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Boys are like Girls: Insights in the Gender Digital Divide in Higher Education in Switzerland and Europe

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Abstract: This paper explores the differences between boys and girls in their approach to ICT. Data were gathered from students in the final grades of high school in the Swiss Canton Ticino as part of a wider European project, with a particular focus on the potential uptake of a study or professional career in ICT. Preliminary focus groups with teachers and interviews with women with a job in ICT were followed by a quali-quantitative study which involved 539 students. Results indicate that there are no big gender differences when it comes to ICT use and perception. Small differences are found in the perception of the gender digital divide, while relevant differences were found in the perception and values attached to future professional or academic careers in ICT.

Keywords: gender, digital divide, college, Switzerland
Categories: K.4.2, K.7.0, L.3.3, L.3.7

1 Introduction

This paper addresses an issue important from social, economic and educational points of view, namely, the decline in the number of students choosing to follow an educational path leading to a career in ICT or Computing. This issue, which can be framed within the negative trend in the number of students taking up a career in STEM (Science, Technology, Engineering and Mathematics) disciplines, is particularly acute amongst females. There are serious problems with the take up of ICT by females at all levels – from choice of school subjects in post-compulsory education, choice of university degree, and career choices. In the computer industry, there are big gender imbalances in both seniority, and pay [BFS n.d.], even when seniority is taken into account. An industry which suffers an overall shortfall of professionals cannot afford to neglect half the population when looking to recruit staff.

Where does such a situation come from? There is a general cultural stereotype that computers are "boys' toys", and it is possible that such stereotype is reflected in schools, generating is a bias in the curriculum which turns females away from ICT and Computing careers.

This paper reports on findings made within the wider context of the European project Promoting Equality in Digital Literacy (PREDIL) [PREDIL n.d.], involving 7 countries. PREDIL was funded under the Lifelong Learning Program, Comenius action, in 2009 and 2010. Led by the Foundation for Research and Technology Hellas, Institute of Applied and Computational Mathematics (FORTH/IACM) in Greece, PREDIL was built on the premise that evidence-based gender-sensitive pedagogical methods and teaching approaches can be catalytic in increasing both the quality of educational provisions and students' motivation in ICT. The project intended to (a) conduct a study to achieve a better understanding of the gender digital divide, and then (b) to map current teaching practices onto students' preferences with regard to ICT applications in the curriculum, in order to (c) support teachers. To this end, the PREDIL partners developed a multi-method multi-national research and development programme.

This paper reports data from the Swiss branch of the study, and places its findings within the wider European context. The dimensions explored here are (a) the perceptions of school children with respect to the use of computers in school and at home, and (b) attitudes to computing and computing careers. In this study, we looked for evidence of gender bias in computer use and attitudes to computing as an educational and professional track.

The next section provides a literature review on gender and ICT. In the following one, we will identify some trends and messages surrounding our issue. This is followed by sections presenting the research methods and results of the PREDIL programme as implemented in Switzerland. The final sections discuss the paper, draw some conclusions and propose concrete lines of action for engaging young girls with the world of ICT.

2 Literature review

2.1 The gender digital divide

Becoming a top-flight player in the ICT sector, one of the fastest growing sectors globally, requires a skilled workforce. At present, the uptake of ICT-related careers and courses of study by women in Europe is very small, with two important consequences: first, the loss to the economy of the talents of a significant portion of the potential workforce; second, the direct economic implications for women, many of whom are excluded from very well paid and flexible jobs.

The *gender digital divide* (GDD) refers to the gap in opportunities to access, use and shape of ICT between men and women [BRIDGE 04]. According to international research, it represents one of the most important challenges in the knowledge society [Ertl 11]. The UNESCO recognizes in particular GDD as the most significant inequality to be amplified by the digital revolution [Brandzaeg 05]. The very concept of GDD, even if under the cover of different terms, has quite a long tradition in the literature. An extensive list of references on the subject has been compiled by

PREDIL partners [PREDIL 10b]. But what are exactly the features and dimensions of the GDD? A literature research reveals contrasting findings.

A number of studies in the 80s and early 90s, indicated computing as a male dominated activity [Williams 93] [Brosnan 96] [Wilder 85], showing that both boys and girls perceived computers to be more appropriate for males than females, and technologies as "masculine". For example, Fetler [Fetler 85] found that high school boys in California consistently outperformed girls in computer tasks, and that they also reported more experience with computers than girls. Sink et al. [Sink 08] provided a review on this topic, concluding that, with regard to gender differences, "schoolchildren's computer skills and attitudes appear to be influenced by their home and learning environments, culture, peer groups and various psychosocial factors" (p. 50).

One hypothesis is that the root of this perception is environmental rather than innate, and is reinforced through schooling. Some studies suggest that the GDD starts at an early age [Haugland 00] and that particular consideration should be given to boys and girls in primary and secondary education [De Craene 06] [Brandtzaeg 05]. [Brosnan 99], designed an art-based projective test engaging primary school students in drawing a computer user. In this study, almost all the boys drew male users, while only two thirds of the girls drew female users. The author concluded that boys, for a variety of reasons, perceive computer use as a male-dominated activity, and it is this which influences the perception of girls, who tend to refrain from engaging with computers in order to be consistent with their gender attitudes. Such cultural gender biases, are reinforced in school, and are exacerbated in professional domains. For example, in investigating career choices, Igbaria et al. [Igbaria 91] concluded that the women in their study, working in ICT, were more oriented towards the successful integration of family and professional lives and less technically oriented than men. This was revisited many years later by Joshi et al. [Joshi 10], who claim that the perception of the importance of ICT varies across genders, and has an impact, along with ICT self-efficacy, on the potential uptake of ICT-related careers.

2.2 Narrowing the gender digital divide

Some more recent studies seem to indicate that the gender gap is not so severe or does not exist. Madell and Muncer [Madell 04] reviewed a number of studies from the early 2000 and concluded that "research (…) does not provide consistent evidence for the presence of otherwise of a gender gap in Internet use across different groups of males and females. Results vary depending on the demographics of the sample on which the research was performed" (p. 230). In their study, the authors found no significant difference in the access, use and perceived skills between English boys and girls in secondary education, with the exception of a slightly greater percentage of boys than girls declaring themselves as internet users (85.7% vs. 80.2%). In 2001, Hackbart [Hackbart 01] found that primary school students display similar, very positive, attitudes toward computers, demonstrate the same level of competences in using them, and have a similar computer-related vocabulary. Differences in performance with computers seem to depend more on the teacher's strategy for integrating computers in the classroom, than on gender.

Such findings are supported and reinforced by the claim by other authors [Quesenberry 08] that gender is not the sole factor determining the GDD, and in

particular, does not have a direct influence on career choices. This echoes Wajcman's [Wajcman 91] observation that "although studies do find evidence of differences between the sexes, the variation within the sexes is more important than differences between them" (p. 157).

Nevertheless, despite many years of campaigns and initiatives and the passing of legislation, a gender gap still seems to exist in Europe. The Global Gender Gap Report [Hausmann 10] provides a composite measure based on a range of measures and these show that whilst small gains have been made in terms of equality, there still remains work to be done.

However, evidence clearly indicates different gender proportions in the uptake of ICT careers – whether a divide or a choice, this calls for a greater understanding and study of the phenomenon and its development, and the development of methods through which such issue can be tackled. In this respect, schools remain a key agent in introducing young people to technology and science.

2.3 Considering the gender digital divide today

A reading of the numerous GDD studies from the 80s up to the current days reveals striking differences. Some of them can be ascribed to different conceptualizations of the term *gender* [Quesenberry 08], which is interpreted differently in different research domains, and leads to different, and sometimes not fully comparable, methodological choices.

Differences may be attributed to the evolution of technologies: conceptions of ICT in the mid-80s, were very different from today's smartphones, ubiquitous wireless access and tablet computers. The market penetration of such devices is also very different, such that barriers to access cannot be considered in the same way.

Sex differences vary across cultures, and we can assume that the GDD is different across cultures too. Such an assumption is entirely reasonable if we consider a Western nation, where the ICT penetration is widespread, and education at 95% with a country in the developing world. However, the same can be said also in Europe, where member States enjoy different languages, traditions, school systems, and technology penetration figures. For this reasons, this study focuses on Switzerland, and tries to contextualize its data within the broader frame of Europe. It is important that educators do not accede to the cultural folk wisdom current in their societies by adopting inappropriate practices regarding the promotion of careers and educational programmes. The following section provides the key figures for describing such reference context.

3 The current context

3.1 Europe

In recent years, a number of surveys have been carried out, in Europe and the USA, concerning boys' and girls' and their access to and use of new media. Among the most important of these is the American study by Rideout, Foehr, Roberts and Brodie [Rideout 99], based on a representative sample of more than 3000 children aged 2 to 18 and focused on their use of television, the cinema, PCs, games, music and reading.

In the European context, the study by Bovill and Livingstone [Bovill 01] represents a milestone. Its subject is the relationship between children's (aged 6 to 16) use of the media and the importance of the media in both school and leisure contexts. The 2004 Eurydice Report [Eurydice 04] on key data highlights that there are different patterns of use between boys and girls and, importantly, that there appears to be some correspondence between digital and economic exclusion.

All of the above-mentioned international research projects show a large and consistent gender difference in computer use that begins as early as 3 to 4 years old. A significant pattern is that boys use computers and the Internet more than girls do, particularly for games and other entertainment. National Data on Performance in High-Stakes Examination in the UK reveals that, while girls perform better than boys with more grades in the range A-C in the 8 most popular examinations subjects [PREMA 07], boys outperform girls – if only by a modest amount – in ICT. The analysis of the A Level Entries (post-compulsory level) reveal that far more boys than girls take Mathematics and the related subject area of ICT (7849 boys vs. 4332 girls). The message from these data is that the relative take-up of ICT as a subject overall favours boys. Similarly, in the Greek Computer Society tests, far more boys than girl participate: in 2007, among the 30 finalists there was only one female pupil. CERI/OECD's Workshop in 2008 on the theme of school practices on ICT and gender further justifies engagement in this field.

3.2 Switzerland

The general trends identified around Europe are confirmed in Switzerland. 2009 data from the Federal Office for Statistics [BSF 10] indicate a strong progressive overall decrease in the enrolment in STEM courses, including ICT (namely, bachelor programs in Informatics and Computer Engineering).
This is combined with a lower proportion of women enrolled in programs in the area of Technical Sciences (see Figure 1).

This issue exists within a diverse situation in primary and secondary education in Switzerland [Botturi 10]. The Swiss school system is complex, mainly due to its internal diversity: education is a cantonal concern, so that basically each canton has a different school system, so that 26 different school systems coexist in the country. A state-wide harmonization process is currently ongoing, under the label of *HarmoS* [HarmoS n.d.]. While it is difficult to present an extensive description of all cantonal school systems, few cantons have a strategy for the inclusion of ICT in school teaching. Even fewer have specific ICT classes, having made the decision to include ICT in other subject areas (usually, Science and Mathematics). However, most cantons have funded an ICT competence centre, whose aim is to support schools, thus clearly indicating the intention to facilitate a smooth and effective exploitation of digital media in school teaching. Understanding what these strategies are, and how they are implemented in school teaching would be an interesting area for further research, as currently few data are available.

The differences between cantonal school systems make the identification of national trends or issues problematic, and hinder international comparisons. For this reason, for the purposes of the PREDIL project, Canton Ticino was selected as an exemplar for the current study.

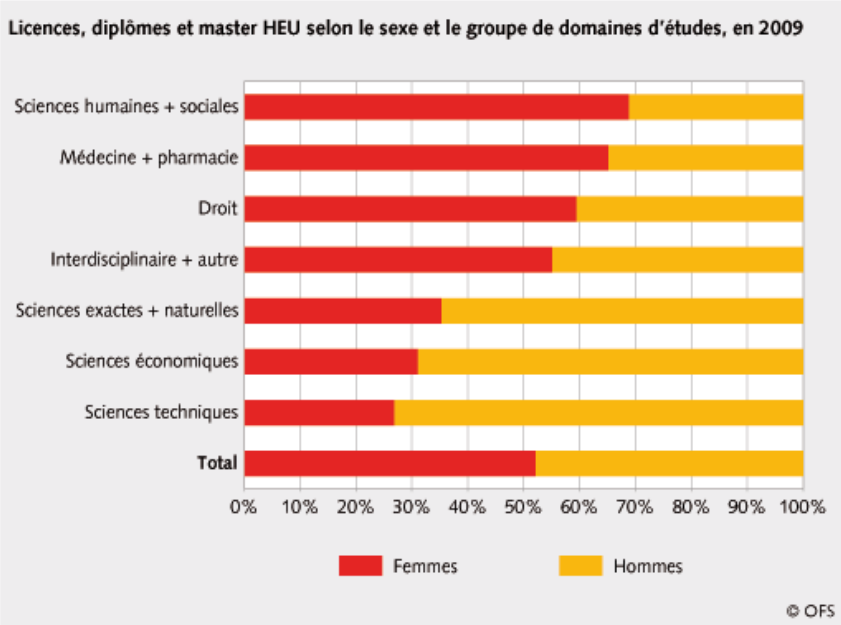

Figure 1: Proportion of male and female academic enrolments by subject area in Switzerland in 2009 (taken from BFS, 2010).

3.3 Schooling and ICT in Ticino

Ticino, with its population of over 300'000, is the most Southern canton in Switzerland, laying South of the Alps and bordering with Italy. Also, Ticino is the only Canton whose main language is Italian: this makes it a peculiar cultural region, strongly influenced both by Italian and Swiss cultures.

The school system in Ticino is different than in the rest of the country. For the largest part of children, schooling starts between 3 or 4, although kindergarten is not compulsory. Primary school spans from grade 1 to 5, and it is followed by 4 years of lower secondary education (middle school). Up to grade 9, all children follow the same path, differently from the German-speaking Cantons, where a first decision about taking up an academic or professional track should be already made during lower secondary grades. Higher secondary education can be either academic (*liceo*) or vocational (in different modalities). Academic tracks give access to university education (either at Universities or at Polytechnic Schools), while some professional tracks give access to Universities of Applied Sciences.

So far, Ticino has not developed a consistent strategy for the integration of ICT in school curricula. Nevertheless, experimentations have been done both at lower and higher secondary levels, and an up-to-date computer lab is usually available at all schools.

4 Research goals and questions

PREDIL aimed at mapping students' perceptions of ICT, ICT courses of study and professional ICT careers, along with their perceived learning needs with respect to specific subjects, their personal attributions for success/failure in these subjects, and appreciation of ICT processes and tools. The goal of this study was to facilitate the formulation of the framework for encouraging and supporting teachers to reflect on classroom practices in teaching ICT or teaching with ICT. The research focused on two goals: (a) understanding differences between boys and girls with respect to digital technologies as a potential course of study or professional career, and (b) identifying guidelines for a sensible intervention aimed at reducing the gender gap in the uptake of ICT careers.

The first goal was translated into the following research questions, explored using quantitative methods:

- Are there gender differences in the actual use of ICT at home and at school?
- Are there gender differences in how ICT is perceived?
- Are there gender differences in how desirable a future ICT course of study or professional career is perceived?

The second goal was translated into the following research questions:

- How would young boys and girls prefer to learn or engage with technologies at school?
- What do young boys and girls perceive as attractive in a future course of study or career in ICT?

5 Methodology

5.1 Assessing the GDD through self-perception

The main standpoint of this research study is that the GDD is mainly connected with the self-perception of students. The GDD is not rooted in different computer skills or attitudes, rather in young boys' and girls' views on the role of technologies in their lives. Perceiving ICT as distant, useless, or threatening, will then results in poor digital literacy, pushing a negative loop. Young boys' and girls' perceptions of ICT include their perception of the space of ICT in their life, of their own digital competences, and of their attitude (attraction, repulsion, etc.) for ICT.

The design of the study reflects this perspective, and is based on a survey assessing students' self-perception. The development of such a data collection instrument was prepared through direct involvement with other stakeholders: teachers, and women with a professional career in ICT.

5.2 A three-step process

The research process was structured according to the following three steps:

1 Two *focus groups* with 8 teachers from senior high schools in Ticino, with the goal of assessing the perceived relevance of the GDD issue to teachers and to map existing related practices.

2 Three *interviews* to women engaged in ICT careers, with the goal of identifying key qualitative elements that supported, motivated or facilitated their choices.
3 A *questionnaire* for students in the last two senior high school grades. These grades (class 3rd and 4th according to local denominations, grades 12 and 13 internationally) were selected as they are when students should make a first explicit and (to some degree) non-reversible choice concerning their future career.

Steps 1 and 2 were instrumental in developing the survey, which is the core of what is presented in this paper. All tools and methods developed in the project are presented in the PREDIL Comparative Analysis Report [PREDIL 10], and were implemented in concert across the PREDIL team in each member country.

5.3 Focus groups with teachers

Two focus groups gathered altogether 8 teachers (7 males and 1 female) teaching STEM subjects from two public senior high schools in Ticino. They were all involved in integrating ICT teaching at their school (e.g., science teachers in charge of introducing ICT in their program). Participants were first introduced to the project through the presentation of key national and regional figures, and then were asked to discuss (a) how they see the interaction of their students with ICT, (b) how they use ICT in class, and (c) if they perceived any differences in ICT use between male and female students.

The focus groups, of about 90 minutes, were recorded, and key passages were transcribed and analysed by two researchers. The results, presented below, were taken into consideration in the development of the student questionnaire, and also formed the general canvas from which hypotheses were drawn during the interpretation of qualitative data.

5.4 Interviews with women with careers in ICT

Three women with successful ICT careers in Ticino were interviewed: a researcher and practitioner in the field of ICT for development, a university professor in Engineering and Informatics, and a Ph.D. student in Informatics. The interviews, which followed a semi-structured approach, took about 45 minutes, and focused on the key moments, events and people, in their career choices, on their feelings and on the challenges and support they experienced.

Interviews were audio-recorded and then transcribed. Two researchers carried out independent analyses, which were then compared and discussed. The results, which are also presented below, were used in combination with questionnaire results to generate the recommendations for narrowing the GDD formulated at the end of the paper.

5.5 Student Questionnaires

Based on the information collected through the focus group and the interviews from all participating countries in PREDIL, the project partners developed and discussed a common questionnaire to collect data from local high school students. The draft versions of the questionnaire were tested in each country with a panel of students. The

final version of the questionnaire was localized and few questions were added, developed especially for the Swiss context.

Questionnaires were distributed in March 2010 to schools in paper form. Data from completed questionnaires was uploaded to an online database developed with Lime Survey, to align the data with other project partners.

The questionnaire was composed of four sections:

1 Demographic data (age, grade, gender, etc.).
2 Data on the use of technologies at home and at school and within different school subjects, using Likert scales.
3 Conceptions about ICT and careers in ICT, using open questions; asking for example, for adjectives describing girls and boys who are good at using ICT, or for at least one positive aspect of a technology degree, or for preferences about a possible choice of academic program.
4 Attitudes to ICT, e.g. asking students if they agreed with the assumption that boys are better than girls in the use of ICT, asking if family factors can influence motivation to embark on a career in ICT. Students were also asked if they perceived different expectations in teachers toward males and females with respect to technology.

5.6 Questionnaire sample

For the purposes of this research, all public and private academic high schools (thus, excluding vocational high schools) in Ticino were contacted through their directors. 5 out of the 8 existing schools agreed to participate in the study, 3 public and 2 private. The school director in each school selected classes to participate in the survey.

School	Students in target grades	Valid responses	%
Public 1	480	131	27.29%
Public 2	246	139	56.50%
Public 3	290	174	60.00%
Private 1	70	49	70.00%
Private 2	60	46	76.67%
Total	1146	539	47.03%
Summary		M = 223	(41%)
		F = 316	(59%)

Table 1: Sample data.

Initially, responses were subjected to a process of data cleaning, whereby individual questions were excluded because incomplete. In particular, questionnaires were rejected (a) if they were less than 70% complete, (b) if they lacked gender information or (c) if the respondent age was out of range (i.e., date of birth before 1988 or after 1998). In total 539 valid responses were collected, over a total of 1146 students in the target grades in sample schools. Table 1 describes the sample population.

Although the sample was somewhat opportunistic and to some degree self-selecting, given that school directors and teachers were required to consent to participation, a relatively high valid response rate was achieved.

6 Results

In the following, results from the three steps are presented. A comparative analysis at the European level can be found in [PREDIL 10].

6.1 Focus groups

As already mentioned, ICT do not appear as a stand-alone subject matter in the cantonal curriculum. As a consequence, teachers use only a few technologies in the classroom and experience difficulties in finding resources for infrastructure and planning innovative teaching units. During the focus group, teachers observed that while students are generally skilled in using "light" applications such as instant messaging, mobile or smart phones and other personal devices, they lacked skills in the use of computers for learning and working.

In general, teachers tended to report no differences between boys and girls when it came to ICT, both in terms of their expectations and in terms of proposed activities. At first, teachers in the focus group claimed that there are actually no real gender differences. However, during the discussion, such claims faltered: when prompted to reflect on their experience, teachers started to acknowledge that differences between males and females exist and should be considered. Teachers stated that the most observable differences between boys and girls is that girls use technologies for communication (e.g., mobile phones, social networks, etc.) much more than boys do. Teachers reported that girls pay more attention to the aesthetic qualities and to the presentation of what they produce with digital media. On the other hand, boys seem to be much more engaged in tasks where they have to analyse and solve technological issues, "to make things work". This attitude is observable in other subject matters and tasks as well: girls generally want to be well prepared and organized, while boys tend to "jump into tasks" with less concern and preparation. Teachers also think that this "boys' approach" in itself can facilitate learning to use ICT, which are designed for autonomous learning and are in some way "fool-proof".

Another general tendency that some teachers observed and that might contribute to explain the gender gap in career selection, is that girls seem to be much more attracted by jobs where they can establish relationships with other people, and are consequently less interested in "dealing with a machine". This will be partially confirmed by the questionnaire results.

6.2 Interviews

While representing very different stories, some common features could be clearly identified across the three interviews. All interviewees said that their interest in ICT started late, at the end of secondary school, or just before the choice of an ICT-related university program. Also, interviewees shared that the choices of an ICT program and then career were more due to curiosity and challenge than to actually learning about the use of computers or for a future job. ICT were perceived as something new and challenging, a new way of communicating, like some kind of "new language".

The main obstacles encountered in their career are the sense of being less prepared and thus performing more poorly than males, even if their results in the exams were actually better.

The theme of "paternalism", or patronizing, emerges from two of the stories, i.e., a general tendency of male fellow students and colleagues to protect or support the interviewees even when they did not ask for it. This seems to be rooted in a male preconception that women cannot be as good as they are in ICT, so that they should be protected. In the interviewees' stories, male colleagues took over tasks which the women were carrying out, and, as a result, the women felt that they lacked the opportunities to show what they could achieve. However, they also reported sometimes, consciously or unconsciously, exploiting this situation to their advantage. With regard to teachers, the interviewees did not report of any preconception or different expectations towards male or female students.

Finally, interviewees agreed that they experienced no exclusions or barriers to entering a professional career – if anything, they felt it more likely that some advantages came from "being perceived as a minority". The main reported difference in employment was the issue of motherhood, where the interviewees spoke of the difficulties in try to reconcile their roles as mother and as professional. However, even in this, the fact of being a minority provided an opportunity to create high solidarity among the few women working in the field.

6.3 Questionnaire

The initial data set was coded following protocols developed by the PREDIL project team. All responses were treated anonymously and school names were coded making them unrecognisable during analysis.

The analysis was divided into 3 main steps:

1 Descriptive statistic analysis of the quantitative questions, using SPSS, first analysing frequencies, then correlating results according to the main variables: male and female, male/female and school specialization (literary, scientific, linguistic), male/female and place of residence, male/female and school year attended.
2 Qualitative analysis of some of the open questions creating word clouds with the attributes: how boys/girls see boys good at the use of the computer, how boys/girls see girls good at the use of computers.
3 Semantic analysis of answers to open questions, following a grounded approach [Birks 11]. In order to analyse the answers to the open-ended question of section 3.1, a codebook analysis was carried out involving 3 raters and checking for inter-rater agreement.

6.4 Gender and the use of ICT

The use of ICT was analysed asking students how often they use, at home and at school, different tools or manage different tasks, such as: word processing, spreadsheets, presentations, databases, graphics and arts, surfing the web, download data (e.g., music), etc. Overall, results were strikingly similar between male and female students, with a few exceptions, presented in Table 2.

		MALES		FEMALES	
		AT SCHOOL	AT HOME	AT SCHOOL	AT HOME
Word processing	Don't know	2.2%	.9%	1.9%	.9%
	Never	28.3%	3.2%	25.3%	8.5%
	Often	12.6%	52.20%	13.9%	39.0%
	Sometimes	55.2%	43.7%	58.5%	49.8%
	Would like to learn	1.8%	.0%	.3%	1.80%
Graphic Arts	Don't know	1.30%	1.3%	1.6%	.6%
	Never	78.0%	43.0%	80.1%	28.2%
	Often	3.6%	18.4%	1.9%	19.3%
	Sometimes	13.5%	32.3%	7.0%	38.6%
	Would like to learn	3.6%	4.9%	9.5%	13.3%
Play Games	Don't know	1.8%	2.70%	1.3%	.6%
	Never	71.7%	22.4%	92.1%	63.9%
	Often	8.5%	28.7%	.9%	5.4%
	Sometimes	17.5%	46.2%	4.7%	29.1%
	Would like to learn	.4%	.0%	.9%	.9%

Table 2: Uses of ICT (selection).

Students use word processing software more often at home than at school. Nearly every student has used this application and there is hardly any interest in learning more about it. The percentage of boys who use it at home often or sometimes is slightly higher than that of girls.

Graphic arts software (Paint, Photoshop, Picasa, etc.) is seldom used at school, and if such software is used at all, boys (3.6% often, 13.5% sometimes) used it more than girls (1.9% often, 7.0% sometimes), even if girls seem to be more motivated in learning more about it (9.5% vs. 3.6%). This result is different at home: it is clearly used more often than at school and in that case the number of girls who use it exceeds the number of boys (girls: 28.2% never, 19.3% often, 38.6% sometimes; boys: 43.0% never, 18.4% often, 32.3% sometimes). Also in this context, girls seem to be more willing to learn more about graphic arts software (girls: 13.3% would like to learn; boys: 4.9% would like to learn).

On the other hand, and as expected, very few girls (5.6% often or sometimes) but many boys (26% often or sometimes) play games at school. At home, games are played more often than at school, and boys play games clearly more often than girls (boys: 28.7% often, 46.2% sometimes; girls: 5.4% often, 29.1% sometimes).

However, considering that the questionnaire included 18 items about ICT use, and the three mentioned above are the only ones which present significant differences, we can state that there are hardly any salient differences between boys and girls in the overall use frequencies of standard software and of the Internet, both at home and at school. In general, young boys and girls use ICT more at home than at school, remarking once more the differences between the school and home environment when it comes to digital technologies [Prensky 00].

Specific data were collected about the use of ICT at school, asking in what subjects or classes they were actually used. As expected, students say they do not use much ICT at school, with a few exceptions in Foreign Languages (in Ticino: French, English and German), Geography and Sport.

As a summary of this first part of the survey, we can claim that there are no significant differences in the actual use profile of ICT between Ticino boys and girls of the considered grades, neither a school or at home.

6.5 Attitudes towards ICT and gender

The exploration of our second research question (are there gender differences in how ICT is perceived?) was carried forward through two sections in the questionnaire: three questions about students' perception of the GDD, and the collection of adjectives about the “successful” boy/girl in ICT. The former is presented in this sub-section, the latter in the next.

One part of the GDD relies in the fact that girls might perceive themselves as less suited to ICT than their male colleagues. Studies demonstrated that girls are less likely to believe that they will succeed at computer-related tasks (self-efficacy), and when they do, they are more likely to attribute their success to luck rather than skill [Cooper 06]. However, lower self-efficacy does not necessarily mean that girls’ skills are weaker than boys’ [Sanders 05]. For this reason, the questionnaire included questions to explore students’ perspectives and attitudes on the issue of gender and ICT. These questions focused on the perceived ICT skills of boys and girls, on family influences and the treatment of boys and girls in ICT classes.

What emerged from the data, presented in Figure 2, is a difference in the perception of the competences of girls and boys toward ICT. Namely, boys tend to reinforce the view that boys are better at ICT (50%, 22% disagree), but also 29% of the girls agreed with that, while 47% disagreed.

On the other hand, about 1/3 of both boys and girls think that teachers formulate different expectations about ICT towards boys and girls. 20% of both boys and girls disagree on this point, and about half of them do not have an opinion.

Finally, family factors have quite a balanced perception, with 50% of the boys and 42% of the girls considering this factor influential.

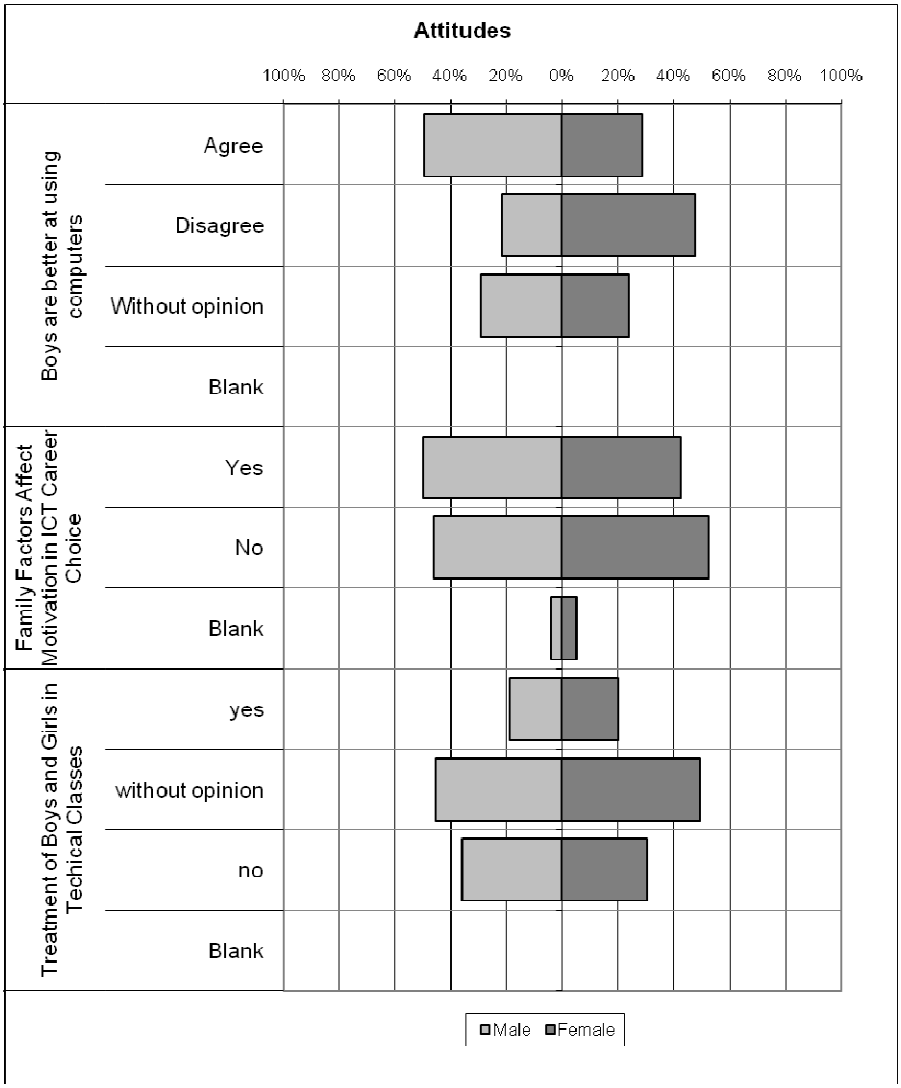

Figure 2: Perceptions about gender differences.

6.6 Perception of ICT: results from word clouds

Two questions asked respondents to write 3 adjectives to describe the typical boy and the typical girl "good at ICT". This resulted in a large set of words, in Italian, which was first revised by coders: they matched synonyms or different versions (e.g., singular/plural, "wearing glasses" and "goggles", etc.), and removed (few) offensive terms. The word lists were then used to produce four word clouds, presented in Figures 3 and 4: boys describing girls and boys, and girls describing boys and girls. Word clouds are typical Web 2.0 representations, where the relative size of each word corresponds to its relative frequency in the dataset.

Observing word clouds, by far the most popular term emerging in all cases is *clever* (it. *intelligente*): using ICT requires intelligence, and those who do it with success demonstrate their intelligence.

Girls then describe both boys and girls good with ICT as *asocial*, *quick* (it. *veloce*), *curious*, and *practical*. Further analyses reveal a few words that girls use for boys, but not for themselves, namely: *nerd*, *dependent*, and *smart* (it. *sveglio*). On the other hand, girls describe other girls that can use computers well as *skilled*, *logical* and *shy* (it. *introversa*). So, boys who are good at using ICT are perceived as smart but with some weak points. However, this is not the case of the ICT-skilled girl.

How do boys describe their peers good at using a computer? Right beside *clever*, boys seem to say that *wearing glasses* (it., *occhiali*) is an indicator of ICT mastery, both for boys and girls, followed by being *passionate* and *shy*. Boys describe other boys who are good with ICT as *skilled*, *asocial*, *nerdy* and *dependent*, whilst similarly talented girls are *smart*, *skilled*, *determined* and *ugly* (it. *brutta*; though in some, but fewer, cases, *pretty* is also found).

Comparing boys' and girls' descriptions, it is remarkable that boys use a higher number of different adjectives. Generally, girls use words that describe temperamental and psychological features, such as *practical*, *smart* or *dependent*; boys instead focus more their attention on physical features, such as *pretty*, *ugly*, or *wearing glasses*. Nevertheless, overall, there are only minor differences: both boys and girls focus on being *clever*, not very social or even with poor relationships (*asocial*, *shy*, *nerdy*). Boys emphasize being passionate or determined in using ICT, while girls tend to emphasize being smart and skilled. In short, boys and girls do not perceive their successful peers with ICT as different depending on gender: the characteristics associated with success in the digital environment are the same for both genders.

The analysis of perceptions about the GDD and of word clouds provides an answer to our second research question: boys and girls have only slightly different perceptions of ICT and in how they see themselves with respect to ICT. The major difference is the bigger proportion of boys thinking that boys are generally better than girls at using ICT.

Figure 3: What girls say about a boy (left) or girl (right) good with ICT.

Figure 4: What boys say about boys (left) and girls (right) good with ICT.

6.7 Boys, girls and ICT careers

Students were asked about their future plans after completion of high school, and in particular about the university programs they might consider. The answers confirm the trend presented in the first section of this paper, with a high imbalance in the choice of programs in the area of Engineering and Technology. Only 2% of girls indicated that they were thinking of taking up such a career – a very low proportion, especially when compared to the 17% of boys who making the same choice.

So, while we found no big gender difference in the use of ICT at home and at school, and also no big difference in the perception of ICT and of the GDD, here we found a macroscopic difference. In order to better understand it, we analysed the qualitative data coming from two questions: "What would be the good things about enrolling in an ICT-related academic program?" and "What would be the good things of having a professional career in the field of ICT?"

Answers to these open questions were coded by three researchers, allowing tests for inter-rater reliability, following a grounded approach: first, the three raters took

the same 30 answers and coded them independently, each generating a list of categories. After a review of dissimilar cases, they identified a shared list of categories, and proceeded coding 50 further answers. A second review was carried out, to refine and integrate categories. This led to a list of 6 categories for each question. Finally, the remaining answers were divided among coders and coded. A final review was carried out by a fourth researcher to control for consistency and to make minor adjustments. The results are presented in Figures 5 and 6.

Girls and boys found the same positive aspects in an ICT career: learning skills and knowledge (30% both for boys and girls) and good job opportunities (22% both for boys and girls) are in both cases the most often cited. They then emphasize the current importance of ICT (boys 1% more than girls), the potential to earn a good salary (2% of boys, while girls do not mention this item) and social recognition (boys 1% more than girls). Girls also mention more often the idea that ICT will be important in the future (4% more than boys). Again, only a minor difference, but that which possibly indicates a longer-term view amongst girls.

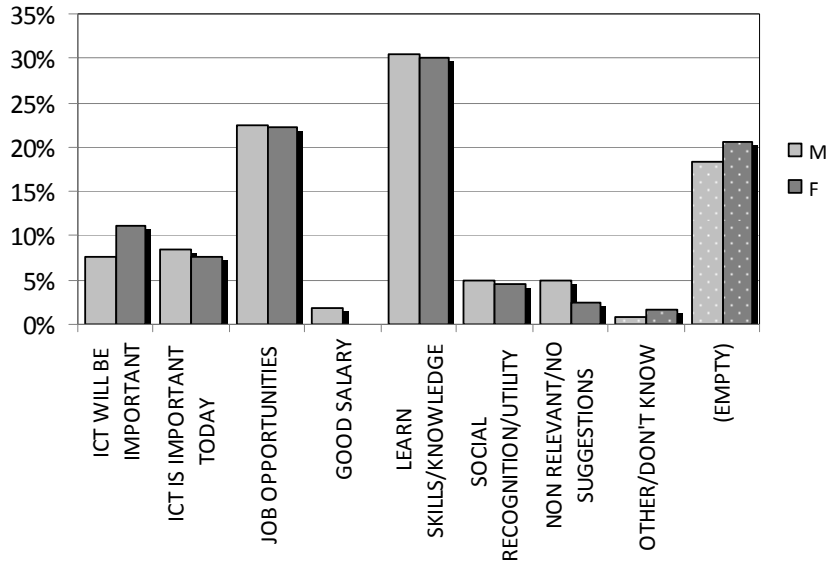

Figure 5: Good things in getting a degree in ICT

When considering a career in the field of ICT, important differences emerge. Boys emphasized the potential of finding a good job (24%, girls: 22%), and receiving a good salary (9%, girls: 2%): views centred on the employment opportunities within the ICT sector. Girls seemed to have a different view: they mentioned ICT being socially useful (11%, boys 7%), staying up to date (22%, boys 18%), and being a protagonist (5%, boys 3%); i.e., girls give more importance to the actual content or human and social side of the profession.

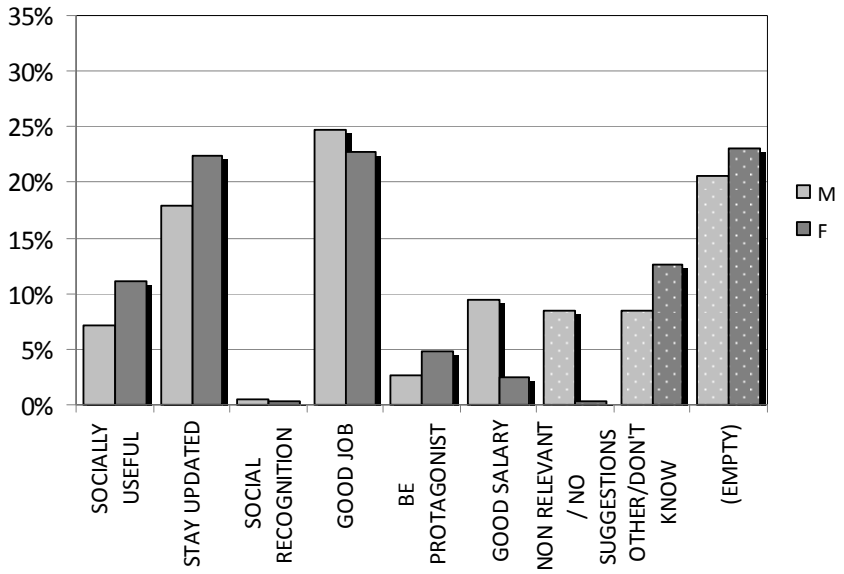

Figure 6: Good things in having a career in an ICT-related field

This analysis led to the identification of a key gender difference that can impact the uptake of an ICT career, namely, the motivation that girls seek in such a career is more bound to human and personal values than in its practical and "lay" features, which boys seem to appreciate more.

6.8 Learning ICT

A final question in the questionnaire asked students to suggest ways teachers could improve their learning of ICT. The answers were coded with a process similar to that presented in the previous sub-section.

Here again the data, presented in Figure 7, point to interesting differences. Both boys and girls would like to have more ICT courses at school, but boys have a clear preference for using ICT in other classes and for other subjects (26%, girls 18%), while girls favour having ICT classes or a "computer hour" (33%, boys 28%). Also, girls seem to require more opportunities for guided but autonomous use of ICT ("use for student activities").

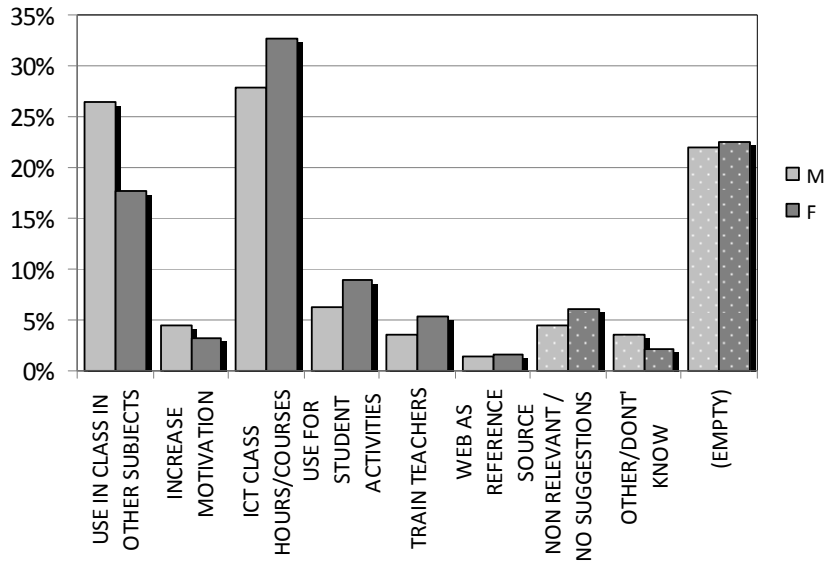

Figure 7: What teacher could do to improve ICT learning

7 A European perspective

This section presents a very brief summary of the wider quantitative findings of the PREDIL project [PREDIL 10], providing European context in which the Swiss data collected from Ticino should be interpreted.

7.1 School / Home Results

The European reports of the use of computers for educational purposes at home and at school are quite revealing. Whilst keeping in mind that the sample is somewhat limited, there are nevertheless some strong messages about educational uses of computers. One might expect to see that computers are often used for educational purposes at school. However, this is not apparent in the data. One of the key messages to emerge from the PREDIL data analysis was the limited range of types of software in use at home and at school. For example, less than 50% of students report ever having programmed or written a web page, and the only educational application which seems prevalent is the generic use of computers for school research – and area in which girls reported greater use than boys. In general, across all the countries within the PREDIL partnership, the use of ICT within the school context is strongly driven by classroom practices, which tend not be gender specific. As such few differences are between boys and girls in terms of their use of ICT in school, are reported.

By contrast, other activities such as voice (Internet telephony), playing games and social networking are almost universally popular at home, yet never used in the classroom. This raises the issue if the school technological environment should follow the trends from the "real world" or not. Moreover, when compared to the large differences in the types of activity that are popular at home vs. at school, the differences in patterns of use by girls and boys are modest.

Across Europe, supporting the findings from Ticino, results showed that girls and boys are exposed to similar level of ICT in school, and their use of educational software outside of school is also similar. Girls and boys were also seen to have very similar pattern of behaviour with regard to use of ICT in the home environment. Some small differences were noted in social networking, but this occurs in a context where participation is almost universal.

7.2 Attitudes to ICT

Attitudinal data collated as part of the PREDIL project showed that across the European partner countries girls did not think that boys were better than them with computers. A clear majority of boys and girls thought that they were given equal treatment in the classroom and a clear majority of boys and girls thought that family influences were important. Information on the nature of these influences was not collected.

7.3 University choices

Stated intentions for university choice were grouped into broad categories (Pure Sciences, Applied Sciences, Humanities & Social Sciences and Commerce) to allow an overview of the differences in choices being made by participants in the survey. In this domain some clear gender differences became apparent, confirming national trends. There was a strong bias towards the boys with regard to intentions to study applied sciences. This may be associated with the related result that a larger proportion of girls tended to select each of the other categories. However, the explanation is not so straightforward as participants were allowed to select as many courses as they wished. Some sharp contrasts arose when the data was analysed at the finer grain of course level. Subjects such as Technology, Engineering and Mathematics are strongly favoured by boys, by about 3 to 1. By contrast many subjects are chosen such as Art & Design and Medical course are strongly favoured by girls. Under this respect, the situation in Switzerland is aligned with the European trends.

8 Discussion

While illustrative of the relationship between young people and digital technologies, this research study has a limit in its sample, which is not randomized. Moreover, it investigated only a specific regional population, in Ticino, which cannot be said to be representative of the rest of the population in Switzerland due to geographic, cultural and linguistic differences.

Another important limitation of the study is its method, which is mainly based on interviews and a questionnaire, and is therefore only measuring respondents' perceptions. While this reflected the main methodological stance of this study, different, and complementary results would possibly come from an objective evaluation of ICT skills (such as the one currently being carried out in the ICILS project [ICILS n.d.], of from a longitudinal study about career and professional choices.

Within such limits, the study delivers two interesting results for understanding the roots of the GDD. The first result alerts researchers and practitioners to the idea that the GDD cannot be tracked back to a difference in the ICT skills of boys and or to the self-perception of those skills, or personal "digital identity". The second result provides a hypothesis about where the key difference between boys and girl lays: in the expectations attached to future professional careers. Boys and girls that would choose a career in ICT would tend to do so for different reasons. Reasons which are perhaps more common among boys than amongst girls.

Such results provide pointers for devising interventions in schools with the goal of reducing the GDD. First, they confirm the fact that training programs, aimed at developing ICT skills are important, but not central to this issue. Interventions on the GDD should rather consider working on the development of an attitude, or better a conception and image of careers in ICT which do not raise conflicts with the human values and relational expectations that girls have. This could be done through showing examples of successful women in the ICT field, and learning more about the actual content and social contribution as opposed to the techniques of ICT professions. For example, exemplifying the provision of ICT services to the media industry or in web development for non-profit organizations, instead of simply explaining how the web or digital image formats work.

This study provides the basis for interesting outlooks. Within the project, more sophisticated correlation analyses could be carried out, and a deeper analysis on the semantics of word clouds could also deliver interesting additional details. The next obvious step is further exploring the international comparison begun with the PREDIL project, and the same project could be extended to include other Cantons, aiming at confronting the modes of integration of ICT in different cantonal school systems.

9 Conclusions

This paper presents the results of the Swiss component, conducted in Ticino, of a European a study concerning the gender differences in the perception of ICT and in the decision to take up a course of study or professional career in ICT. The study was developed through 3 phases: a focus group with teachers, interviews with women with a career in ICT, and a questionnaire which involved 539 young boys and girls from high school grades 12 and 13 (and of high school). The primary contribution of this paper is to report the findings of a study on the GDD targeting today's technologies and a specific region, where a recent study of this kind was missing.

The data reveals that, in Ticino, boys and girls have a common pattern of ICT use both at home and at school, with minor differences only in the use of graphics and word processing applications and in video games. We can therefore conclude that

boys and girls at that age do not have a significant difference in perceived pattern of ICT use and ICT skills. Moreover, the study found that there are no big differences in the perception of the GDD either. This supports the findings of other studies referenced in the literature review section, indicating that the GDD is not consistently broad, but that it tends to diminish over the years and can vary across different populations.

However, boys and girls have a different perception of themselves in relation to possible professional careers in the field of ICT. Namely, their expectations are different, with boys focusing more on the world of work and employment, and girls expecting more from the human side of the profession. This difference however concerns only potential future jobs (so a distant future) and not the actual choice of a university program (a nearer future). This specific finding seems to be new in this domain, and stems from the decision to focus on self-perceptions in a broad sense, extending the research scope beyond access to and use of computers and related skills. To the eyes of young people, ICT acquire meaning not as a technology, but rather as the enabling factor for developing a personal and professional identity. We think that this result can provide an interesting development track for educators and stakeholders in this domain.

Finally, boys and girls provide different indications about how they would like to learn to use ICT in schools: boys through integration across the curriculum and girls through time specifically devoted to digital technologies, with autonomous activities involving computer use.

This project provides fist data for a better understanding of the GDD at the transition from secondary to higher education or to the profession. As such, we hope it can be the platform for further research and development aimed at tackling these issues through collaboration with teachers and decision makers in the education system.

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