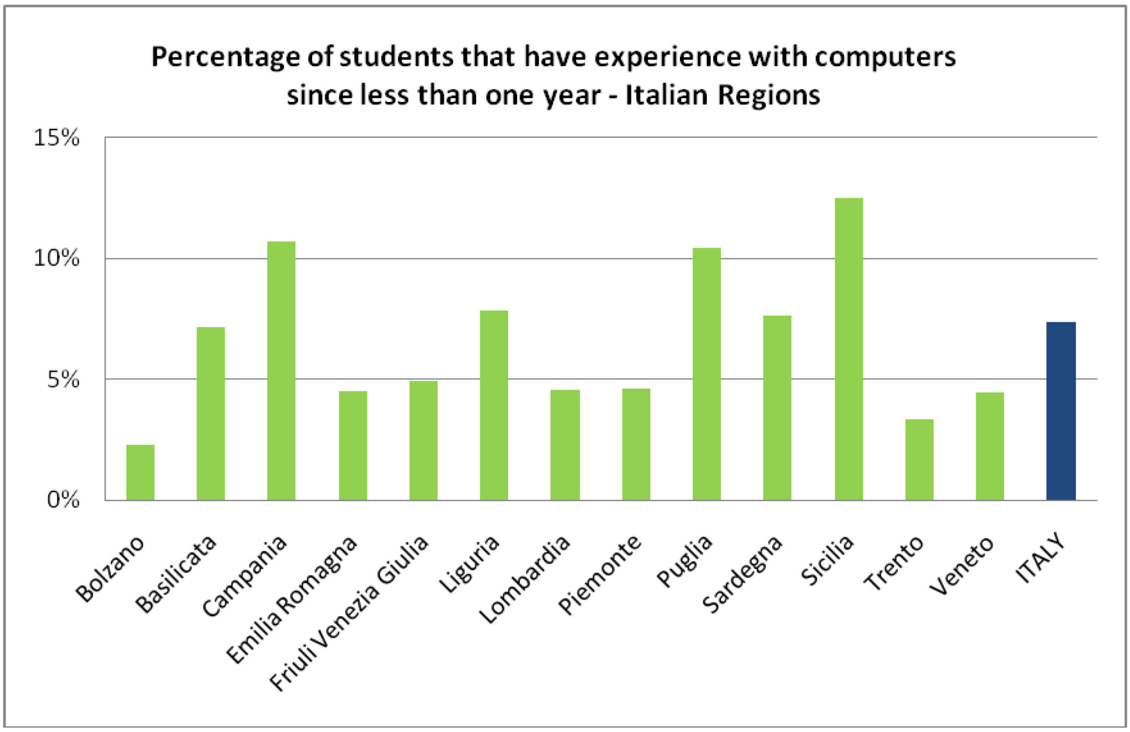
[2] General access, as measured by previous use.

In Italy, 45.5% of 15-year-olds were using a computer by the age of 10. The EU average is 51.7%. It is a very recent experience, by contrast, for 7.4% of young Italians and 6.0% of young Europeans overall. The northern European countries, where about 90% of 15-year-olds have been using computers for at least three years, are significantly in advance in this respect.

In Italy, there are significant differences from one region to another. In Sicily, Campania and Puglia, more than 10% of the 15-year-olds have less than one year's computer experience, as against only 2% in the Province of Bolzano.

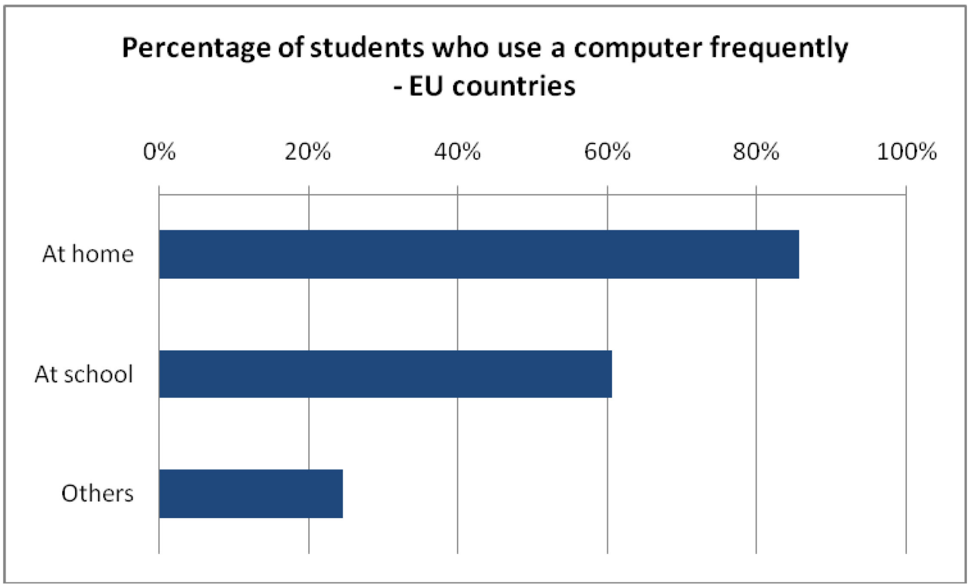
Figure 2: Percentage of students with less than one year's experience with computers



- ## Computer access and frequency of use at home

School and home are the two main places where young people use computers, as shown in Figure 3. Access and frequency of use, relative to place of use, will be analysed separately.

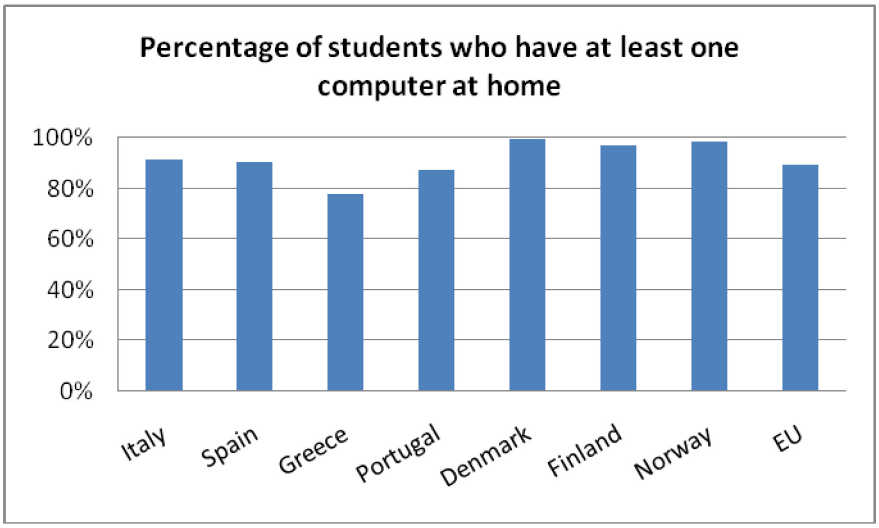
Figure 3: Percentage of students who use a computer frequently at home, at school and elsewhere



Do young people have a computer at home, with an Internet connection?

Computers are found in most European homes, and also in those of Italy, where 91.3% of 15-year-olds have at least one computer at home, and this (or at least one of them) is almost always available to them for their school work (89.3%). These figures are comparable to the European averages. In the Nordic countries – Denmark, Finland and Norway – close to 100% of families have a computer. Greek families are the least well-equipped, since fewer than 80% of 15-year-olds say they have a computer at home.

Figure 4: Percentage of students who have at least one computer at home

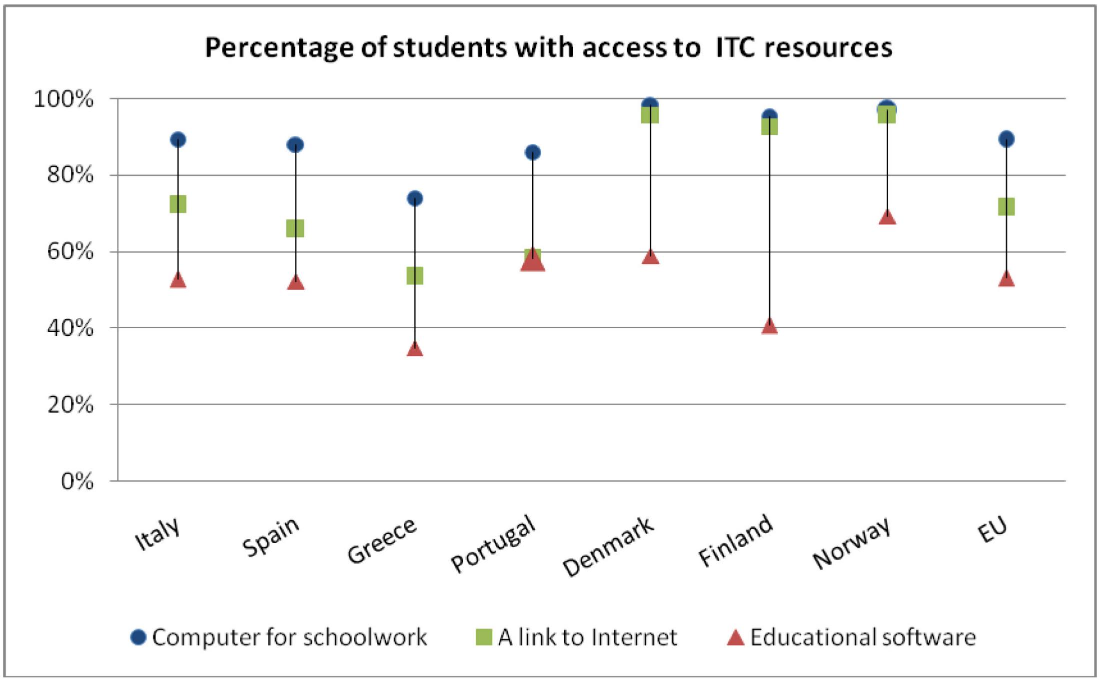


In Italy, there is little difference between most of the regions. Computers are found in more than 90% of homes, except in Sardinia (88%), Puglia (86%) and Sicily (85%).

About three quarters (72.2%) of the Italian students also have an Internet connection at home, slightly above the European average (71.5%).

Finally, as regards educational software, one Italian student in two says he or she has some at home (55% in Europe overall).

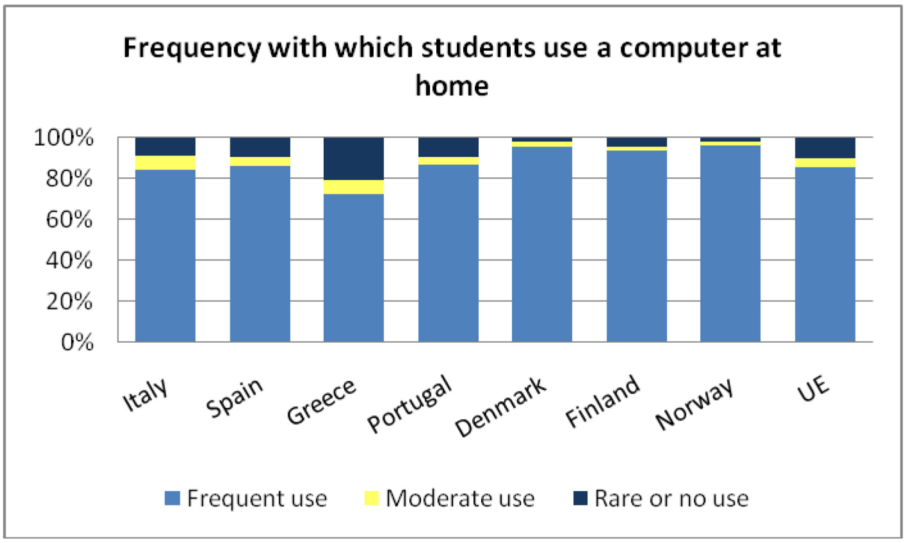
Figure 5: Percentage of students with Internet access and educational software at home



How often do 15-year-olds use a computer at home?

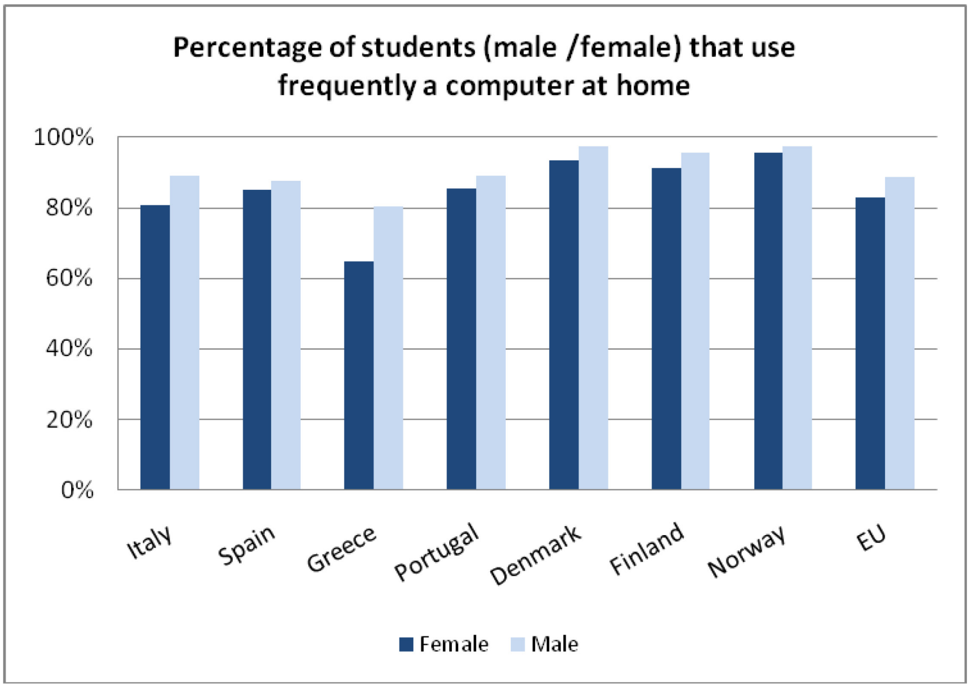
The great majority of young Italians, like other young Europeans, make frequent use of computers. 84.7% of the Italians and 85.7% of European students overall say they use a computer almost every day or once or twice a week. As Figure 6 shows, use is more frequent in the Scandinavian countries.

Figure 6: Frequency with which students use a computer at home



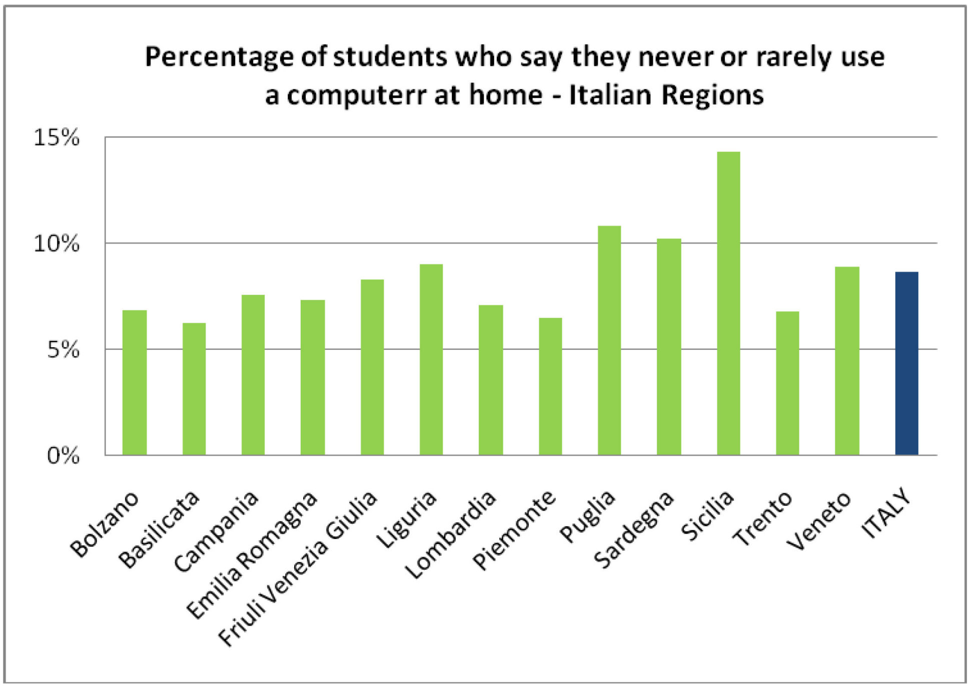
However, boys and girls behave differently: in Italy, 80.1% of the girls as against 89.1% of the boys make frequent use of computers. The differences between the sexes are fairly comparable from one country to another; only Greece has a more marked gap between girls and boys. So, while access to ITC is generalised, there is still a gender gap as regards actual use.

Figure 7: Percentage of males and females who frequently use a computer at home



Alongside these many students who use computers almost daily, there remains a non-negligible proportion of 15-year-olds who use them rarely or never. This is true for 8.7% of the Italians – 10.5% of the girls and 6.3% of the boys – and for 10.3% of European 15-year-olds overall. Students using rarely or never computers are significantly less numerous in Italy compared to the rest of Europe. The Italian average has some regional variations, as shown in Figure 8.

Figure 8: Percentage of students who say they never or rarely use a computer at home - Italian Regions



In Sicily, Sardinia and Puglia, more than 10% of the students say they only rarely use a computer at home. These figures are no doubt related to the smaller proportion of home computers in these regions.

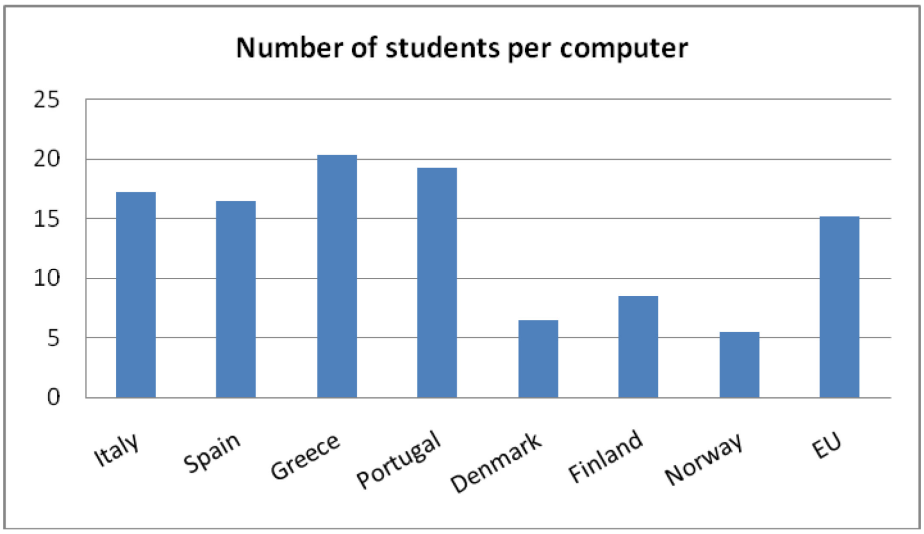
• Access and frequency of computer use at school

Another dimension of young people's access to ICT resources which may be of relevance for educational policies is access to computers at school. Do students have access to computers at school? How often? How many computers does the school have per student? What proportion of these computers is connected to the Internet? These are the questions addressed in this section.

Number of computers per student

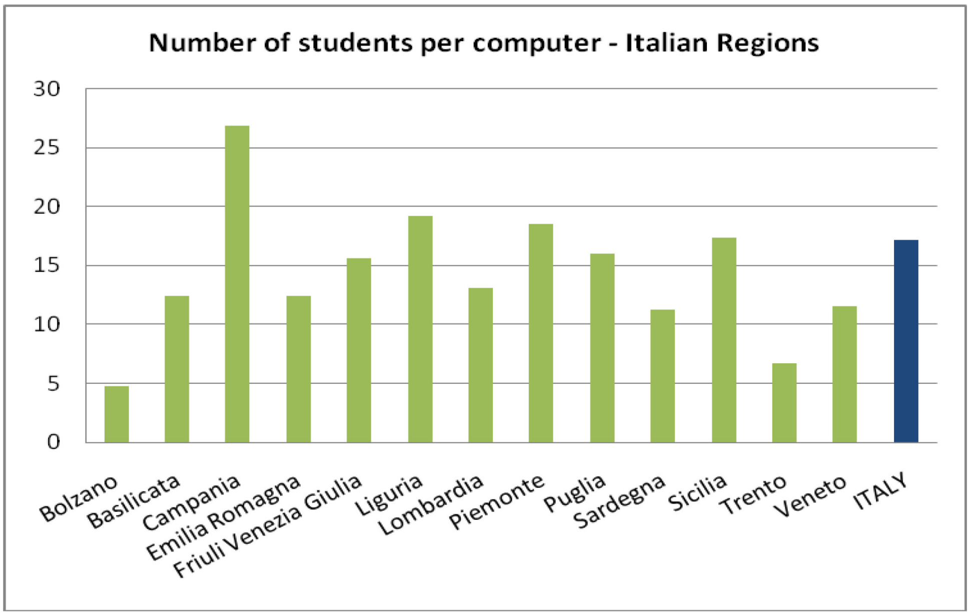
The computer facilities available in schools will partially determine the ITC experience that students can develop at school. The quantity of such equipment varies considerably between northern and southern Europe. Italy is one of the countries, along with Spain, Portugal and Greece, where there are on average more than 15 students per computer available for teaching; in Denmark, Finland and Norway, there is a computer for every five to eight students.

Figure 9: Number of students per computer



In this regard, there are considerable variations between the Italian regions (Figure 10). The best equipped region is the Autonomous Province of Bolzano, with fewer than five students per computer, and at the other extreme is Campania where on average almost 27 students share a computer. The regional differences in computer equipment are not however simply differences between North and South. In southern Italy, Basilicata and Sardinia are better equipped (with one computer for every 12.4 and 11.2 students respectively) than Piedmont or Liguria, in the North, where 18.5 and 19.2 students respectively share a computer.

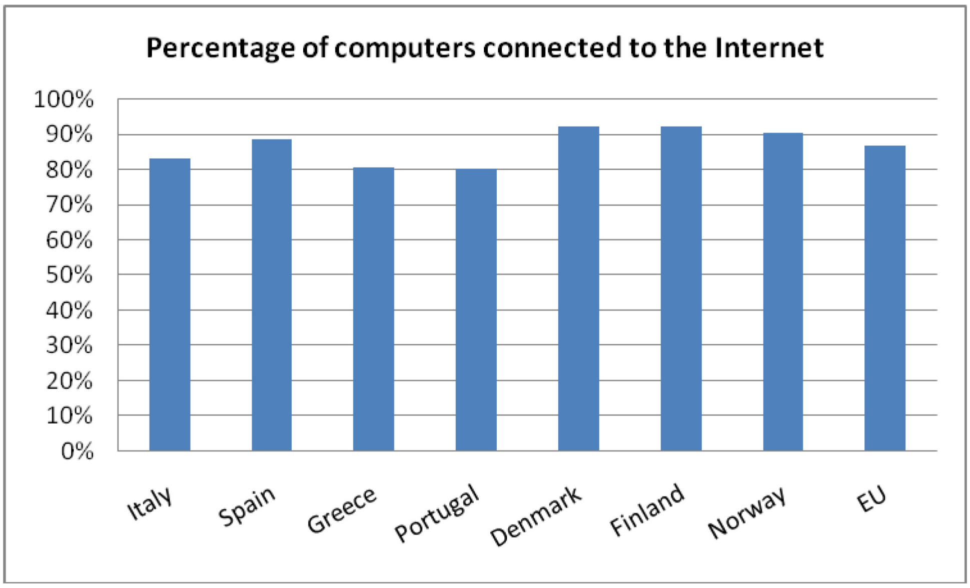
Figure 10: Number of students per computer – Italian Regions



Percentage of computers connected to the Internet

Overall, the Internet is well implanted in schools. The average proportion of school computers throughout the European Union connected to the Internet is 86.7%. Few variations are observed between countries or between the Italian regions.

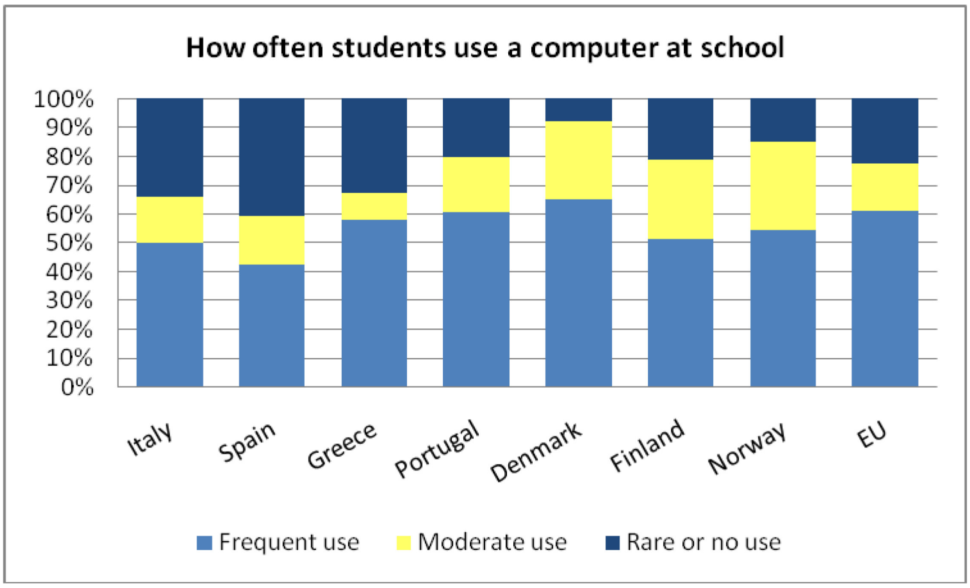
Figure 11: Percentage of computers connected to the Internet



How often do 15-year-olds use a computer at school?

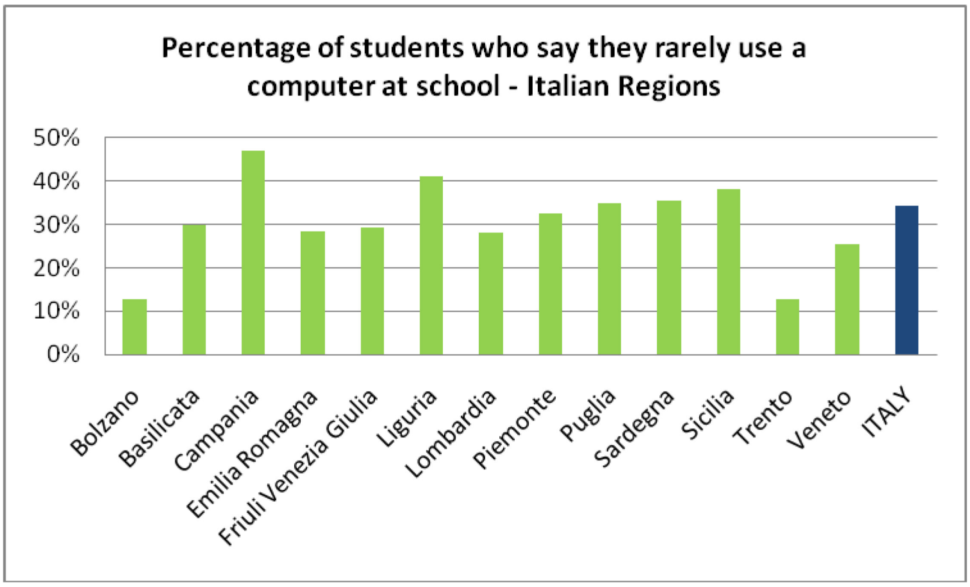
Computers are used less often at school than at home. Alongside students who say they use a computer frequently at school – 60.6% across Europe and 49.6% in Italy – others rarely or never have access to them. These very occasional users are most numerous in Spain, Italy and Greece – respectively 40.1%, 34.2% and 33.1%. Portugal seems to manage its ICT resources more effectively, since, despite the small number of computers available to students – one for every 19.2 students – the frequency of computer use is comparable to the international level.

Figure 11: How often students use a computer at school



There are fairly marked differences between the Italian regions in this respect, ranging from the Autonomous Province of Trento where only 12.6% of the students rarely use a computer to the region of Campania where almost one student in two (47.1%) rarely does so. These gaps are relatively comparable with those that exist in terms of school equipment.

Figure 13: Percentage of students who say they rarely use a computer at school – Italian Regions



1.2 Various uses of ICT resources

How do young Italians use computers? Is it mainly to communicate, or to find information on people and ideas, do they use software (spreadsheets, etc.)? This section aims to analyse the different ways 15-year-olds use computers, whether at home or at school.

The PISA ICT questionnaire asked students 11 questions to discover how often they carry out various activities with the computer. On the basis of these questions, two composite indices were constructed, defining two broad types of computer use: use of the Internet for entertainment (six questions relate to this) and use of various programs (five questions).

PISA constructed these indices in such a way as to set the OECD average (i.e. the international mean) at 0 and so that two-thirds of OECD students score between -1 and +1. Because the scores for Italy are here compared with the average for the European Union rather than the OECD, the indices have been re-centred on the EU. A positive index means a type of use that is more developed among Italians than the European average, but does not necessarily mean that they more frequently carry out each of the ICT activities that compose the index. Likewise, a negative index indicates a type of use that is less common among Italians than the European average.

- ## Use of computers for Internet and entertainment (INTUSE)

Using a computer and connecting to the Internet for entertainment is an activity that students mainly do at home. It is therefore partly dependent on possession of a computer and an Internet connection at home.

The table below shows, among young people who have access to a computer an Internet connection at home, the percentage who say they frequently (almost every day or once or twice a week) carry out various activities related to entertainment.

Table 1: Percentage of students who say they use computers almost every day or a few times a week for the following reasons

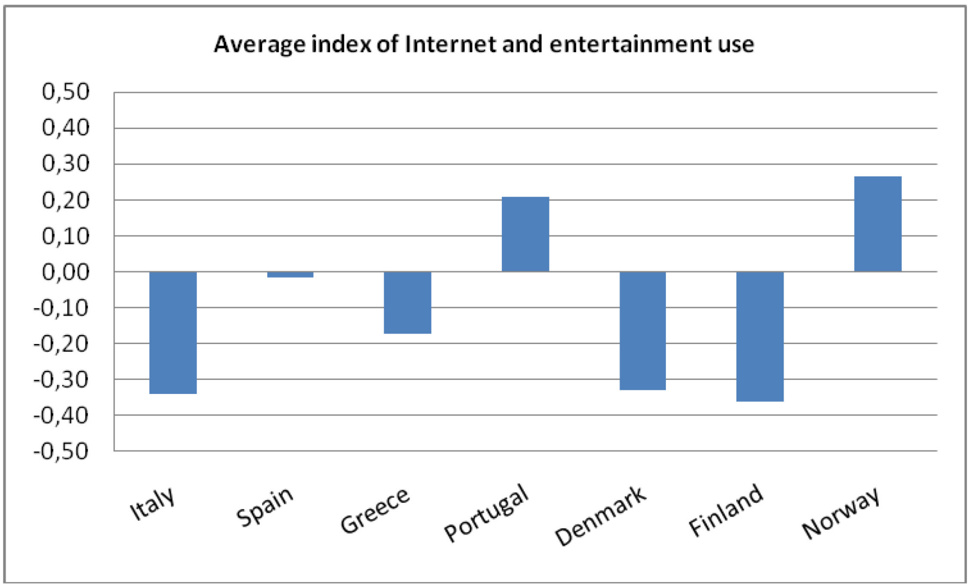
	Italy		EU	
	%	SE[3]	%	SE
Browse the Internet for information about people, things, or ideas	67.53	0.56	68.89	0.30
Play games	57.31	0.65	58.35	0.33
Use the Internet to collaborate with a group or team[4]	25.09	0.54	48.14	0.30
Download software from the Internet (including games)	53.78	0.67	53.86	0.31
Download music from the Internet	63.60	0.61	69.33	0.30
Use the Internet for communication (*e.g.* email or chat rooms)	53.66	0.87	81.26	0.28
Average index	-0.34	0.01	0.00	0.05

For Italy, the average index of -0.34 shows that entertainment through the Internet and the computer is less pronounced for young Italians than for 15-year-old Europeans as a whole. If one observes the different variables composing the index, it can be seen that Italians diverge from Europeans as a whole mainly as regards communication through the computer: more than 80% of young Europeans use the Internet to “chat” and send emails, as against only 54% of young Italians. Likewise, very few of the latter (25%) use the Internet to collaborate with a group or a team. By contrast few differences emerge as regards games, for example, or searching the Web for information.

[3] Standard error

[4] This item covers for example the use of multi-player on-line games, social networking (Facebook, etc.), discussion forums, etc. (These examples do not, however, figure in the question put to the students in the test, so that one cannot know what the students understand by the term.)

Figure 14: Average index of Internet and entertainment use (INTUSE)



The index of Internet and entertainment use of computers distinguishes Italy from the other Mediterranean countries. In this respect, the behaviour of young Italians is closer to that of young Danes or Finns, although there are some differences for certain variables (few Finns, for example, say they download music).

At the level of the Italian regions, Campania comes closest to the European average (index = -0.10) while Veneto is the one in which the computer is least used for entertainment (index = -0.53).

Table 2 specifies the index value for the girls and for the boys, and also for the 25% least advantaged and the 25% most advantaged students. For the boys and girls, the differences are those commonly brought to light, namely a less pronounced use of the Internet by girls, mainly as regards downloading music, playing games and using various software. For “chatting” and sending emails, i.e. activities that involve written communication, the gender differences are less marked.

As regards socioeconomic differences, the most disadvantaged young people – even if they have a computer and an Internet connection – use ICT less often for entertainment than the most advantaged. One explanation for this certainly lies in the differences in the computer facilities available to them. Programs and other software often require powerful computers, Internet connections may be fast or slow, some game sites charge for access... all these factors privilege the better-off. In addition, higher-income families tend to have several computers at home, reducing the need to share a computer.

Table 2: INTUSE index by student's gender and socioeconomic level

	Italy		EU	
Mean index	-0.34	0.01	0.00	0.05
Index for girls	-0.58	0.02	-0.29	0.05
Index for boys	-0.11	0.02	0.27	0.05
Index for the 25% most disadvantaged	-0.47	0.02	-0.12	0.07
Index for the 25% most advantaged	-0.27	0.03	0.05	0.06

• Program and software use (PRGUSE)

The PISA ICT questionnaire included three questions on the frequency of use of certain programs and software, chosen from among those most often used in schools. One question was on the use of educational software and a final one was on writing computer programs.

These activities are more specifically 'scholastic' and therefore performed at school as well as at home. However, because computers are in general used significantly more at home than at school, the frequencies of program and software use continue to be influenced by possession of a computer at home. For this reason, the frequencies and the PRGUSE index are here calculated for those students who have a home computer.

Table 3 shows the percentages of young people who say they often (almost every day or once or twice a week) use various programs or write programs.

Comparison of Tables 1 and 3 shows first that 15-year-olds use computers for entertainment more than for programs and software. The only type of program that is frequently used – by a small majority of Europeans – is word-processing software such as Word® or WordPerfect®, whereas five of the six entertainment activities exceed this median percentage, in some cases by a wide margin. This is also true for Italy.

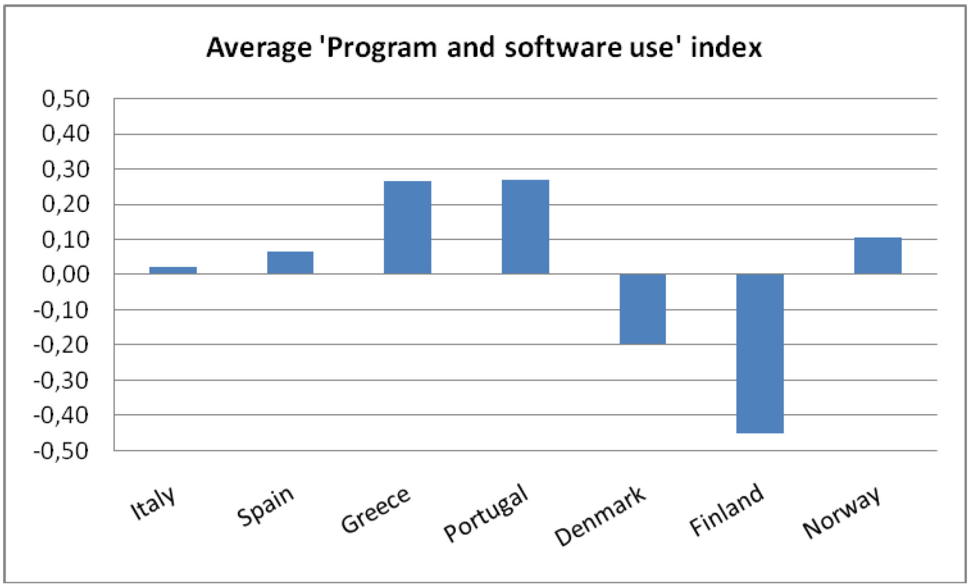
On the scale of the PRGUSE index (Table 3), the behaviour of young Italians is similar to that of other young Europeans. The index is very slightly positive (0.02), but not significantly different from the European average. However, analysis of the variables that make up the index reveals frequent use of educational software by one young Italian in three (34%) as against less than one in five (19%) within the European Union. In Italy, just under one student in three (32%) also declares that he frequently writes computer programs as against the European average of 22%.

Table 3: Percentage of students who say they use computers almost every day or a few times a week for the following reasons

	Italy		EU	
	%	SE	%	SE
Write documents (e.g. Word® or WordPerfect®)	52.72	0.73	50.42	0.31
Use spreadsheets (e.g. Lotus123® or Microsoft Excel®)	25.64	0.57	25.07	0.29
Drawing, painting or using graphics programs	31.39	0.73	34.35	0.29
Use educational software such as mathematics programs	34.35	0.29	18.61	0.27
Writing computer programs	31.63	0.60	21.95	0.28
Average index	0.02	0.02	0.00	0.04

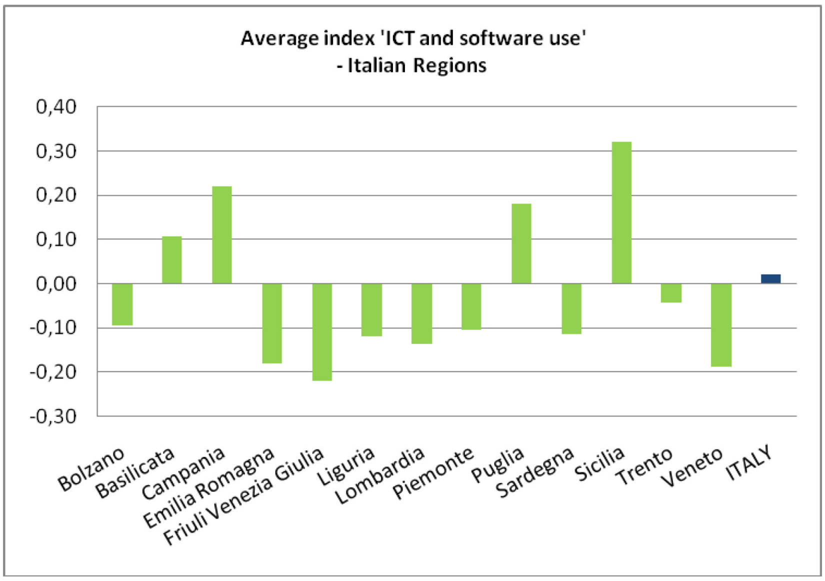
Among the countries compared in Figure 15, Greece and Portugal have the most positive indices – 0.26 and 0.27 respectively – revealing a more frequent use of computers for educational purposes than in other countries, especially Denmark and Finland.

Figure 15: Average "Program and software use" index



While the average index is close to zero in Italy (i.e. it is comparable with the international average), it conceals significant regional differences. Figure 15 shows that in the southern regions – Basilicata, Puglia, Campania and Sicily – the index is positive (strongly so in the case of Sicily, with 0.32) whereas in the north and in Sardinia it is negative.

Figure 16: Average "Program and software use" index – Italian Regions



Factors influencing "Program and software use" (PRGUSE)

Internet and entertainment use of computers is exclusively dependent on indices of family wealth and resources (home possessions, economic/social and cultural status, home educational resources) and the student's gender. No other variable investigated in the PISA survey shows sufficient correlation to influence frequency of computer use for entertainment. The greater the family's resources and especially its wealth, the more a student, and especially a male student, will tend to play on computers. The "poorer" the country, the stronger this correlation is (see detailed analysis in annex 1).

The situation is quite different as regards "Programs and software use". Correlation analysis interestingly brings to light the impact of motivational factors and variables linked to the methods used in science teaching (Table 4).

At European level and at the Italian national level, the index most correlated with this type of ICT use is an index of young people's attitude to the sciences – the index of participation in science activities. For the European Union, one finds an average correlation coefficient of 0.26 and even 0.29 for Italy. This index is derived from the frequency with which students say they (i) "Watch TV science programmes" (ii) "Borrow or buy books on science topics", (iii) "Visit web sites about science topics", (iv) "Listen to radio programmes about advances in science", (v) "Read science magazines or science articles in newspapers" and (vi) "Attend a science club".

One might at first sight suspect that the individual variable "Visit web sites about science topics" explains the totality of this correlation and so biases interpretation of the impact of the composite index. This theory is not fully verified since, while the variable "Visit web sites…" does indeed have a positive correlation with the "Use programs" ICT use index, this is also true of other variables, such as "Watch TV science programmes", "Borrow or buy books …" or "Read science magazines...". It is therefore reasonable to suppose that there is a category of students who are both motivated by science activities and also led by curiosity to be interested in science outside school, and that these students are partly the same as those who enjoy using programs and software… perhaps future scientists or engineers, attracted by science and technology.

This hypothesis would also explain why information about careers in science, self-concept in science and general interest in science are positively correlated with the "educational" use of ICT.

Science teaching that encourages personal research is the second factor positively influencing the "educational" use of computers. This link may seem at first sight remarkable, but the development of a scientific attitude of investigation and initiative in students is conducive to the learning and (self-taught) use of various software programs. Two other indices linked to the methods used in science lessons show non-negligible correlations (over 0.20 for Italy): the index concerning science lessons emphasizing hands-on work and the index concerning the teaching of models and their application in the external world.

These three methodological axes are conducive to the cultivation of responsible scientific behaviour in the student in the sense that he/she is an actor in the construction of his/her scientific knowledge and know-how and that scientific knowledge is anchored in the reality that gives it meaning. Such scientific competences prove to be useful in a "proactive" approach to the computer.

Analysis of the correlations confirms, if it were necessary, the absence of real relationships between the PRGUSE index and the student's gender (correlation coefficient = 0.09) and socioeconomic level (correlation coefficient = 0.10).

Nor does any linkage emerge with performances in any of the three disciplines (mathematics, reading and science) assessed by PISA. This absence of linkage with student performances in science should be emphasized, since it is precisely a scientific attitude oriented towards use of the computer that one might venture to call scientific. The students' performances do not speak either for or against such behaviour vis-à-vis the computer.

Table 4: Coefficients of correlation between the index of ICT use for programs and software and student variables

	Italy	**EU**
Taking part in science activities (SCIEACT)	0.29	0.26
Science teaching with student investigations (SCINVEST)	0.28	0.24
Student information on science-related careers (CARINFO)	0.25	0.21
Science teaching with hands-on activities (SCHANDS)	0.23	0.19
Science teaching with focus on models or applications (SCAPPLY)	0.23	0.18

Science self-concept (SCSCIE)	0.21	0.19
Home educational resources (HEDRES (HEDRES)	0.20	0.23
General interest in learning science (INTSCIE)	0.17	0.20
Home possessions (HOMEPOS)	0.14	0.19

Differences also emerge among the Italian regions. They are illustrated in annex 2 for four slightly contrasting regions (Bolzano, Lombardia, Sardegna, and Sicilia).

1.3 Students' own perception of their ICT skills

How capable do students feel themselves to be of performing certain tasks with a computer? The PISA 2006 ICT survey questioned the students on this subject with a series of 14 questions. Self-confidence was measured for two types of task: Internet-related tasks and tasks designated as "high-level" (virus control, digital edition, databases creation, etc.).

The results are presented for the same set of countries and the average for the European Union countries is given. International comparisons are made but these should be interpreted with some care since it should not be forgotten that the student responses are subjective – the way young people perceive themselves and their capacities may vary from country to country. While the international comparisons are not without interest, the analysis should perhaps focus more on national comparisons.

• Students' own perception of their Internet skills

The students were asked to respond in relation to five different tasks and had to choose between four possible answers: "I can do this very well by myself", "I can do this with help from someone", "I know what this means but I cannot do it", "I don't know what this means".

Table 7 indicates, for the different tasks, the percentages of Italian and European students who say they can do it very well by themselves.

The young Italians' general index of their perception of their Internet skills is distinctly negative. They are much less confident than their fellow Europeans in all the activities mentioned, whether they involve written communication (chat, email) or more "technical" tasks, even those connected with leisure (downloading music, for example), although here the difference from the other Europeans is somewhat smaller. Their lack of confidence in communication activities to cooperate can be directly related to the less frequent use of these in Italy than in other European countries (see Table 1).

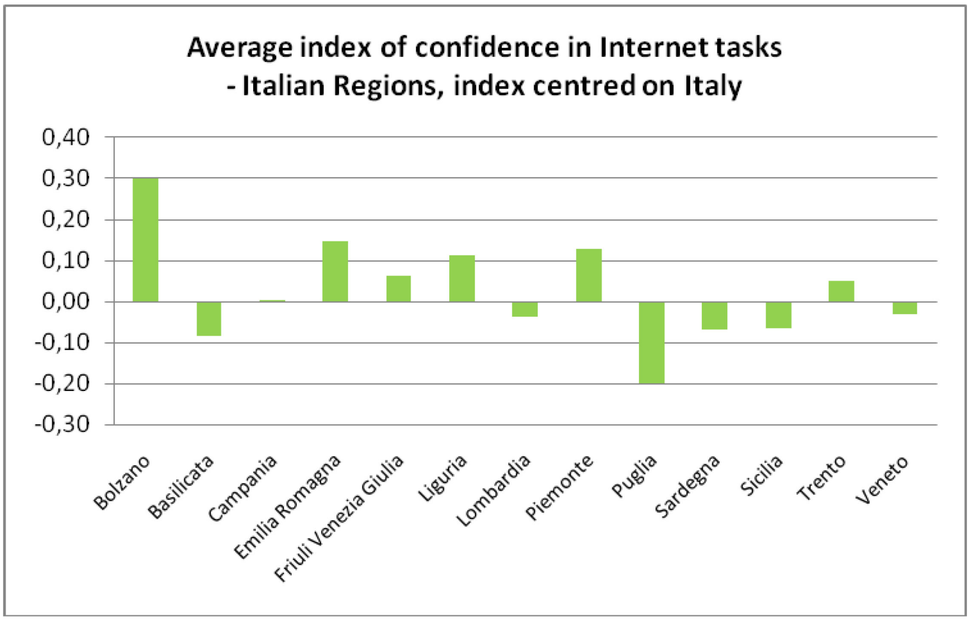
Table 5: Percentage of students who say they can do this very well by themselves – Internet tasks

	Italy		EU	
	%	SE	%	SE
Chat on-line	57.52	0.78	82.00	0.27
Search the Internet for information	76.0	0.59	90.4	0.24
Download files or programs from the Internet	66.0	0.64	74.6	0.29
Attach a file to an email message	48.1	0.64	68.8	0.30
Download music from the Internet	64.7	0.51	74.3	0.28
Write and send emails	57.9	0.70	82.2	0.27
Average index	-0.58	0.02	0.00	0.05

To facilitate interregional comparisons, the indices are this time centred on Italy.

It emerges that students in the Autonomous Province of Bolzano are significantly more confident of their Internet skills than their counterparts in the rest of Italy. Students in the southern regions and in Lombardy and Veneto position themselves below the national average.

Figure 17: Average index (centred on Italy) of confidence in Internet tasks for Italian regions



• Students' own perception of their skills in high-level computer tasks

Eight complex tasks were put to the students, so as to identify their ability to cope with high-level computing tasks. The possible responses are the same as for the previous index.

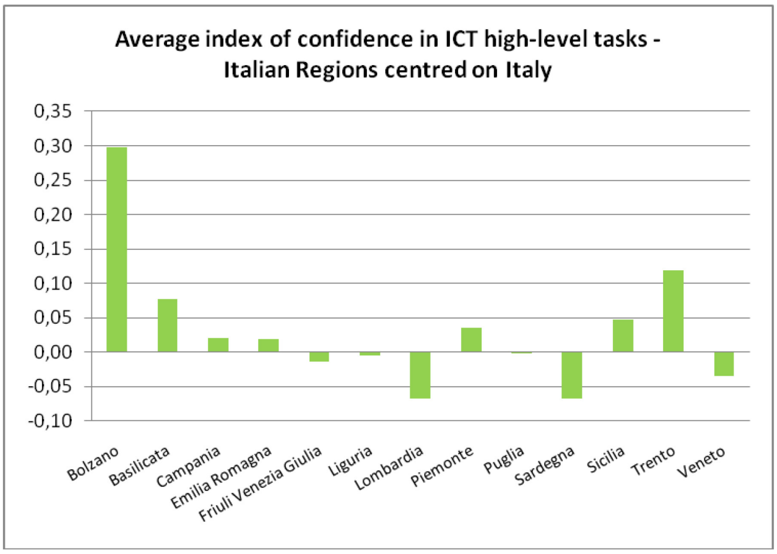
Quite logically, both Europe-wide and in Italy, the proportions of students who say they can perform high-level computing tasks are lower than those who say they can use the Internet and perform the corresponding tasks (previous section). Italy nonetheless presents an unexpected characteristic in this respect: the gap between confidence in Internet activities and confidence in the high-level activities is narrower than in the rest of Europe, where the drop in the percentages claiming to be competent is much steeper. It would appear that the Italian deficit Italian is more in the area of basic skills (such as those described in the previous index relating to the Internet) than in high-level computing skills. Although the proportion of students declaring themselves competent in fairly specific skills is lower than the European proportion at the level of the overall index, on the one hand the difference is smaller than that observed in the previous section and, on the other hand, for certain items, the Italians seem better or as well prepared as their European counterparts.

Table 6: Percentage of students who say that they can do this very well by themselves – High-level tasks

	Italy		**EU**	
	%	SE	%	SE
Use software to find or get rid of viruses	30.56	0.46	44.01	0.30
Edit digital photographs or other graphics	47.97	0.55	58.01	0.29
Create a database (e.g. using Microsoft Access®)	18.46	0.42	26.83	0.28
Use a word processor (e.g. to write an essay for school)	83.46	0.50	80.98	0.27
Use a spreadsheet to plot a graph	46.0	0.70	51.67	0.31
Create a presentation (e.g. using Microsoft PowerPoint®)	54.8	0.79	56.51	0.33
Create a multimedia presentation (with sound, pictures, video)	44.5	0.67	43.26	0.31
Construct a Web page	18.4	0.46	26.60	0.29
Average index	-0.16	0.01	0.00	0.04

Again, for high-level tasks, the Autonomous Province of Bolzano shows more confidence in its skills than the other regions, which differentiate themselves relatively little.

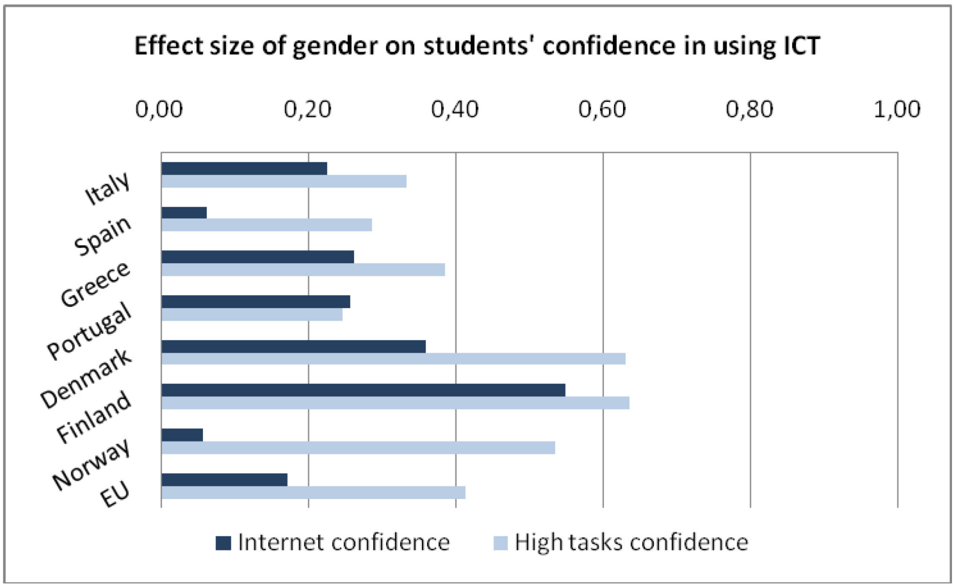
Figure 18: Average index (centred on Italy) of confidence in high-level ICT tasks for Italian regions



- ## Influence of gender and socioeconomic level on students' level of confidence

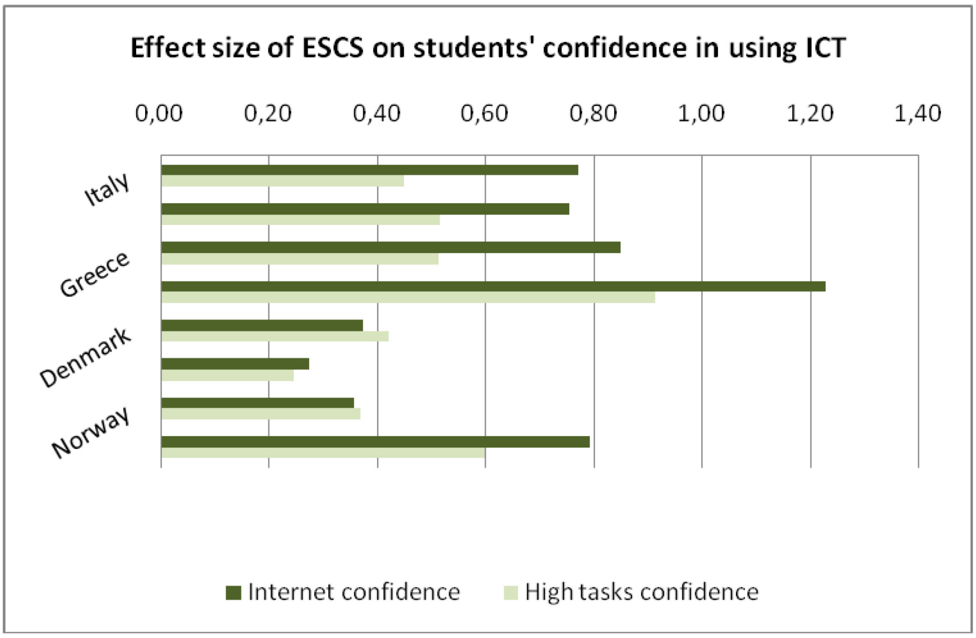
In some countries, such as Finland and Norway, and also on average at the European level, the contrast between the girls and the boys does not appear strongly in the index of confidence in Internet-related tasks. In Italy, on the other hand, the effect size is above the threshold that has been set for declaring an effect of gender. By contrast, in all countries, Italy included, for high-level tasks the difference in favour of the boys is marked.

Figure 19: Effect size of gender on students' confidence in using ICT



When one looks at the size effect of socioeconomic background on the two indices, the findings are reversed. The difference appears in Internet-related tasks, not in high-level tasks. It is interesting to note that the latter perhaps imply less of a financial barrier for students, and are therefore less inaccessible to the disadvantaged, since most of the tasks proposed are feasible with the basic programs available on any computer.

Figure 20: Effect size of socioeconomic level on students' confidence in using ICT



1.4 Influences on performances

The analysis in section 2 showed the absence of a link between students' performances in mathematics, sciences or reading and the type of use they make of the computer. A high-scoring student does not typically use the computer for other purposes than a low-scoring student. What about frequency of use? Do young people who have been using computers for a very short time achieve performances[5] comparable to those of the others? Does one find differences in performance between very occasional users and frequent users? Is there a link between frequent use of computers at school and performances in the PISA test? And home use? This chapter seeks to answer each of these questions.

The aim of the analysis is not to compare performances between countries but to study the differences in performance according to how long a student has used a computer and how often he/she uses it. The data by country are therefore presented in terms of differences and not in terms of scores on the PISA science scale.

- ### Years of computer experience and performances in science

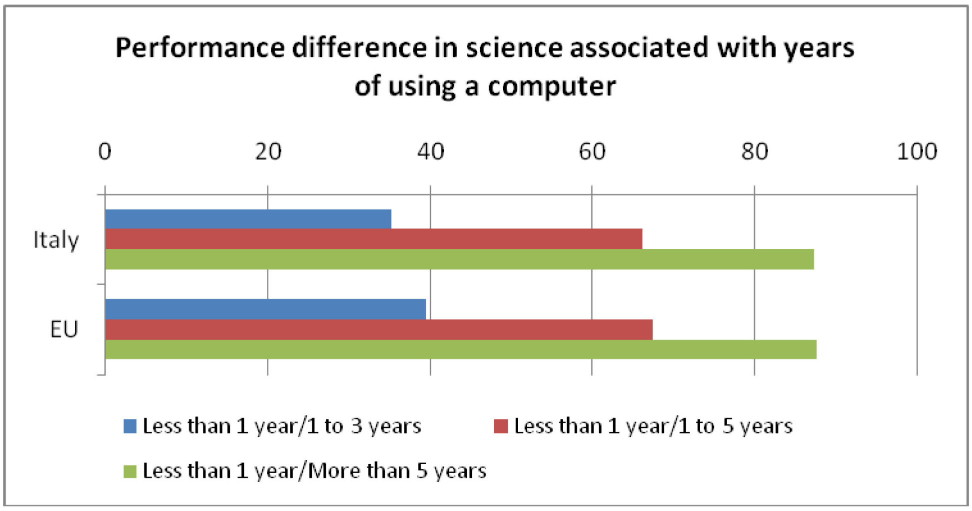
The analysis in section 1 showed that in Italy and in all the countries with which it is compared, the majority of students had started to use a computer by the age of 12 years, i.e. on entering secondary school. Nonetheless more than one 15-year-old Italian in four (26.1 %) has less than three years' computer experience. It is therefore legitimate to examine the differences in performances in relation to their number of years of computer use.

Figure 21 shows that the differences observed in Italy and their progression are similar to what is observed on average in the European Union. One to three years' computer experience is accompanied in Italy by a gain of 35 points on the scientific literacy scale.[6] Students who have used a computer for more than five years have an average score 87 points higher than those who have used one for less than a year. Thus one observes a clear progression related to the extent of familiarity with computers, but the main gain is found in the first years of use.

[5] This analysis relates only to performances in science (the main focus of the 2006 PISA survey).

[6] The scientific literacy scale has a mean of 500 and a standard deviation of 100 at the level of the OECD. A 35-point difference corresponds to approximately 1/3 of standard deviation.

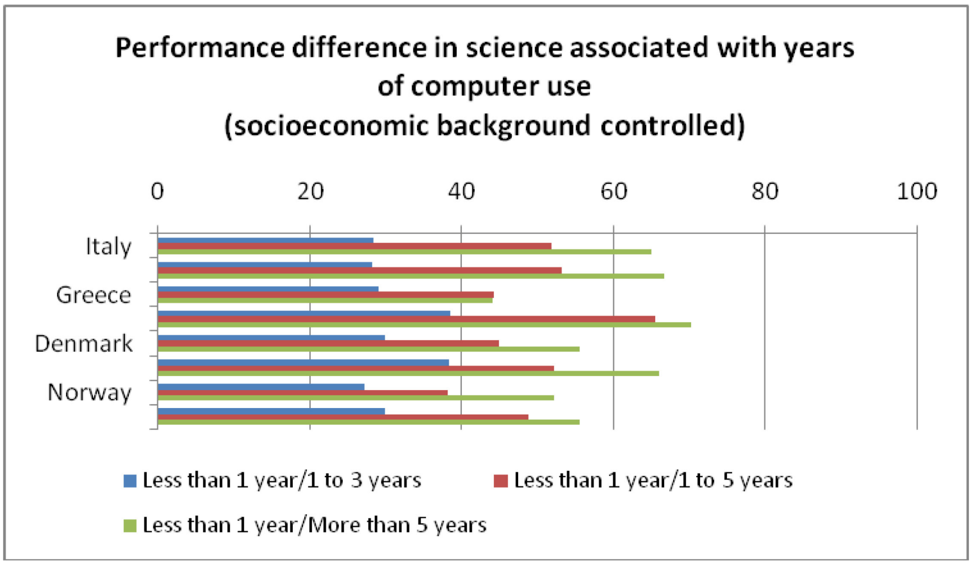
Figure 21: Performance difference in science associated with years of using a computer



The students' socioeconomic level has a non-negligible influence on access to computer resources, so it can be hypothesized that socioeconomic level (ESCS) largely explains the performance differences observed according to familiarity with ICT. Figure 22 shows that differences in performance according to years of experience remain even when ESCS is controlled. On average, for the European Union, students with one to three years' computer experience have a score 30 points higher than those whose experience is recent, at equivalent socioeconomic level. In Italy, the gains are comparable with the international average for the first two categories, whereas the gain resulting from a long experience of ICT (more than five years) is significantly greater than that observed in Europe (64.9 points in Italy as against 55.5 for the European Union).[7]

Figure 22: Performance difference in science associated with years of computer use when socioeconomic background is controlled

[7] In terms of the standard deviation in science in Italy (std = 95.55) and in the European Union (std = 93.81), these differences in scores remain significant.



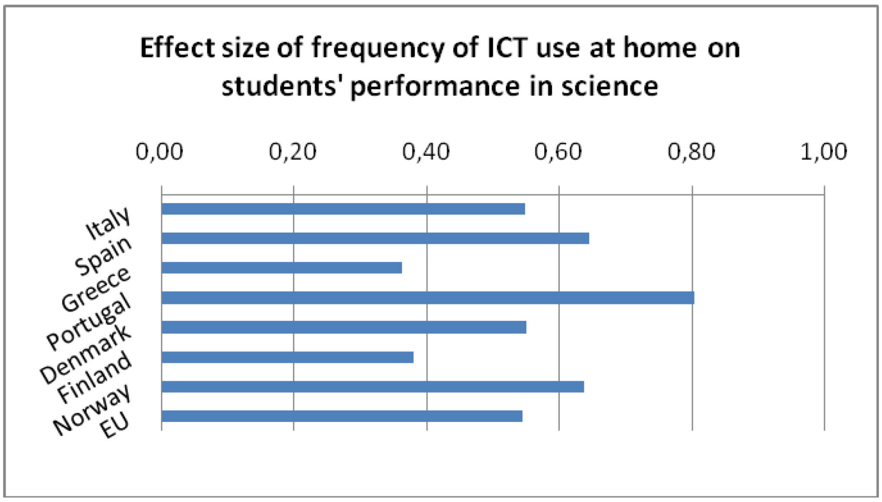
Without establishing a causal link, this analysis makes it possible to show that students who perform well in science are more familiar with ICT than students who perform less well, regardless of their socioeconomic level.

• Frequency of computer use at home and performances in science

The differences in performances in science were measured between occasional home computers and "heavy" users. In the light of the results of the previous analysis, the students' socioeconomic level was this time not controlled, with differences in performance persisting at constant socioeconomic level.

To facilitate international comparisons, these differences have been translated into effect sizes, which indicate the differences from the standard deviation calculated for the country. In practice, effect sizes under 0.20 are regarded as weak, those of the order of 0.50 as medium and those over 0.80 as important.

Figure 23: Effect size of frequency of ICT use at home on students' performance in science



In Italy, students who frequently use a computer at home (once a week or more) score on average 484.4 on the PISA scale[8] whereas those whose frequency does not exceed once a month have an average score of 433.5. This difference of 50.9 points corresponds to 0.55 times the standard deviation for science scores in Italy. The effect size (0.55) is medium and comparable to that observed overall for the European Union. The countries that diverge most from the international average are Greece, a country in which the frequency of home computer use has a weak effect on performances, and Portugal, which, by contrast, shows an important effect of this frequency of use on performances in science.

The correlation coefficient also makes it possible to estimate the link between the two variables. It is 0.15 for Italy and 0.16 for the European Union, indicating a weak but non-negligible link. However, it is perhaps pertinent to recall that the existence of a correlation does not establish a relationship of cause and effect.

- **Frequency of computer use at school and performances in science**

On average at the international level, frequency of computer use at school does not have a significant effect on performances (effect size =0.04). The only countries for which the effect is non-negligible are Italy, Greece and Denmark. Italy and Greece show a negative effect, which seems to indicate that it is the students whose performances in science are weakest who most use computers at school. This effect is, however, weak for Italy (0.21). By contrast, in Denmark one finds a slight positive effect, meaning that the performances of students who have frequent access to computers at school are slightly better than those of students who rarely use them.

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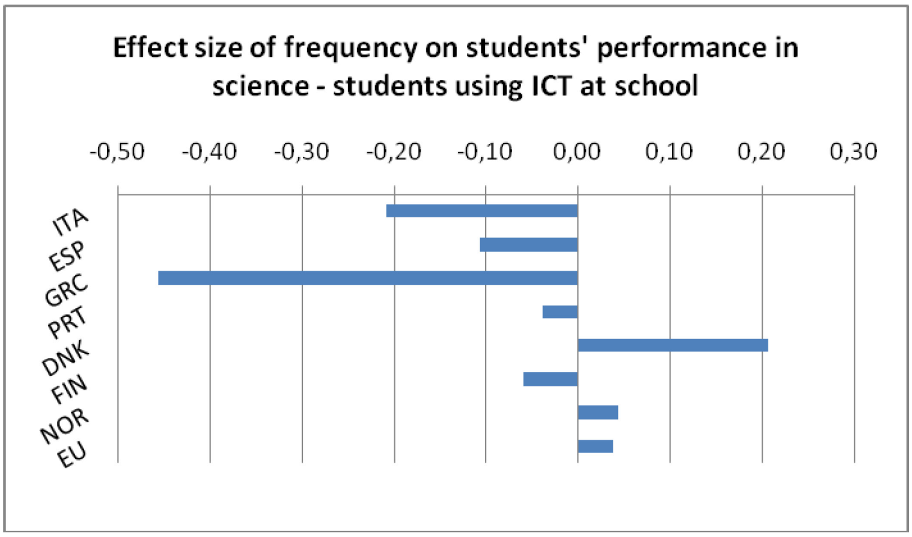
[8] The mean for all OECD countries is set at 500 and the standard deviation at 100.

Figure 24: Effect size of frequency of ICT use at school on students' performance in science



However, correlation analysis reveals no link between performance in science and more or less frequent computer use at school (for Italy, r^2 = -0.09). Only Greece shows a negative non-negligible negative correlation (r^2 = -0.21), which would mean that that the weaker students tend to be exposed to computers more often than stronger students. This tendency is not observed in any other European country.

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2. Italian schools and ICT – Comparative analysis from the SITES 2006 survey

Main findings

This analysis of the SITES 2006 study compared a subset of 6 countries – Norway, Finland, Denmark, Catalonia, France and Italy. It examined the findings at system and school levels which were based on the answers to the questionnaires to national coordinators, school principals, technology coordinators and teachers.

In terms of ICT provision, training and support, the Nordic countries - especially Denmark - seem well placed. Italy on the other hand, has issues in some of these areas and compares less favourably. Technical support is broadly similar in all 6 countries though interestingly this type of support from students is very low in Italy whereas it is quite high in Norway for example.

At the same time however, Italy is broadly similar to the other countries in terms of teachers' pedagogic orientations, classroom activities and student practices and in fact is higher than the other 5 countries in terms of the dominance of its science teachers' lifelong learning orientations. School principals in Italy also place a greater emphasis on lifelong learning and connectedness than principals in the other countries. However they score second lowest in seeing ICT as the catalyst which will bring about this change.

The findings at system level offer some interesting insights. Among the 6 countries compared Italy has the second highest population and the second lowest degree of urbanisation. Finland also has a large rural population, but unlike Italy, its overall population is less than 10 million. Italy also has lowest GDP, the highest income inequality and the lowest spend per GDP on education of the 6 countries. Yet it has the highest increase in expenditure on ICT in education over the last 5 years.

There are similarities and variations across the countries in terms of curriculum, teacher training and pedagogy. All the countries except Finland have centralised control of the curriculum and none of countries have an ICT-specific requirement for teacher certification. However all 6 countries indicated that Government subsidy is provided for in-service or professional development for teachers covering

ICT skills, use of ICT in subjects, use of ICT in administration and use of ICT for new approaches in learning.

Where teacher pedagogic practice is concerned, Italy indicated the highest increase in non-traditional pedagogic practices such as inquiry-based learning, interclass collaboration etc, while Finland was the lowest. Yet when it came to pedagogy *and* ICT, Italy and Catalonia indicated 0 new pedagogies whereas all the other countries indicated some increase with Norway the highest.

This seeming contradiction between an increase in new/21st century pedagogic orientations in general, yet no change in this direction in terms of ICT begs questions. Government spend on ICT provision has increased and while there is not a mandatory requirement for ICT in teacher certification, funds are available for ICT in-service training for teachers. Thus questions need to be asked about the nature and scope of this training and the degree of uptake. Also questions may need to be asked about ICT provision. As will be seen in the findings from the ICT coordinators survey at school level, there is a perception among Italian coordinators that there is a lack, among other things, of digital resources, communications software and email accounts for students and teachers. Such applications are fundamental to the development of 21st century skills and thus it may be that the nature of current provision across schools needs to be revisited.

Finally across the 6 countries Italy compared favourably in terms of their education policy for ICT in as much as it seemed to espouse the values of ICT in learning and teaching and define a strategy to support uptake and integration. However, the fact that at system-level the perception is that changed pedagogy has not embraced ICT use would indicate that there may be issues with how the policy is being implemented.

The findings at school level on the basis of school principals and ICT coordinators answers indicate that provision, support and teacher professional development in Danish schools is consistently high across most aspects, as indeed is provision for all the Nordic countries. On the other hand, Italy shows significant differences in terms of provision and access. In terms of applications and software to support communication and collaboration such as web-based environments, mobile devices, email accounts for students and teachers, perceptions of the ICT coordinators is that there is a real need for these technologies in the schools. This begs questions as to the nature of current provision across Italian schools, and perhaps the need to align this with both policy aspiration and at school level, with the declared vision of principals towards connectedness and lifelong learning pedagogic orientations. Clearly both connectedness and lifelong learning pedagogic orientations are not solely dependent on an ICT-rich environment, however it also undoubtedly true that applications such as web-based environments and general communications software greatly facilitate collaboration and communication in terms of immediacy and 24/7 availability. They also support user creation, independence and collaboration which are central to 21st century learning outcomes.

Availability of technical support in general appears roughly similar in all 6 countries. However Denmark seems the best supported system in terms of availability of such support for specific teacher activities. Equally Denmark indicated the highest levels of teacher pedagogic support and in terms of teacher training with ICT.

The findings at school level based on the teachers answers shows that in the 6 countries compared, teaching activities are predominantly structured to achieve the traditional curriculum goals of assessing learning and preparing students for future education. However curriculum goals of lifelong learning and connectedness are also espoused by teachers. Thus there is a gap between what is aspired to and actual classroom practice. Teaching practices reflect this with using worksheets as a dominant activity. Science teachers in Italy are the one exception as they rate lifelong learning practices with students higher than either traditional or connectedness practices. Overall however, the study found that student practice in general is largely passive.

However when teacher and student practice with ICT was examined a different picture emerges especially for students. The dominant teaching activity (except for Finland) is still using ICT for traditional activities, though lifelong learning and connectedness orientations are also visible. Student use, on the other hand, reveals a much more connectedness orientation in usage despite the fact that their ICT-use is limited. Such difference could be seen as the growing gap between use by digital natives (students) as opposed to that of the digital immigrants (teachers). However this may be a rather simplistic analysis and perhaps other factors have to do with available technical and pedagogic support, training and type of ICT provision and access in schools are more likely to be key factors impacting on the types and degrees of use. Finally curriculum goals, teacher and student practices with and without ICT, teacher pedagogic activities and learning assessment were all more 21st century oriented for science teachers. More science teachers use ICT than maths teachers though in Italy it is approximately the same, and the study stressed that there appeared to be no obvious link between this and system-level factors such as actual ICT provision in the school.

Introduction

This chapter takes as its focus the SITES 2006 international comparative study and analyses and compares the findings in Italian schools with those in Norway, Denmark, Finland, France and Catalonia. SITES2006 looked at how ICT is changing teaching and learning practices in mathematics and science in 22 countries around the world.

A key aspect of most if not all of national education policies in the context of globalization, the knowledge economy and in the EU, the Lisbon agenda, is the integration of ICT into learning and teaching. Since the '90s governments have made major investments in infrastructure, connectivity, hardware and software on the understanding that such investment would transform education and contribute to the development of the skills and competencies needed for the new economic era. The time scales, scale and impact of this investment has been different in different countries. However, most current research including SITES 2006 indicates that the rhetoric of transformation is not reflected in the reality and there is much disappointment and soul-searching about the perceived 'failure' of ICT to deliver on its promise.

Research in this area reveals the multifaceted nature of ICT integration into learning and teaching and identifies a range of issues. 'Top-down' factors such a subject-based curriculum that is content-heavy, a strong focus on assessment *of* learning and the nature of school structures and processes are seen as supporting the status quo of traditional approaches to learning and teaching and contributing to the lack of impact of ICT in learning and teaching. .

However, 'top-down' is only one side of the argument. There is also much research on the 'bottom-up' teacher factors such as issues with the technology, lack of pedagogical and technical support, teachers' perception of need and lack of confidence and general resistance to change, all of which are seen as barriers to widespread ICT integration. (BECTa 2004,, Twining et al, 2006, Impact 2006, Cartwright & Hammond, 2007). Finally, a lot of current research is focussed on the impact of Web 2.0 and the user as creator as well as consumer, the uptake of web 2.0 technologies in the informal learning space and how the digital divide in terms of access and information is leading to considerable inequalities and exclusion (OECD, DR & Systemic Innovation, 2008, OECD report on Web 2.0 technologies, 2007). Taken together this combination of top-down and bottom-up factors at the levels of national system, local institution and teacher and pupil illustrates the complexity involved in embedding ICT.

It is within the context of this discussion and debate that, the findings for Italy, France, Catalonia, Norway, Denmark and Finland in the SITES 2006 study are analysed and compared.

Data for the SITES study was gathered at a number of levels: system, school and teacher. At each level a questionnaire was prepared and administered to the relevant personnel. Before looking at the data from the SITES module 3, a brief background of the overall research is necessary to understand its focus and development.

The first 2 SITES studies, modules 1 and 2 sought to define and characterise ‘emerging pedagogic practices’ in schools around the world. They defined these practices as follows:

“In brief, the emerging practices included those that described students as being actively engaged in, and responsible for, their own learning, that involved students in cooperative or project-based learning, that engaged students in searching for information, and that allowed students to work at their own pace and to determine when to take a test.”(SITES2006, p.6)

These new practices were in contrast to ‘traditionally important practices’ which they defined as:

“those that emphasized the development of skills, with all students working on the same materials at the same pace, and teachers keeping track of all student activities and progress.” (SITES2006. p.6)

Module 1 was targeted at policy makers to help them position their country *internationally* with respect to ICT in education. A questionnaire methodology was used and these were filled in by school principals and technology coordinators. Overall the findings from module 1 indicated that countries were investing in ICT, there were changes in schools with respect to emerging pedagogical practices and to some extent these changed practices included ICT. However there was significant variation within and between countries.

Module 2 took a comparative case study approach which identified and described innovative pedagogic practices using ICT based on 174 studies.. Specifically, they looked at the degree to which teachers*: “were engaging in constructivist, knowledge-building practices that integrated ICT into the curriculum and assessment.”* The study found many positive effects from the changed pedagogy including a changed role for the teacher to one that more guiding, supportive and monitoring and a changed student role to more independence and collaboration both within and between schools resulting in reported skills development in problem solving and collaboration. However, these practices had little overall impact on the curriculum nor did they disseminate in any major way. A key concept that emerged from this study was the notion of ‘connectedness’ whereby learners and teachers ‘connect’ with their peers and/or experts outside the school.

SITES2006/Module 3 is the basis of the present analysis and *“sought, through surveys of teachers, principals, and ICT coordinators, (1) to understand the extent of and the ways in which countries around the world accomplish ICT-integration in their classroom practices, and (2) to identify those factors that most contribute to the effective integration of ICT in learning and teaching” (SITES2006, p.16).*

The two key orientations in terms of 21st century teaching practice and learner outcomes at the heart of this study are ‘connectedness’ and ‘lifelong learning.’ The connectedness orientation is derived from module 2, however the notion of lifelong learning was introduced in module 3 to capture the global nature of education and the need for schools curricula to ensure *“…relationships between* *learning at school and learning in non-school contexts." (Young, 1999 in SITES2006, p.18).*

Four questionnaires in total were administered, 3 at school level (to school principals, ICT coordinators and teachers) and 1 at system level.

2.1 System-level comparisons of Italy, France, Catalonia, Norway, Denmark and Finland

At system-level a national context questionnaire (NCQ) which included open-ended and closed-ended questions was administered to the SITES national research coordinator (NRC). The questions covered demographics, education system, pedagogical trends, and ICT-related policies (data on demographics and technology from the UN Development program 2006 was also used).

- ***National contexts***

In terms of size, Denmark, Finland Norway and Catalonia have low populations numbers of less than 10 million. Whereas France and Italy have much higher numbers of 60.3 and 58.0 millions respectively. In terms of urbanization Finland and Italy are lowest with a total of 61% and 68% respectively. Norway has the highest GDP (38, 454) followed by Denmark (31,914), Finland (29,951), Catalonia (29,645), France (29,300) and Italy (28,180). Italy has the highest income inequality of the group (11,600$) followed by Catalonia (10,300$), France (9,100), Denmark (8,100) Norway (6,100). The country with the lowest income inequality was Finland (5,600). Italy has the highest cell phone penetration (1,090 per 1000), followed by Denmark (956 per 1000), Finland (954 per 1000), Catalonia (905 per 1000), Norway (861 per 1000) and the lowest is France (738 per 1000). Internet use per 1000 was highest in Denmark (696 per 1000), followed by Finland (629), Italy (501), France (414) and Norway (390). The lowest internet usage per 1000 of population was Catalonia (336*). (These figures on based on 2003 data and so will have changed since then.).*

- ***Management and Administration of funding for hardware/software/connectivity***

Denmark, Finland, Norway and France do not have primary centralised funding. Catalonia does and no information about Italy was given. Catalonia, Denmark, France, Italy and Norway all have centralised control of the curriculum. Finland does not.

The study also looked at how education systems managed hardware and software funding and acquisitions. The options given included: funds provided through a central facility, funds provided to schools, matched or partial funding provided by a government unit, government funds for internet connectivity, funding is an integral part of the school budget, no government funding.

The responses were as follows:

Catalonia: funds provided thro' a central facility, funds provided to schools, government funds for internet connectivity

Denmark: matched or partial funding provided by a government unit, funding is an integral part of the school budget

Finland: government funds for internet connectivity, funding is an integral part of the school budget

France: funds provided to schools, government funds for internet connectivity

Norway: funding is an integral part of school budget

Italy: No information given

- ***Expenditure on ICT in Education***

The data covers any increase or decrease in expenditure in the area of the 7 aspects of non-traditional practices in the last 5 years. It included expenditure on ICT including: internet connections and networking, classroom-based ICT, instructional technology support, professional development related to ICT in teaching, and school leadership development for ICT in learning. Italy had the highest increase in expenditure on ICT with a sum total response of 28 across the 7 aspects. This was followed by Norway, 25, Catalonia 24, and Finland 22, France 21. No figures were given for Denmark. The total public spending on education divided by GDP shows the lowest as Catalonia (4.5), followed by Italy (4.9), France (6.0), Finland (6.5), and Norway (7.7). The highest was Denmark (8.4).

- ***Teacher Certification***

Italy and Finland both selected the 'other' response to indicate the teacher certification requirements in their countries. Finland requires a master's-level university degree for teaching at Grade 7 and higher and all teachers have to take teachers pedagogical studies and basic educational or disciplinary studies as part of this degree. It was not made clear what is required in Italy. Catalonia requires any post-secondary degree plus a certificate in education, France requires any post-secondary degree, and Denmark and Norway require a post-secondary diploma and/or certification in the education field.

None of the 6 countries compared have an ICT-specific requirement for teacher certification, though Catalonia noted that private schools can and do specify such requirements, and several systems in the overall study (not named) said that such a requirement was encouraged though not required. Responses to requirements of between one and seven aspects of teacher professional development; Italy, Catalonia, Denmark, Finland and Norway indicated that none of the 7 aspects were required, whereas France indicated all 7 as being required. All 6 countries indicated that Government subsidy is provided for in-service or professional development for teachers covering ICT skills, use of ICT in subjects, use of ICT in administration and use of ICT for new approaches in learning.

- ### *Change in pedagogical practices/Non-traditional practice*

The data on 'change in pedagogical practices' was based on the sum of the answers covering six aspects of non-traditional practices including *individualised learning, inquiry-based tasks, collaboration for project-based learning, inter-classroom collaboration, interschool collaboration* and *international collaborative projects.* The question sought to ascertain if these practices had decreased or increased over the 5 years previous to the study. Italy indicated the greatest increase in non-traditional practice with a sum of 23. France and Finland indicated the lowest increase with a sum of 14. In between, Denmark was 15 and Catalonia and Norway 19. The study showed a median increase for *all* countries compared in the study as 20.

The data on *new pedagogies using ICT* was based on a sum of 5 new pedagogies using ICT including: student-centred pedagogies, online learning, connecting with other schools and cultures and collaborative team learning. Italy and Catalonia indicated 0 new pedagogies with ICT, Denmark and Finland indicated 3, France 4, and Norway was the highest at 5.

- ### *Education Policy and 21st century skills*

Data on ICT in education policy was based on 11 specific policy components including: clear vision, support for curriculum innovation, desired mode of integrating ICT in teaching, desired minimum level of access of ICT, desired internet connectivity, goal to reduce digital divide, attempts to ensure ICT access outside of school, teachers' PD requirements on ICT, stimulation of teachers' professional development in ICT, evaluation policy for ICT implementations and funding arrangements. Finland was highest with a sum of 9 out of the 11 education policy components, Italy 8, France 7, Denmark and Catalonia at 6 and Norway at 5. However, Norway indicated other policy components such as digital literacy as a core competency.

The study defined 21st century skills as having 2 components: *collaborative inquiry and connectedness* and in response to the question about the systems' policies which promote the approaches that mention 21st century skills, Catalonia, Denmark, and Finland said yes they mentioned 21st century skills in their policies. France, Italy and Norway said no. The country national reports show how 21st century skills are mentioned (or not) in policy as follows: *(I have summarised the reports and quoted in italics*).

Catalonia/Spain (within Country Region) :

> Focus on fostering pedagogical strategies to develop communication skills and build shared knowledge. *"Secondary education students must develop, across all school subjects and*

through the application of ..digital resources and devices, the information-processing and management skills they need to create text, support oral and distance communication, and work with numbers and figures." Also they should use multimedia for artistic expression. Teacher should have advisory, facilitator role. *"A key principle is that learner autonomy, ICT-skills and student values have to be developed in harmony"*

Denmark:

Danish government action plans indicate the need to: *"..increase student skills in ICT and the need to integrate new pedagogic opportunities into learning. In addition to requiring the purchase of computers, the action plans focus on better access to the internet, email, and virtual networks, increased use of ICT in relation to tests and examinations and increased integration of ICT in pre- and in-service training of teachers*."

Finland:

"Finland's ICT-skills-related strategic intent for year 2015 is that ICT will be inseparably linked to the daily life of citizens and organizations, and also to the ability of individuals and work communities to renew and continue to develop knowledge and learning…"

France:

"In 2006, France established the "IT and Internet Proficiency Certificate." This qualification specifies the ICT-skills development required at all levels of the education system. The emphasis is on subject-specific ICT-related learning activities."

Italy:

"In 2006, Italy established a national teacher training programme on ICT. This initiative, which is a continuation of the so-called 'ForTic' programme, involves implementation of a national web portal for technological training through a blended-learning modality. The programme has 3 main goals: improving teaching and learning processes, enabling students to master multimedia, and enhancing teachers' professional capabilities by providing them with training in the use and application of ICT."

Norway:

"The aim of Norway's multi-year " Program for Digital Literacy (2004-2008)…addresses the entire education sector. Digital literacy consists of basic ICT-skills, deemed equivalent to reading, writing and numeracy, and more advanced skills that ensure creative and critical use of digital tools and media, including tasks such as locating and controlling information from different digital sources. …the strategy focuses on the use and accessibility of digital learning resources. In the field of research and development, the strategy promotes innovative and pedagogical use of ICT at all levels of the education system."

2.2 School-level comparisons

2.2.1 Principals and Coordinators Questionnaires

Overall the questionnaires were designed to interrogate conditions in schools that might affect teaching, teachers and use of ICT, and any changes in pedagogic orientations between 1998 and this study. Of key consideration in these questions were the conditions for sustainable change, the vision for pedagogy in general and with ICT in particular and the measures taken by principals to put their views into practice.

The questions for principals looked at the schools' vision for ICT, ICT-infrastructure provision, and staff development opportunities. In terms of a leadership vision, the questions sought to gauge this vision in terms of connectedness, lifelong learning and traditional orientations.

- **Leadership**

The principals responses with respect to their leadership vision for pedagogy lifelong learning and connectedness indicated that Italy was highest and Finland lowest. In terms of traditional pedagogy the response was between Norway which was the lowest at 3.09 and France which was the highest at 3.49. Italy with Catalonia, Denmark and Finland, was in between. Interestingly, Norway was also lowest in terms of connectedness and second lowest in terms of lifelong learning. It is also noted in the report that in Finland *"..only 5% of the school principals considered ICT very important for improving the performance of students.."* Finland did not recognise ICT as a catalyst for change whereas within this subgroup of countries being compared, Norway scores highest as viewing ICT as a catalyst for change followed by Denmark, France and Italy, with Catalonia comparatively much lower and more in line with Finland. The report also notes that parental and/or community expectations have little impact in Catalonia and France. In summary, a comparison of the principals' views across the 6 countries can be summed up as follows:

1. **Italy** was highest in terms of the vision for LLL and Connectedness
2. **Norway** was lowest for 'connectedness and second lowest for LLL
3. **Norway** was highest in seeing ICT as a catalyst for change
4. **Italy** was second lowest in seeing ICT as a catalyst for change
5. **Finland** was lowest in seeing ICT as a catalyst for change

Questions looking at the potential barriers to ICT use by teachers identified factors such as type of courses available, type of pedagogic and technical support given.

- **Access, equipment, software, location ease-of-access, and maintenance**

Student/computer ratio

In the study a comparison is made between findings in the 1998 study and the 2006 study. There is very little difference in the availability of computers for grade 8 students in all 6 countries. While Finland, and Norway had 100% in 2006, Catalonia, Italy, and Denmark were close behind with 99% and France was lowest with 96%. However the picture changes when this availability is looked at in terms of ratio of pupil to computer. Norway is highest with a ratio of 1 pupil to fewer than 5 computers, followed by Denmark, France and Finland with a ratio of 1 to fewer than 10. However, the ratio in Italy is 1 to over 10 in most schools. The report notes that overall, serious inequities in terms of provision exist within systems.

In terms of change since 1998, Italy is the only country that shows a significant increase in the number of computers from 79% availability in '98 to 99% in 2006. France on the other hand shows a slight decrease from 100% in '98 to 96% in 2006. Finland, Denmark and Norway show no change and there is no evidence for Catalonia.

Internet Access

In terms of internet access all the countries except Catalonia (no evidence given) show an increase in internet access between 98 and 2006. Whereas this increase is slight for Finland ((96% in '98 and 100% in 2006) slightly more for Denmark (85% to 100%),

Norway (81% to 100%), and slightly more for Italy (73% to 99%), France shows the greatest increase going from 55% access in 1998 to 98% in 2006.

The research added a further dimension to this aspect by asking a question about the 'student-internet-computer' ratio to clarify the number of available computers that were connected to the internet. The findings were positive indicating the most computers available in schools are connected to the internet.

Hardware devices

One final area looked at in terms of access was the use of other devices such as laptops, PDAs, Smart Boards, graphic calculators and digital projectors (referred to as 'beamers' in the report). The report looked at their availability and the degree to which students brought their own. The report also includes a table on the availability of digital projectors and here all countries in the survey indicated less than 5 per school. However among the 6 countries being compared here, Italy scores lowest with 8% of schools with no projectors, 48% with 1, 43% with between 2 and 5, and 2% more than 5. By comparison Norway had 69% with between 2 and 5 and 12% more than 5, followed by Denmark, Finland, France and Catalonia.

Software Applications

|In terms of tutorial and general software and multimedia production, Denmark has the highest percentage of provision followed by Norway, France, Finland, Italy and Catalonia. Provision of data

logging software shows some interesting variations: Norway is the lowest at 28% followed by Denmark at 44%, and Finland at 64%. However, France is highest at 76% followed by Catalonia at 73% and Italy at 70%. Caution is needed when trying to interpret these differences but they may suggest a more traditional orientation in terms of using toolsets which 'automate' processes. There is clearly a gap between the usage in France, Italy, Catalonia and Finland and that of Denmark and Norway.

Simulations are highest in Catalonia (59%) followed by Denmark (53%), and France (50%). Denmark, Norway and Italy, on the other hand, use them much less at 21%, 34% and 37% respectively. Communications software is highest in Denmark (97%), Norway (95%), Finland (92%), and Catalonia (89%). France is lowest at 71% followed by Italy at 73%.

Web-based environments

In terms of Learning Management Systems (LMS), Italy was lowest with only 19% followed by France at 26%,Catalonia at 44%, Finland at 46% and Denmark at 51%. Norway was the highest at 70%. Equally in terms of email accounts for pupils, Italy was lowest at 14% and Denmark highest at 89%. France had 48%, followed Catalonia at 49%, Norway at 54% and Finland at 59%

However the picture is quite different for email accounts for teachers. Finland is highest at 97% followed by Denmark at 96%. Italy is lowest at 64%. Norway is 89%, followed by Catalonia at 88% and France at 78%.

Provision of Smart Boards is low in all 6 countries with Norway and Catalonia the lowest at 07%, followed by Finland at 10%, Italy at 11% and France 14%. Denmark are highest at 25%.

Finally availability of mobile devices is low in all 6 with Catalonia highest at 21% followed by France at 18%. Denmark, Finland and Italy are lowest at 11% and Norway is 13%.

Materials not available in schools, but which ICT co-ordinators would like to have.

The responses from ICT coordinators who were asked whether they perceived a need for the same range of applications and facilities mentioned in the previous section, suggested that provision in Italian schools compared unfavourably to the other 5 countries. The responses have been compiled in the table presented in annex 4 to illustrate this difference.

The following is a summary of the findings at school level based on the principals and coordinators questionnaires in terms of access and equipment:

- The ratio of student to computer is highest in Italy at 1 computer < 10 students. Norway is the lowest with 1>5 students
- Italy shows a significant increase in computer provision since the 98 study whereas France shows an actual decrease
- France shows the greatest increase in internet access from 55% in 98 to 97% in 2006. Italy also shows an increase from 73% to 99%

- Italy score lowest with respect to the number of digital projectors available in schools. Norway was highest
- France and Italy show lowest scores for use of communications software
- Italy has the lowest score for using LMS at 19%, followed by France at 26%. Norway is highest at 70%
- Italy is lowest in terms of email accounts for students at 14%. Denmark is highest at 89%
- Italy is lowest in terms of email accounts for teachers at 64%. Finland is highest at 97%
- Provision of Smartboards is low in all countries but Denmark is highest at 25% and Norway and Catalonia lowest at .07%. Italy is 11%

Among the 6 countries low priority for levels of computer: student ratio was given by Denmark followed by Italy. But whereas the ratio in Denmark is less than 1: 10 it is significantly greater 10 in over 60% of schools in Italy. However improving this ratio is not perceived as an immediate issue by principals. A related question to coordinators on the potential obstacles to achieving pedagogic goals due to insufficient ICT provision ranked insufficient bandwidth as highest compared to the other 5 countries. One final point of interest relates to the location of computers in schools. All countries in the study indicated that by far the greatest concentration of computers was in computer laboratories. In the subset of countries being compared here, Catalonia and Finland indicated the highest number of computers in laboratories and Norway the lowest.

• Support for teachers

Questions to ICT coordinators with respect to technical support indicated that in all 6 countries this support is provided mostly by the ICT coordinator. In Norway this support is available in all schools and is supplemented by support from other ICT staff in the school in over half of the schools, by teachers in almost three quarters of the schools and students in slightly less than half the schools. The picture is similar in the other 5 countries including Italy, though all these countries indicate a very small percentage of schools where students offer technical support. However when coordinators were asked the extent to which teachers had *technical* support when engaged in 11 different activities using ICT all the countries except Denmark indicated that there was little or no support available.

With respect to available *pedagogic* support, Catalonia indicated the lowest levels, followed by Finland, Norway and France, Denmark was indicated the highest levels of pedagogic support followed by Italy.

• Teacher training

Questions on staff training to develop teacher competence and confidence in using ICT asked what schools were doing to support their teachers in this area. A range of channels were indicated including informal contacts, the ICT coordinator, peer training by teachers, school group or committee, staff meetings, newsletter, courses given by an external agency, observation and discussion with colleagues and reading professional journals. Italy scored lowest on all of these activities compared to the other 5 countries especially in terms of observation and discussion with colleagues. And in terms of the different types of internal and external courses made available for the teachers, again Italy was lowest overall and this was especially significant in courses on multimedia use and courses on pedagogical issues related to integrating ICT. By comparison, Denmark had the highest percentages across all the courses provided. At the same time however, in areas of teacher training to do with developing a common pedagogical vision, managing the innovative pedagogical practice, ensuring teachers understand the relevance of developing student responsibility for their own learning, learning from peers outside school re best practice in ICT and promoting collaboration between teachers, in terms of priority, Italian principals ranked all of these as high priority except in the area of learning from outside practices.

2.2.2 Findings from teachers' questionnaire

The central questionnaire of the SITES2006 study was the one administered to teachers. Science and Maths teachers from some 400 schools were targeted and the questionnaire was designed to understand their pedagogic orientations. A total of 5 orientations were defined – 3 core and 2 additional ICT-based – as follows:

- Curriculum goal orientation
- Teacher practice orientation
- Student practice orientation
- ICT-using teacher practice
- ICT-using student practice

Information on these 5 orientations was further supported by information relating to teaching and learning situations including:

- Methods of organizing teaching and learning activities
- Types of learning resources used
- Assessment methods adopted
- Teachers' use of ICT for various pedagogical situations

- **Curriculum goals**

In order to establish how science and maths teachers prioritized their curriculum goals the following question which incorporated 12 goals in all was asked: 'In your teaching of the target class in this school year, how important is it for you to achiever the following goals?' (12 in all).

Findings across the whole population in the 22 countries indicated that the 3 highest ranking goals were: *increase learning motivation, prepare students for upper secondary education and beyond, and to improve assessment performance.* The lowest scoring was to; *learn from experts and peers from other schools/countries.* Also ranked low was *to prepare students for competent ICT-use, to prepare students for responsible internet behavior and to foster communication skills.*

The Box diagram below is taken from the Study and shows how the curriculum goals link to traditional, lifelong learning and connectedness pedagogic orientations

Curriculum-goal orientation	Specific curriculum goals included in the scales*
Traditionally important	• To prepare students for upper secondary education and beyond • To improve students' performance in assessment/examinations • To satisfy parental and community expectations
Lifelong learning	• To provide activities that incorporate real-world examples/settings/applications for student learning • To individualize student learning experiences in order to address different learning needs • To foster students' ability and readiness to set their own learning goals and to plan, monitor, and evaluate their own progress • To foster students' collaborative and organizational skills for working in teams
Connectedness	• To provide opportunities for students to learn from experts and peers from other schools/countries • To foster students' communication skills in face-to-face and/or online situations

This clearly shows that 2 of the top three curriculum goal priorities for teachers are traditionally important goals. (The increased motivation goal was not included for statistical reasons).

- ## Teachers practices

In another question looking at teacher practices, teachers were asked how often they engaged in a range of activities while teaching. These practices were divided into:

- *Traditionally* oriented practices such as demonstrations, giving instructions, assessing student learning, and engaging in classroom management to ensure orderly classrooms
- *lifelong learning* oriented practices such as tailoring instruction, providing advice and feedback to suit individual needs and guiding and monitoring open-ended enquiry, collaboration and team work
- *connectedness* oriented practice such as organizing and/or mediating communication between students and experts/peers, liaising with collaborators internal and external and collaborating with parents etc in support of student learning

Again findings indicated that across all countries the most common role for both science and maths teacher was that of traditional practice and the least common role was that of connectedness. With respect to the 6 countries being compared there was little difference with the degree to which the roles of their science and maths teachers were predominantly traditional with France seeming slightly less so than the others. The picture is largely similar for lifelong learning orientation. However in terms of connectedness in the teaching role Italy is significantly higher than the other countries. The Study notes that the stronger lifelong learning orientation with respect to curriculum goals suggests that though such orientation is espoused as a curriculum goal, it will require some time before this can impact on actual classroom practice.

Questions on the activities that students engage in, in the classroom were also categorized into traditional, lifelong learning and connectedness orientations as indicated in the box below which was taken from the study:

Student-practice orientation	Student practices (roles of the student)
Traditionally important*	• Working on the same learning materials at the same pace and/or sequence • Complete worksheets, exercises • Answer tests or respond to evaluations
Lifelong learning	• Students learning and/or working during lessons at their own pace • Determine own content goals for learning (e.g., theme/topic for project) • Explain and discuss own ideas with teacher and peers • Give presentations • Engage in self- and/or peer-evaluation • Reflect on own learning experience
Connectedness	• Collaborate with peers from other schools within and/or outside the country • Communicate with outside parties (e.g., with experts) • Contribute to the community through their own learning activities (e.g., by conducting an environmental protection project)

(SITES2006)

Once again findings across all countries revealed student practices in both maths and science classes as being predominantly traditional, the most statistically reliable and valid indicator being *'completing worksheets and exercises'*. The least common practices were those to do with connectedness. However Italy was the only country across all the countries compared where lifelong learning student practices were rated highest by science teachers, followed by traditional and then connectedness. Overall student practices generally indicated that students play a more passive role and it is teachers who can and do engage in pedagogical activities. Student engagement is even less if 21st century activities are involved.

• Teachers and students practices with ICT

There are some interesting variations when teachers and students practices *with* ICT are examined. Data on the use of ICT in science and maths classes revealed that science teachers were more likely to use ICT than maths teachers though overall its use was mainly within a traditional orientation. When teacher overall practice was compared with ICT-using teacher practice the evidence indicated that in Finland, for example, teachers using ICT were more likely to avail of its possibilities for connectedness. Among the 6 countries being compared here it is the same, that is, except for Finland which showed a more marked connectedness orientation in ICT-using teacher practice, all the other 5 countries have similar orientations in overall teaching practice and in ICT-using practice which is a traditional orientation. However there are some variations for example, after traditional, France indicates a more lifelong learning orientation with ICT than one associated with connectedness. Denmark and Norway by comparison are connectedness oriented than lifelong learning and Italy shows a slightly stronger lifelong learning orientation that connectedness.

When student practices were examined it was found that students were more actively engaged when using ICT than they were in the non-ICT classroom In terms of student practices generally and those with ICT in particular, the data shows that use of ICT is changing student practice much more than teacher practice despite their relatively low overall use of ICT. The data also indicated that their orientation was more strongly connectedness. In Catalonia, Denmark, Finland and Norway students' connectedness orientation with ICT was greater than the teacher orientation in this area. In France it was the same as the teachers' and in Italy it was less than the teachers. In terms of pedagogical activities that teachers engaged in, both maths and science teachers used traditional activities such as practicing procedures and giving lectures most. However science teachers had a wider range of activities including extended projects, product creation and looking up information and ICT use was mostly to support these activities.

3. Inspiring national initiatives and practices

Several pieces of evidence, PISA and SITES included, supports the fact that the use of ICT in schools generally doesn't reflect their full educational potential. Some observers even underline the lack of understanding of their full potential. Holistic approaches have nevertheless inspired recent national initiatives, and continue to do so with a view to remedy to this situation.

Some of these national initiaves are presented hereafter. Some of them are subject to evaluation reports – to be soon available - that can only of utmost interest.

Some pilot projects developed at school level with a view to foster innovative technologies are also presented to reflect bottom-up initiatives developping throughout Europe[9].

3.1 National pedagogically innovative interventions

• *Austria: FutureLearning Programme (2007-2010)*

ICT is now part of a specific 'ICT in education' policy: the FutureLearning Programme (2007-2010), a development of the eFit initiative. It fosters a new concept of ICT, linked to the opportunities provided by Web 2.0. Interactive whiteboards as well play a central role but mainly in secondary education. FutureLearning aims at connecting pupils, teachers and students to a web-driven communication and learning tool ("Mobile Computing Interface") and to adapt learning to individual and school needs. With a budget of €15m, it targets pupils and school students aged 6 to 19, adult learners, teachers and special target groups such as isolated children and children in hospitals – project IICC, migration pupils, and mentally and physically disabled pupils. It involves schools, service providers, public-private partnership with ICT and ICT training companies. The FutureLearning project strands of activity include:

- Digital content and ICT services;
- Social software and Web 2.0 at school;
- New equipment (sub-laptops, mobile phones for learning, PDAs, iPods);
- Teacher training (e-learning didactic courses, online academies, eBuddy/eTutor concepts, real time platforms, eGovernment content for teachers);
- Equipment guidelines and initiatives for all schools;
- Reduction of barriers for specific target groups;

[9] The information presented hereafter has been kindly provided by Roger Blamire (European Schoolnet).

- Quality projects in schools and integrated use of ICT, e.g. arts and creative projects with institutes such as Ars Electronica Center Linz.

- ### *Denmark: ICT in Public Education*

The Danish government initiated the Euro Policy Programme (2004-2007/08) “ICT in Public Education” with a budget of €66 million spent on purchasing computers for 3rd grade children. It was co-funded by municipalities for a total of more than €116 million. The programme also included grants (based on open tenders) to publishers to develop comprehensive ICT based content; content and services on the national portal for education (www.emu.dk); pupils’ ICT licence; interactive whiteboards; a national repository platform for learning resources (Materialeplatformen); professional development for teachers; grants for virtual learning environments and LMSs allowing all schools to choose and purchase them; and support to a network of ICT innovative schools. A report on the evaluation of the programme is to be published in the Autumn 2009.

- ### *Norway: Programme for Digital Competence*

The 'Programme for Digital Competence' covers primary and secondary education and training, higher education and adult learning. The vision of the Programme is digital competence for all. The Programme’s priority areas are: infrastructure, competence development, research and development, digital teaching resources, curricula and working methods. Digital competence builds bridges between skills of reading, writing and doing arithmetic; it includes the competence required for using new digital tools and media in a creative and critical way. The Programme had the following four main objectives to be reached by 2008:

- Access to high quality infrastructure and services;

- Digital competence at the heart of all levels of education and training. All learners, inside and outside schools and universities/university colleges, must be able to use ICT in a secure, confident and creative manner in order to develop the knowledge and skills they need to fully participate in society;

- The Norwegian education system should be one of the best in the world as regards to the development and use of ICT in teaching and learning;

- ICT should be an integrated tool for innovation and quality development in Norwegian education, based on organisational and working methods promoting learning and innovation.

The evaluation of this ongoing programme by the University of Oslo highlights that, despite the improvement of ICT infrastructure, the use of ICT in schools does not reflect the increased possibilities. Moreover, there is a lack of a holistic understanding of digital competence, making policy-strategies often too specific and narrow.

3.2 School pedagogical innovation

GERMANY: Moodle-based experimental science teaching for immigrant pupils with learning difficulties

eXplorarium, Berlin, http://show.elearning-erkunden.de/ - Ten schools in inner Berlin with up to 90% immigrant pupils from low-income families with learning and language difficulties use eXplorarium, a scientific workshop based on Moodle. It provides teaching plans which combine constructive learning and modern didactics of media studies. The project fosters students' expertise concerning subject matters, media competences and language skills through an exploring and constructive learning approach which is the basis for the development of all courses. There is no training-software or downloading of worksheets, but interesting tasks related to research and exploring, with individual feedback to questions, thoughts and results of the students.

- *Outcomes*: The learning-process becomes transparent to all participants when observations and research-findings from the real world are transferred to the digital one. Children's individual approaches to different tasks become visible and the students have extensive possibilities to communicate and present their results. Projects are designed for interdisciplinary lessons and for joint teaching of different grades. By using ICT as a learning tool, students can learn at any time in any place. In notebook classes, whose numbers are increasing, working with ICT is becoming very active, flexible and the results are self-evident.
- *Enablers*: eEducation Masterplan Berlin.
- *Challenges*: Convincing older teachers to use ICT and teachers in general to use new methods in teaching.

DENMARK: Flexible organisation to enhance learning process

Sondervangskolen, Hammel, http://www.soendervangskolen-hammel.dk - Sondervangskolen is in the Jutland region, 25 km from Arhus. There are 700 pupils, comprising special needs or severely handicapped children, and 80 staff including teachers and social workers.

The main focus of the school is how children can learn better and how the school can be organised to help them concentrate more. The role of the school is seen as creating knowledge instead of giving knowledge. Space organisation and ICT availability in classrooms and the library are flexible in order to respond to these needs. Computers are located against the wall with specific arrangements to attach the keyboard and mouse. There are two pupils per computer in order to communicate and help each other. Chairs on wheels allow other configurations for learning and space for children who need to move. Children can also learn while relaxing on a couch or in the cinema room. Strong evidence of the impact of ICT can be found in the way learning processes has been developed and in the tools and strategy adopted to improve learning.

In the Mlearning project, under the "School of tomorrow" initiative, pupils went to school one day a week and worked from home the remaining four days. They kept in touch with the teacher by text messages on mobile phones, photos and wikis.

- ## *FINLAND: A VLE for science self-regulated learning*

Oulu Teacher Training School, Oulun Yliopisto, https://norssiportti.oulu.fi - An 8-week intervention project was directed to 4th graders involved in a science activity. Teaching practices and pedagogical methods were aimed at promoting self-regulated learning. The students' way of work (2-3 lessons per week) included classroom lessons supported by a virtual learning environment called gStudy. gStudy provides an environment to enhance and analyse learners' SRL. It can be used for providing students with learning kits in science and for supporting them with a set of tools to self-regulate their learning.

- *Outcomes*: When students work using gStudy, their trace data can be collected to allow researchers to track back students' actions. The project forced pupils to create a link with their learning process: they had to think about their own goals and to set up a plan in order to achieve them. Surprisingly, the role of the teacher was so different from what is used to be.
- *Enablers*: Development of school libraries; cooperation with the Faculty of Education; laptops.
- *Challenges*: Narrow understanding of the learning process; lack of understanding of Web 2.0 tools; the limited time a pupil can spend a week in using ICT.

- ## *FINLAND: Integrated use of ICT in teaching practices*

Mäntymäki primary school, Mäntymäki, http://www.mantymaki.fi/ - Mäntymäki public primary school is one of the three Finnish schools in the town of Kauniainen (Fi) /Grankulla (Se), located about 15 km West from Helsinki. It is situated in a bilingual region (58% Finnish speakers) and offers Swedish language immersion as a teaching tool for one third of the pupils. There are about 350 pupils and the classrooms have small numbers of children per class (about 20/class). In the last years the number of pupils has declined, so in the future the school aims at attracting children from the town nearby. The school building is in a very good condition, dating up to the 50s with annexes added later. The computers are located in classrooms and in a number of other different areas in the school (e.g. library), where teachers and pupils can easily access them. Mini-laptops are currently being piloted. As all the computers are thin-clients, any pupil can log-on to any of the computers and access their personal data files. The school also has its own wireless network.

There are 18 full-time teachers, 4 teachers with Special Education skills, 9 class assistants, additionally 4 teachers give lessons in subjects such as Islam, German, dance and hand craft. Lower classes start with about 20 hours a week. Since a few years, the school is obliged to offer after-school activities to pupils, 70% of the parents have signed-up for a 3h/day or 5h/day option. They include clubs and possibilities to do homework, but mostly focus on non-educational activities under the supervision of the class-assistants.

The school has integrated ICTs in many of the teaching practices. Besides computers, teachers also have beamers and overhead scanners that allow displaying parts of a school book through the projector on the wall. During a science class, 5th grade pupils watched a video about black holes provided by the Finnish Broadcasting Company YLE through their educational portal "Areena". It was mostly in English with Finnish subtitles. Pupils sat in groups of four and teacher's desk was on the side of the classroom. During another lesson, first grade pupils used the new mini-laptops to write a story about Finnish Easter traditions. The assignment asked to describe what happened before the picture was taken, during and after it. All the pupils had a mini-laptop at their disposal with a Finnish distribution of Linux and OpenOffice.

- ### *NORWAY: Individualised Learning Management System*

Røyse Skole, Røyse, http://www.royse.gs.bu.no – The school has introduced a learning management system in the 5^{th} and 7^{th} grades. It is an individual, digital working plan connected to a digital work space whose aims are to increase flexibility in layout, periods, learning styles, methods and learning resources, and improving home-school linking. All teachers, students and parents had training sessions, including teachers from other grades as the school would like to scale the use of the learning management system up to all the classes of the school.

- *Outcomes*: The University of Oslo has followed the pedagogical process related to individualised work plans, and the school's ICT plan was designed according to the results of this pedagogical discussion. All teachers took part in the discussion and together designed a model of their ICT plans. A strong pedagogical basis has been proven necessary for a successful technical solution.
- *Enablers*: Digital competence is one of the five basic skills in the Norwegian curriculum. The local authorities have decided to strongly focus on the use of ICT in schools and have given extra money outside the ordinary school budget in the last 7-8 years in order to realise this. People interested in doing research on the use of ICT have followed different ICT projects at the Godoy school during the last 10 years.
- *Challenges*: School leaders, in-service teachers and student teachers often have little or no competence in the pedagogical use of ICT. Even bigger is the gap between the way children, born into a digital world, approach the use of ICT in their learning-process and the way school leaders and teachers think they should approach it, still based upon their personal feeling of a 'stranger element' coming into their lives.

- ### *PORTUGAL: Collaborative learning and teachers' role in laptop programme*

Rossio ao Sul do Tejo Primary School and Chainça Primary School, D. Miguel de Almeida School Cluster Group, Abrantes, http://mochoxxi.abrantes.pt/index.php - Abrantes is about 160km from Lisbon, in the geographical centre of the country. It has both a rural and a urban population. In this area, the Mocho XXII Project was promoted by Abrantes City Council and funded exclusively from the municipal budget.

The project is now in its fifth year. It was a project designed for laptops to be effectively used in the classroom, as a gradually implemented integrated training strategy. The standard equipment was one computer for every two pupils in order to promote cooperation and sharing amongst learners, with a connection to the teacher's computer and a wireless connection to the internet.

It was recognised from the start that teachers play a central role in the implementation of this kind of project. Two teachers were identified as key actors in all project phases, from colleagues training and accessibility of digital learning resources to software choice. Therefore teacher training has always been considered a priority, and it was implemented in conjunction with the municipality's continuing training centre for teachers.

The most profitable year in the project's development was the second, because the teachers participated on a voluntary basis. In Year 3, considered the worst year, all schools including those with the oldest teachers and the largest classes in the urban area were involved. In Year 4, the project was extended to the whole municipality. Pressure from parents and pupils was felt for the success of the use of the laptops in the classroom. At the moment, the project involves 80 primary school classes.

The tools most used among teachers for sharing and discussion are e-mail and the Moodle platform. In Moodle, training resources created within a training context and intended for pupil use are shared and made available. Blogs are also used a lot at class level as a way of production and dissemination of the activities carried out.

ICT skills are learned, above all, in the work in pairs: the pupils teach each other to use the computer. A strategy used by some teachers is to teach a new function or software programme to a small group of pupils who afterwards go and teach their classmates.

- ### *SWEDEN: Skilfully managed group 'play'*

Grevegårdsskolan, Gothenburg, http://www.goteborg.se/wps/portal/grevegardsskolan - Grevegårdsskolan, an all-age school from grade 1 to 9 (end of compulsory schooling), is located in a green and socially mixed area in a suburb of Gothenburg, Sweden's second biggest city. It brings together about 500 children from very different backgrounds who interact together in a harmonious atmosphere.

The educational setting is characterised by a well thought-out structure and an emphasis on learners' conscious choices. The educational goals are high and in line with the Swedish curriculum. The 75 teachers in the school aim to create an attractive and playful environment for the young children. Although some of them need very clear rules, teachers talk with the children in a cheerful tone of voice and in a respectful way. There is a large range of activities on offer and children choose themselves what they want to do. The children also take part in short or long projects, mostly individual choices but teachers prioritise those that arouse other children's curiosity, so an individual initiative often ends up as a common activity.

One of these is the 'Swedish Eurovision Song Contest'. By entering 'youtube' in a search engine the children enter the internet and watch, read about, and listen to their idols. They grab microphones, sing and dance, interacting with each other and the artists on the screen. Every child prints out pictures and writes spontaneously about the singers and their performances. Spelling and grammar are not important at this stage, only joy and self-confidence. The child who is most keen to write is shared by the group and even the most timid child is involved in activities thanks to other children's enthusiasm and teachers' supportive attention.

Describing their educational values, teachers emphasise bringing children's everyday experiences into the pre-school and finding opportunities in their play that help children learn.

- ## *SLOVAKIA: Robotic toys and Dalton pedagogy*

Primary Junior School, Strediskova, www.zslieskovec.edu.sk - The school applies the Dalton pedagogical method, is specialised in informatics teaching since the first grade and makes use of ICT in all subjects. One of the projects pupils have carried out is the building of a house using animations of simple machines (e.g. pulley) and the shooting of the related LEGO-movie. The eldest children shot as well a LEGO-movie called "the traffic education for the Abecedarians". In general, children are able to make animations, do projects, and searching pictures and information on the Internet. They also play non-typical games such as T-Ball and keep their own blog where they publish their works.

- *Outcomes*: The children learn surprisingly fast using ICT and can express their creativity. They also help and teach to each other how to use ICT. For the teacher, preparing lessons is more demanding, but the results are more interesting and effective.
- *Enablers*: Being a pilot school in the Infovek project, introducing ICT in primary schools; Strategy of ICT in Primary and Secondary Education; Strategy for the Information Society in the Slovak Republic.

Barriers: More equipment (robotic toys) needed.

- ## *UK: Linking home and school*

New Invention Junior School, Willenhall, www.invention-j.walsall.sch.uk - New Invention Junior School is in Willenhall, a former coal mining town to the north of Birmingham with a population of 40,000 and historically famous for the manufacture of locks and keys. Some 350 children aged from 7 to 11 are taught by 14 teachers.

The school's use of a learning platform led to a national ICT Excellence award in 2007 for extending learning beyond the school. The school has learnt much in five years' use of the system, particularly about learners' use of it from home. When the system was changed to another product, 11 year-old pupils were involved in reviewing the competing products. They – and the teachers – wanted a system that empowered them and allowed for creating and storing their content, blogs and a personal learning space accessible to all. The social networking aspects of the learning platform have allowed and encouraged the students to review each other's work critically. As on Facebook, students are able to display as much or as little of the Personal home page as they want to others; these are important skills at such a young age. By allowing students their own home page, teachers can often gain some insight into what motivates the child outside school and the school has used this to good effect in the past. (e.g. one child's very detailed knowledge and interest in astronomy). It also allows students to show what they consider to be important and gives them more self worth – they also seem to put in a considerable effort into making this "a good piece of work".

- ## *UK: Parental engagement to reduce community digital divide*

Prince Albert Junior and Infant School, Birmingham, www.princealbert.bham.sch.uk - Prince Albert is a very large inner city primary school in Aston, Birmingham, a socially deprived area populated by a range of different ethnic groups. In a 2006 survey Aston was identified as a ‘significant divide’ community because of its low levels of home computer ownership (15% of homes against the national average of 89%). Almost all 729 pupils aged 3 to 11 come from a Pakistani or Bangladeshi background and speak English as an additional language.

Parental engagement is a major strength of the school. A prime example is the school’s involvement in the Aston Pride Computers in the Home project. The school manages a scheme operating since 2006 to provide computers in the home on behalf of eight schools in the Aston district of Birmingham, charging parents €11 a month by bank transfer for a laptop, educational content, technical support and internet access. The Aston Pride Computers in the Home project aims to address digital divide issues and reduce disadvantage, develop family ICT skills, and to use the child as the educator of the community. 365 children aged 6 to 10 and their families are involved. The school has been awarded the Becta Best Whole School Award and a special award for community engagement. On average 7.6 people use each home computer, parents typically for accounts, shopping online and to access school data about their child’s progress, while children for completing homework assignments. Home computers have the same software installed as the school and internet access is through the Birmingham Grid for Learning (BGFL).

The school has been using BGFLplus for six years as its learning platform, but is developing the use of Moodle. Online activities are popular in which children compete live against peers in other schools, using Mathletics for example. Honeycomb enables children to collaborate with other schools, adding stickers, photos and audio comments to other children’s work. Education City provides personalised mathematics activities for pupils, so that if they have difficulties the system generates remedial activities. Children work over the weekend to complete assignments, do far more than they are set, and continue to use the system during holidays. The school runs sessions between 9 and 10 am for parents after they arrive with children, a six week ‘course’ presented not as training for parents but as a way to help their children make progress in their education. Children make presentations to parents during these sessions.

4. Conclusions

Access, still an issue

The analysis presented above shows evidence about a remaining lack of access to equipment in the broad sense (hardware, software, connectivity, maintenance, emails accounts for students and teachers, etc.) as well as digital content, over the whole Italian national territory and to a broader and sometimes alerting extent in some regions. This evidence comes from the PISA 2006 analysis in relation to ICT use in education, and is confirmed by school principals', ICT coordinators' and teachers' answers to SITES 2006. This lack of access can refer to an insufficient number of computers and other devices, difficulty in accessing them (when they are concentrated or locked in a dedicated classroom/laboratory instead of being spread throughout all classrooms), as well as a lack of technical support and maintenance to guarantee their proper use. This issue about access can be addressed through holistic approaches also simultaneously targeting other measures at a more qualitative level (teacher training in ICT-based pedagogy, change management action plans, etc.) as done in other countries. Access to ICT at school level represents a fundamental condition for a concrete and significant uptake of ICT in learning and teaching processes and should still be on the agenda of Italian public action in the field.

Efficiency of investment and policies

Italy has already largely invested in ICT in education, even to a higher extent compared to other European countries, not only in terms of provision, but also in teacher professional development and other qualitative dimensions. Evidence shows that this effort has nevertheless not met all expectations. The way initiatives in this field have been implemented and obstacles faced, could partly explain this. As far as we know, there are no existing proper evaluation studies,to explore these factors, yet it would seem they deserve some attention. Portugal's profile in the PISA 2006 analysis is interesting precisely in this respect. With lower investment and a higher pupils/computer ratio compared to Italy according to PISA 2006, the use of computers at school by the Portuguese seems to reach a much more satisfactory level. We have not been in a position to analyse the reasons for this in the framework of the present report. Results from the STEPS study[10] do show however that Portugal has implemented high level quality teacher training programmes with the involvement of universities, a curriculum in which ICT has a central role and teachers are given the room and time to experiment with it, as well as spread access to computers within the whole school and not only in dedicated classrooms. These factors, also possibly associated with an open-minded culture and good support by local authorities, can be considered as possible reasons explaining a better use of ICT by students. Investigating the way in which these various dimensions affect the way ICT is implemented in education in Italy, with or without comparing it to other countries, would give much better knowledge on the key elements for success. Developing concrete initiatives and an evaluation culture of public action in the field of ICT education could only bring a useful understanding of the situation as well as an opportunity for all the partners involved (teachers, heads of school, etc.) to build common reference frameworks.

ICT and innovative pedagogy

Concerning the relationship between ICT and the development of innovative learning and teaching processes, evidence from SITES shows that the presence of ICT doesn't favour as such non-traditional approaches. Compared to other countries, Italian school principals, ICT coordinators and teachers seem to be particularly convinced about this. What we learn from the PISA 2006 analysis even suggests that it could function the other way round: science teaching methodologies, when based on personal research, hands-on work, and application of models to the external world, is significantly correlated with an educational use of ICT by students. The PISA 2006 analysis also shows that if no correlation is observed between attainment levels in science, interest for science is correlated with an educational use of ICT by pupils. Additional investigation is needed on these two issues, but available evidence nevertheless suggests that public action to support the pedagogical use of ICT can only be beneficial in associating it with the development of a general scientific culture. It also suggests that the development of innovative teaching and learning processes needs clear initiatives focusing primarily on such pedagogical orientations in association with the use of ICT.

The confidence of Italian youngsters in their differentiated skills and competences

Another direction in which public action to support ICT-based innovative pedagogy could be

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[10] STEPS, Study of the impact of technology in primary schools) study, has been realised in a partnership between Empirica and European Schoolnet for the European Commission and should be published before the end of 2009

developed, is to address the lack of confidence of Italian youngsters in their basic ICT skills, as reported by PISA, and at the same time building on the rather good results of Italian youngsters in higher level ICT skills, again as identified by PISA. An *ad hoc* and detailed analysis would be needed here to better understand the situation and be able to make recommendations. At the very least an attempt to better understand this confidence declared by Italian youngsters in advanced ICT tasks (spreadsheets, presentation, etc) in PISA, could be provided by the SITES findings. These findings suggest that in some countries, Italy included, ICT use is not changing teachers' overall pedagogic practice nor students' overall practices, and even sometimes reinforces the traditional methods, i.e. fairly traditional usage, 'simply' digitising what they previously did with pen and paper. Indeed, results of Italian youngsters are higher compared to other European youngsters in using a processor to write school essays and create a multimedia presentation.

Internet versus *mobile devices in education*

A cross analysis of PISA and SITES 2006 data reveals that communication on the Internet (chat, etc.) is less used by Italian youngsters compared to other European 15 year-olds, and that Italy has the highest mobile phone penetration (1,090 per 1000), followed by Denmark (956 per 1000), Finland (954 per 1000), Catalonia (905 per 1000), Norway (861 per 1000), the lowest being France (738 per 1000). Concerning the first observation, ICT coordinators in Italian schools felt that insufficient bandwidth was an obstacle to Internet use. They also felt that provision of email accounts for both teachers and students was inadequate which may relate to why PISA found Italian students used both email and the internet less often. If bandwidth is inadequate and access ratios very high, teachers may be put off by the impact of speed issues on lesson timing and classroom discipline. Students quickly get bored if they have to wait to connect to the internet. Concerning the second observation related to mobile phone penetration, it has to be noticed that texting as a communication device is probably the most popular technology amongst young people. Could this explain why chat rooms are less popular with Italian youngsters? This hypothesis could be investigated further, having in mind that recent trends in several countries rather advanced in introducing ICT in education, as Denmark and the Netherlands for example, are developing more and more pilot projects related to the use of mobile devices in relation with the learning and teaching processes geared to 21st century education. Could this be an advantage for Italian youngsters who are already so familiar with these mobile technologies?

As a conclusion of the cross analysis between the two international surveys

User profiles defined in PISA give a convincing picture of the current status quo with respect to ICT use in schools. When they are cross referenced to SITES findings, the reasons for this status quo become clear and provide evidence of the fact that ICT use is predominantly traditional, and access limited. Thus, once again, a lot of the findings suggest that teacher training and support, coupled with adequate provision and clear indicators that vision is being translated into practice, are the key issues.

As a concluding remark: the need for high quality experimental research and analysis to deepen findings from international surveys, especially when refocusing issues at national level

PISA, and SITES to a much lesser extent, are two international, comparative studies influential in determining large aspects of national education policies. They offer recommendations with respect to what teachers and schools need in order to change their pedagogic orientation, and identify standards in learning outcomes that set the benchmark for performance at national level. They have a profound impact and as such, have also been subject to much research analysis and scrutiny from different angles. They are nevertheless of immense value in giving a 'global' picture of what is happening and setting out the issues, as shown by the cross-analysis presented here. At the same time, when it comes to using evidence to inspire concrete public action at national level, the present analysis has clearly shown that high quality empirical investigation is needed to better understand, deepen and re-contextualise the evidence collected, and test hypotheses through the implementation of pilot initiatives requiring thorough and timely evaluation.

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Annex 1

Table A: "Program and software use" index by student's gender and socioeconomic level

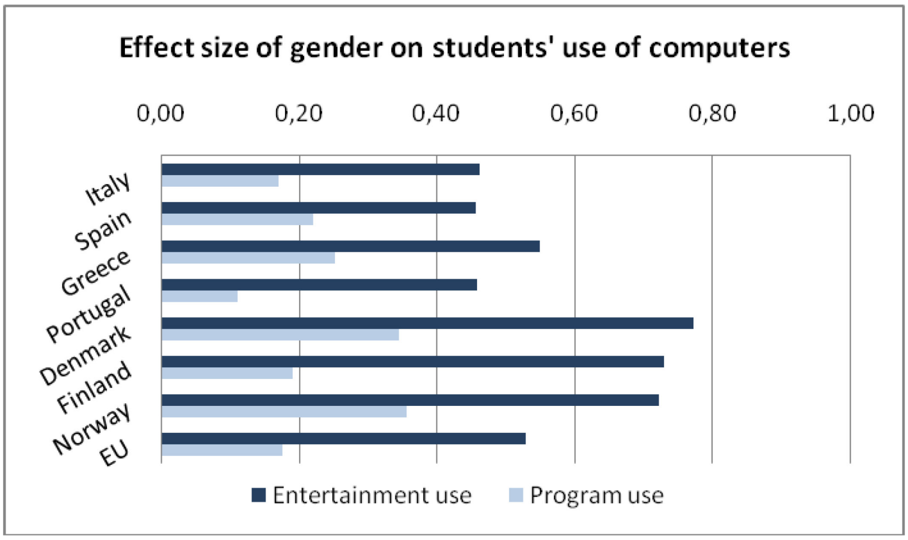
	Italy		EU	
Mean index	0.02	0.02	0.00	0.04
Index for girls	-0.07	0.02	-0.09	0.05
Index for boys	0.11	0.02	0.08	0.05
Index for the 25% most disadvantaged	0.03	0.03	-0.01	0.06
Index for the 25% most advantaged	-0.01	0.03	0.03	0.06

At the international level, the differences by groups (girls/boys, advantaged/disadvantaged) cannot be directly compared, because of the varying distribution of the index among the countries. The differences in the indices between groups have therefore been translated into effect sizes, which are then comparable. Effect size measures the difference of an index between two groups, for example the use of programs and software by girls and by boys, relative to the mean variation of this index for boys and the girls in the country. In practice, effect sizes under 0.20 are regarded as weak, those of the order of 0.50 as medium and those over 0.80 as important.

Figure A1 shows the effect size of gender on the two indices of computer use; Figure 18 shows the effect size of socioeconomic level.

The effect size of gender (in favour of the boys) on the entertainment use index is marked in all the countries appearing in Figure 17. In the Nordic countries, it is particularly important. The effect size of gender on the program use index is negligible for the European Union in general and for Italy in particular. The girls and boys thus seem to be separated more in play activities than in more serious activities.

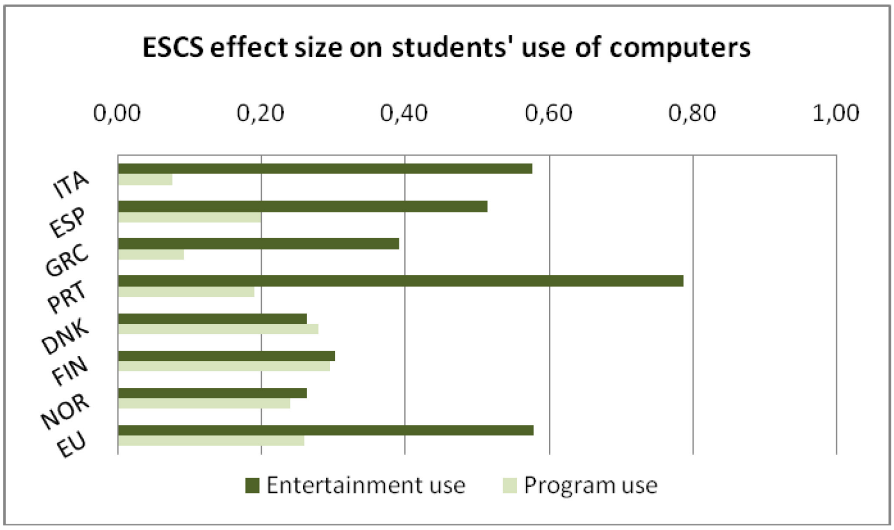
Figure A1: Effect size of gender on students' use of computers



The effect size of socioeconomic level on entertainment use of computers is relatively variable from one country to another. Figure 18 shows it to be considerable in Portugal and relatively important in Italy, Spain and the European Union in general, whereas it is fairly low in the Nordic countries. This is partly explained by the smaller variance of socioeconomic level in the Nordic countries and the greater variance in Portugal. The 25% most disadvantaged students in Portugal are significantly more remote from the advantaged students than in Finland or Norway.

For the second index of use, the effect of the student's socioeconomic level is very weak. It is weakest, and negligible, in Italy.

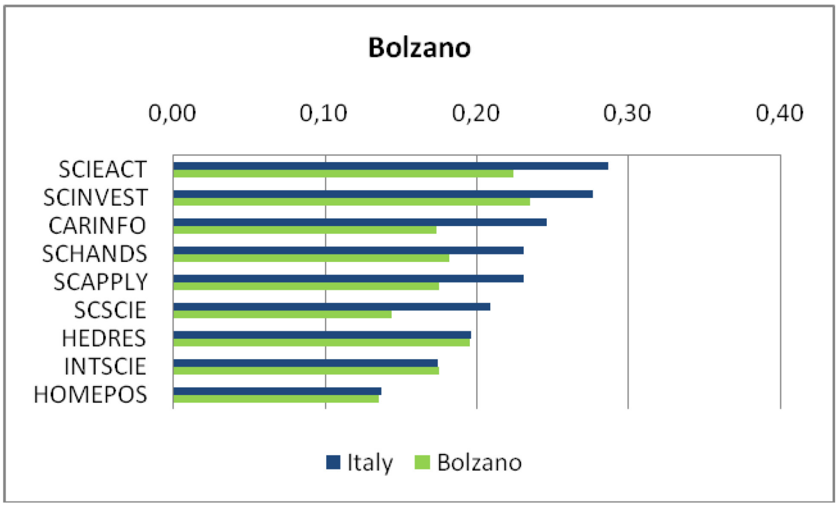
Figure A2: Effect size of socioeconomic level on students' use of computers



Annex 2

The Autonomous Province of Bolzano shows markedly weaker correlation coefficients than the Italian average for all indices except those related to home possessions and interest in science.

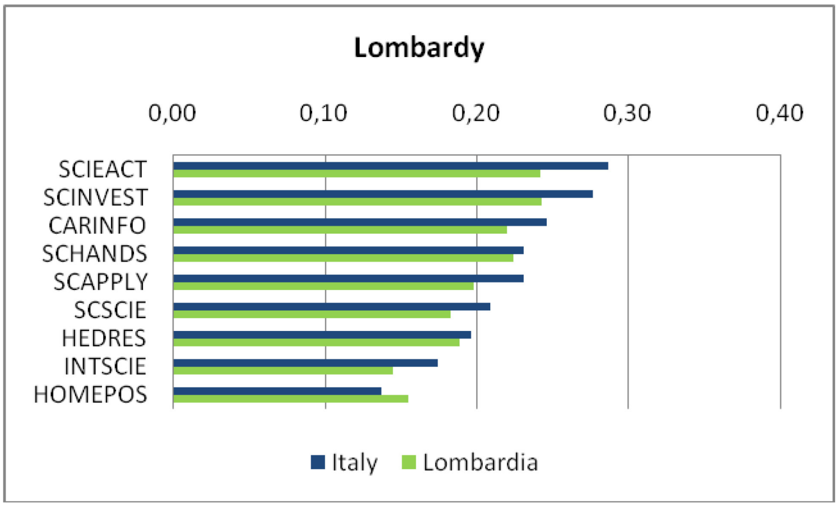
Figure B1: Province of Bolzano – Correlation coefficients between the PRGUSE index and the component variables[11]



Case two: Lombardy shows correlations close to the Italian average. This is also true for Puglia, Basilicata, Liguria and Piedmont.

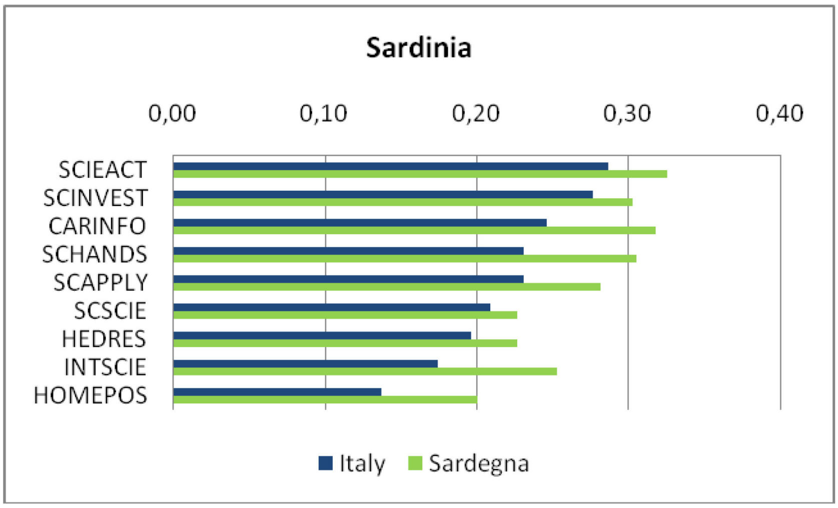
[11] SCIEACT: taking part in science activities, SCINVEST: science teaching with student investigations, CARINFO: student information on science-related careers, SCHANDS: science teaching with hands-on activities, SCAPPLY: science teaching with models or applications, SCSCIE: science self-concept, HEDRES: home educational resources, INTSCIE: general interest in learning science, HOMEPOS: home possessions.

Figure B2: Province of Lombardy – Correlation coefficients between the PRGUSE index and the component variables



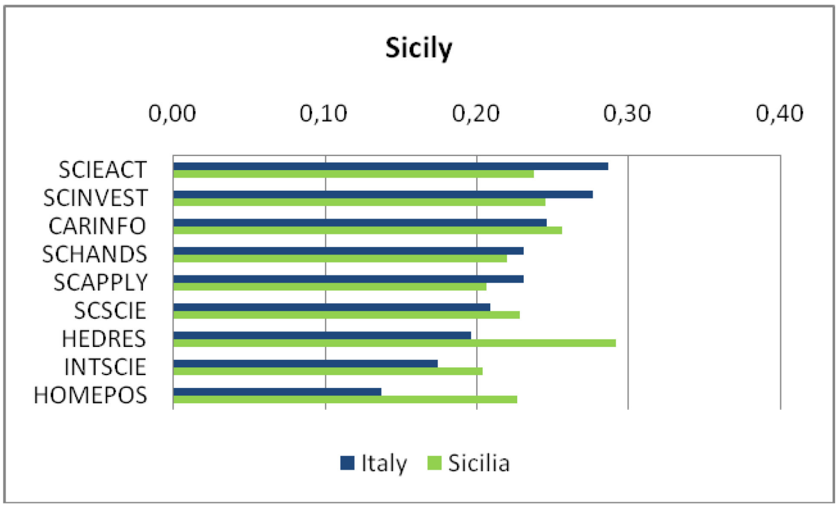
In Sardinia, the correlations are greatest. In this region, the teaching methods and the students' behaviour towards the sciences influence even more the use they make of computers.

Figure B3: Sardinia – Correlation coefficients between the PRGUSE index and the component variables



In Sicily, more than the teaching methods or positive attitudes towards science, it is home educational resources that predominantly determine the PRGUSE index (this is also the case in Friuli-Venezia Giulia). Young Sicilians, who make above-average use of programs and software, are more inclined to do so, the greater the home educational resources.

Figure B4: Sicily – Correlation coefficients between the PRGUSE index and the component variables



Annex 3

Synthesis of analyses by region

Table C synthesises the different frequencies and indices presented according to the region. The figures in green indicate the situations (frequencies or averages) that are favourable relative to the Italian average, and the figures in red the situations that can be regarded as less favourable than those observed on average in Italy.

It comes as no surprise that generally the regions of northern Italy distinguish themselves positively from those of southern Italy, which seems to indicate that the questions relating to the information and communication technologies are partly linked to the level of regional economic development. There are, however, some significant exceptions: the region of Basilicata stands out positively on most of the indicators. The only less favourable indicator concerns the number of years of experience with computers. It is as if the development of ITC in that region were more recent, but the students had been able to make up this gap rapidly, as indicated by the other indicators presented in the table.

Finally it can be noted that the "Program use" index often behaves strangely, in the sense that it moves in the opposite direction from what one might expect. It seems prudent not to over-interpret these data, since this very specific behaviour could be due to a problem at the level of the measuring instrument (translation, social desirability, etc.).

Table C: Synthesis of frequencies and indices by region

	More than five years' experience with computer	Less than one year's experience with computers	Percentage of students who say they never or rarely use a computer at home	Percentage of students who say they never or rarely use a computer at school	Number of students per computer	Average 'Internet and entertainment use' index [12]	Average 'Program and software use' index [13]	Average index of confidence in Internet tasks	Average index of confidence in high-level ICT tasks
Bolzano	**51.79 %**	**2.29 %**	**6.85 %**	**12.62 %**	**4.72 %**	-0.19	**-0.12**	**0.30**	**0.30**
Basilicata	**44.11 %**	**7.18 %**	**6.26 %**	**29.98 %**	**12.44 %**	0.01	**0.09**	**-0.08**	**0.08**
Campania	**38.94 %**	**10.69 %**	**7.59 %**	**47.11 %**	**26.81 %**	0.24	**0.20**	0.00	**0.02**
Emilia Romagna	**53.07 %**	**4.51 %**	**7.37 %**	**28.51 %**	**12.44 %**	-0.06	**-0.20**	**0.15**	**0.02**
Friuli-Venezia Giulia	**51.62 %**	**4.95 %**	**8.32 %**	**29.32 %**	**15.62 %**	-0.18	**-0.24**	**0.06**	**-0.01**
Liguria	**48.15 %**	**7.85 %**	**9.03 %**	**41.01 %**	**19.15 %**	0.04	**-0.14**	**0.11**	**-0.01**
Lombardy	**49.25 %**	**4.56 %**	**7.12 %**	**28.14 %**	**13.07 %**	-0.13	**-0.16**	**-0.04**	**-0.07**
Piedmont	**50.29 %**	**4.62 %**	**6.51 %**	**32.47 %**	**18.49 %**	-0.10	**-0.13**	**0.13**	**0.04**
Puglia	**37.78 %**	**10.46 %**	**10.82 %**	**34.95 %**	**15.97 %**	0.00	**0.16**	**-0.20**	0.00
Sardinia	**47.19 %**	**7.62 %**	**10.23 %**	**35.47 %**	**11.22 %**	-0.08	**-0.14**	**-0.07**	**-0.07**
Sicily	**37.59 %**	**12.52 %**	**14.33 %**	**38.04 %**	**17.34 %**	**0.21**	**0.30**	**-0.07**	**0.05**
Trento	**53.34 %**	**3.37 %**	**6.81 %**	**12.62 %**	**6.66 %**	-0.19	**-0.07**	**0.05**	**0.12**
Veneto	**49.72 %**	**4.45 %**	**8.91 %**	**25.46 %**	**11.56 %**	-0.28	**-0.21**	**-0.03**	**-0.04**
Italy	**45.46 %**	**7.38 %**	**8.69 %**	**34.16 %**	**17.13 %**	**0.00**	**0.00**	**0.00**	**0.00**

[12] The index centred on Italy is calculated for students who have an Internet connection at home.

[13] The index centred on Italy is calculated for students who have a computer at home.

Annex 4

Responses from ICT-coordinators about perceived needs (SITES 2006)

Technologies and Facilities	Perceived Need High	Perceived Need Low
Equipment (PC,s printers etc)		All countries (<9% > 16%)
Tutorial software	**Italy** Finland Catalonia (<30%)	Denmark Norway France (>20%)
General software:		All countries
Multimedia production	**Italy** (<35%)	Denmark Catalonia Norway France Finland (>30%)
Data logging	Norway Denmark (<39%)	Finland Italy Catalonia France (>23%)
Simulations	Finland **Italy** Norway (<40%>58%)	Catalonia Denmark France (>40%)
Communications Software	**Italy** (21%)	All other countries (>14%)
Digital resources	**Italy** (36%)	All other countries (>21%).
Mobile devices	France (43%)	Finland, Norway (26%)

	Catalonia 38% **Italy** 35% Denmark 34%	
Smart Boards	**all countries** (>46%>71%)	
Learning Management Systems	France 60% **Italy 61%**	All other countries (<24%>46%)
Email teachers	**Italy 29%** France 17%	Finland, Denmark, Catalonia Norway <2%>10%)
Email students	**Italy 42%** France 31% Norway 31% Catalonia 29%	All other countries (<5%>16%)