# Factors which influence girls' orientations to ICT subjects in schools. Evidence from Spain

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## ABSTRACT

The low representation of women in computer science and telecommunication engineering studies continues to be a topic of interest within the scientific community, and also a topic of concern to the policy community in Spain. The main aim of this paper is to review the literature in the Spanish language regarding the lack of interest and engagement of female secondary students in ICT-related subjects and careers. The content of the Spanish secondary educational system, the influence of stereotypical beliefs about men's and women's competences and attitudes towards ICTs and the way young women perceive their technology abilities are discussed in this paper. These aspects, together with a group of contextual factors specific to the context of Spain and the influence of parents and career advisors are tackled in this paper. The implications of the empirical findings and future research directions are discussed.

## KEYWORDS

Gender roles; stereotypes; choices; ICT subjects; secondary education.

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**INTRODUCTION**

The lack of women in technology and ICT-related subjects and studies has been the focus of interest of the scientific and educational communities during the last decades (Eccles, 1989; 1994; 2007; Cohoon and Asprey, 2006; Margolis and Fisher, 2002; Simpkins et al., 2006; Sáinz, 2007; Zarrett and Malanchuk, 2005). In Spain, as in other western countries, a complex interaction of different structural and psychosocial factors can be considered to be crucial explanatory arguments for the lower interest and engagement of young women in pursuing ICT-related subjects and studies. For this reason, the topic is not as simple as it seems and must be analysed taking into account the specificities of the educational system; the consideration of the ICT subjects within the academic curriculum; together with stereotypical beliefs about gender, technological expertise and attitudes towards technology.

In most western countries it is a common phenomenon to observe how young women are more likely than young men to aspire to careers in health and biology-related careers and also less likely than young men to pursue maths and physical science-related careers (Eccles et al., 1998; Eccles, 2007; Hannover and Kessels, 2002; Simpkins et al., 2006). In comparison to the over-representation of women in humanities and health related studies, young women are underrepresented in the university degrees of engineering and physical science. Women have attained many goals in our modern society, but they are still at a disadvantage in terms of playing an active role in the design and production of technological appliances and services in the current 'information society'. In this regard, women are not only underrepresented, but also poorly represented in technological fields as they occupy the less prestigious and lowest paid positions within the field (Zarrett et al., 2006).

In Spain the underrepresentation of women in technology-related studies and occupations, together with the poor representation of men in humanities and social sciences, has been widely documented by different institutions and research studies (Elejiabeitia and López-Sáez, 2003; López-Sáez, 1995; MESDP [Ministry of Education], 2011a; Instituto de la Mujer [Women's institute], 2010; Sáinz, 2007). Women represent respectively 17% and 26.59% in the university degrees of computer science and telecommunications engineering. However, whilst the participation of women in telecommunications engineering remains stable throughout the last 5 years, the rate of female engagement in computer science is on the decrease (Instituto de la Mujer [Women's Institute], 2010).

The lower enrolment of young Spanish women in technology-related studies begins to become an issue in secondary education, when students aged 16 have to choose subjects of further study to pursue to *Bachillerato* level. This is known as the 'tracking system' and at this point girls begin to opt out of technical

subjects, whereas boys begin to opt out of humanities and social sciences subjects.

For instance, during the 2008-2009 academic year (MESDP, 2011a), when young women outnumbered young men in secondary education, the rate of young women pursuing science and technology subjects in high school (39.6%) was lower than the percentage of young women enrolled in humanities and social sciences subjects (56.2 %).

In vocational training studies (MESDP, 2011a) at the junior level (post-16 secondary education level), the rate of women's participation in science and technology related subjects was 13.2% in contrast to an enrolment of women in the management and health branches of 75% and 88.2% respectively. In the higher level of vocational training (where there are more female students than in junior vocational training), only 16.3% of young women chose computing related studies and 5.8% electricity and electronics compared with 72.2% and 77.4% in management and health.

As the disparity in academic and occupational choices between young women and young men starts in secondary education, the main purpose of this paper is to provide an overview of some of the emerging literature and empirical research carried out in the Spanish language during recent years, on the factors that deter young women from pursuing ICT-related studies. Firstly, the role that ICTs play in the curriculum and in the schools will be covered. Secondly, some theoretical and empirical arguments will be merged in order to explain young women's lack of interest in pursuing technology and ICT-related studies. Thirdly, habits and attitudes towards computers and ICTs will be analysed with reference to the Spanish context. Finally, the role of parents and teachers will be considered providing empirical evidence on how they approach the use of ICTs.

## FACTORS THAT DETER YOUNG WOMEN FROM PURSUING ICT-RELATED STUDIES: AN OVERVIEW

### The Role of ICTs in the Secondary Curriculum

Secondary education is an important developmental and educational stage for several reasons:

- Adolescence starts at the age of 12, a period in life where the formation of gender identity is crucial for individuals and matches up with the first years of secondary education. The process of gender identity formation puts pressure upon young women and young men to act according to particular gender roles and conform to them (López-Zafra and López-Sáez, 2001). Consequently, young women and young men make decisions congruent with those gender roles in an attempt to be accepted by same sex peers and to accomplish parental and other significant people's goals.
- Secondary education comprises a complex variety of educational and developmental transition periods, critical in terms of developmental changes that young people experience. These transition periods shape young women's and young men's academic and professional aspirations and decisions (Eccles, 1994; Jacobs et al. 2002). Within the Spanish

educational system, the different transition periods during secondary education are as follows: the transition from primary to secondary school, which takes place at the age of 12; the transition from compulsory secondary education to higher secondary education or to junior vocational training, which happens at the age of 16 or above; and finally, the transition from higher secondary education to university studies or to higher vocational training, which takes place when students are 18 years old or above.

- People decide their academic and professional goals during the course of secondary education. For instance, at the age of 15 Spanish students start to decide on which study option they would like to engage with in the future. This decision will determine their future career plans and aspirations.

Before continuing it is necessary to have a quick look at the Spanish educational system and the role that ICT subjects play in the curriculum. Secondary education is divided into 4 years of compulsory education, the ESO (ages 12 to 16) and a further of 2 years of non compulsory education (ages 17 to 18), which are divided into either the *Bachillerato* (two years prior to university studies) or vocational training (comprising of two years to complete junior vocational training and three years to finish higher vocational training). In comparison to the *ESO* (Compulsory Junior Secondary Education) and the *Bachillerato* (Higher Secondary Education), the research community in Spain has not paid much attention to the vocational training phase (Elejiabeitia and López-Sáez, 2003). In general terms, vocational studies are less prestigious –in terms of academic achievement and professional aspirations– than university studies, despite some vocational graduates having more job opportunities than others holding university degrees.

The Spanish academic curriculum of Compulsory Secondary Education (ESO) offers the possibility of developing certain ICT-related skills as a cross-subject academic activity (MESDP, 2011a). This means that computing skills are not part of the core educational curriculum of secondary education, but skills which are regarded as components of all academic study. In some secondary schools, computing lessons are taught as a part of Technology, which means that computing skills are subsidiary and depend on the importance that these skills have for secondary teachers. These teachers in charge of the technology subject hold degrees in different engineering or other scientific or technical subjects, such as physical science.

In post-compulsory secondary education, the role of computing classes differs in the curriculum of the *Bachillerato* and for vocational training. On the one hand, computing is not a subject in itself within the curriculum of the *Bachillerato*. It is a complementary activity to other subjects and plays an important role in the technology-related subjects. On the other hand, vocational training offers a wide variety of specialties to those students who do not want to pursue university studies after the compulsory secondary education phase. Computing together with another 21 different professional topics can be pursued as a professional-

oriented activity in both junior and higher degrees of vocational training. Once the studies of higher vocational training are completed, the students have the opportunity to access university studies or move directly into the labour market.

Apparently, most schools in Spain have the necessary equipment to enable students to be educated in the demands of the information society. According to official data from the Ministry of Education, during the 2008-2009 academic year (MESDP, 2011b) the majority of primary and secondary schools (99.7%) have Internet connection. 87.1% of them (72.0% during the course of the previous academic year) have a broadband connection with a speed greater than 512 Kbps. The ratio of students per computer used for teaching and learning purposes is 5 to 3 in state schools. Connectivity rates are perfectly adequate for educational purposes (MESDP, 2011b).

Unfortunately, official data about quality of equipment and of access to the Internet is not available for schools located in isolated rural areas and those having a low socioeconomic intake. Research has corroborated that rural students -due to infrastructure problems- have lower access to computers than students from urban settings (Sáinz, 2007; Sigalés et al., 2007). On the other hand, students belonging to high and intermediate socioeconomic households have higher access to computers than those with lower socioeconomic backgrounds (Castells and Tubella, 2002; OECD, 2005; Sáinz, 2007).

**The Underrepresentation of Women in Technology-Related Studies**
If we consider that current Spanish society believes in promoting equality and equity between men and women in all aspects of life, and that young people should be brought up according to those values, the aforementioned imbalance in educational and occupational opportunities is striking. However, a recent study carried out with a representative sample of the Spanish population shows that the gender stereotyping has remained unchanged over 8 years (from 1993 to 2001) and follows the same pattern as in other western countries: the assignment of expressive-communal traits to women and of instrumental-agentic traits to men (López-Sáez, et al., 2008).

The assignment of different roles to men and women is associated with different expectations about male and female academic performance and occupational choices. In this sense, young men have traditionally been perceived as more gifted in mathematics and technology-related domains than young women, whilst young women have been thought to have more verbal abilities than young men (Eccles et al., 1998). As a result of this, young women have a lower self-concept of their competence in mathematical and technological domains than young men (Sáinz, 2007; Zarrett and Malanchuk, 2005), which also discourages them from pursuing mathematics and technology–related studies (Creamer et al., 2006; Dickhäuser and Stiensmeier-Pelster, 2003; Eccles, 1989 and 2007; Sáinz, 2007; Zarrett et al., 2007). A low self-concept of ability in certain domains also produces anxiety, which negatively affects performance and retention in the profession (Friend, 1982).

Additionally, stereotypical representations of occupations and professions as being more suitable for either young women or young men influence young peoples' decisions to pursue particular studies and careers. In this sense, the 'geeky' image of computer scientists and IT professionals discourages students, and particularly women, from pursuing studies in the field (Margolis and Fisher, 2002; Sáinz, 2007; Wyer et al., 2010; Sáinz and López-Sáez, 2010; Zarrett and Malanchuk, 2005; Zarrett et al., 2006). Female students are more likely to value people-oriented careers than male students. Male students place a higher value on wealth and competitive positions and are interested in careers involving the use of machinery, mathematics and/or computers (Eccles et al., 1999).

Children start learning about gender and gender roles from an early age in their families and communities because they are continuously exposed to occupational images, and their interests are frequently elicited through constant inquiries about their future aspirations (Low et al., 2005). 'What do you want to be when you grow up?' is a typical question addressed to young children. On the other hand, school education reinforces those gender-related learning experiences, which are in line with the division of the tasks and subjects more appropriate for young women and young men. In this sense, there is empirical evidence in the Spanish literature concerning the tendency of secondary school teachers and students to consider the technology path more masculine than other paths. Both groups of participants, teacher and students, assessed more positively those young women enrolled in the Nature and Health Sciences *Bachillerato* than those registered in the Technology *Bachillerato*. The participating students also attributed more intelligence, capability and other desirable personal qualities to young women enrolled in Medicine studies than to young women in Engineering studies (López-Sáez and Sáinz, 2008; López-Sáez et al. 2011).

A final aspect that is considered crucial in the decision-making process of choosing studies and careers is related to the way young people weigh the potential benefits and difficulties –costs- that they will encounter in the future (Eccles, 2007). In this sense, several studies report that young female students are less likely to pursue technology-related studies because they perceive that these occupations will not allow them to combine work and family roles (Eccles, 1994; Frome et al., 2008; Sáinz et al., 2009).

**The Influence of Attitudes Towards, and Habitual Use of Computers upon, the Subject Choices of Secondary School Students**
There is a wide variety of ICT devices, but most of the literature on gender differences in ICTs is focused on computers and the Internet. Conversely, the use of cell phones and other ICT devices is not extensively analysed. In terms of computer and Internet use, the studies carried out in Spain confirm that most young people have computers at home from an early age and use computers and the Internet more frequently at home than at school (Aranda et al., 2009; Castells and Tubella, 2002; Rubio, 2009; Sáinz, 2007).

When taking a gender approach, most studies conclude that young men use computers and the Internet more intensely than their female counterparts (Aranda et al., 2009; Castaño et al., 2008; Rubio, 2009; Sáinz, 2007; Sáinz et al., 2009). In contrast to young men, young women seem to make a more practical use of ICTs (Aranda et al., 2009; Sáinz, 2007; Sáinz et al., 2009). For instance, whilst more young men use computers for playing games and programming, young women seem to be more proactive than their male counterparts with blogs, social networks and school-related activities (Aranda et al., 2009). These different patterns of use are also confirmed when looking at the intensity and type of videogame use (Aranda et al., 2009). Young men played very different videogames to young women, especially action and sports-oriented videogames. Conversely young women preferred video games that simulate real life situations (Sáinz, 2007).

Contrary to young women (who refer to other members of the family, their parents or siblings), young men report themselves to be the most frequent users of computers at home. In addition, most young people (53.6%) aged 12 to 18 learnt their Internet skills on a self-taught basis.

All of the aforementioned factors are indicators of the extent to which young people can be acknowledged as being 'digital natives' (Bennett et al., 2008) and also of the active role young people play in the current information society. These different uses of ICTs contribute to the formation of attitudes towards ICTs and their final study choices. Furthermore, people prefer jobs and work environments congruent with their attitudes and preferences (Eccles, 1987 and 1994; and Dickhäuser and Stiensmeier-Pelster, 2002).

In addition, women's negative attitudes (by which I mean both their perceptions and their patterns of use) towards computers predict their lower interest in pursuing technology and ICT-related studies (Creamer et al., 2006; Volman and van Eck, 2001; Zarrett and Malanchuk, 2005). Some authors even suggest that a higher computer and ICT use is associated with young people's higher likelihood to pursue ICT-related studies. For this reason, young people who use computers or ICTs frequently, and who hold positive attitudes towards computers and ICTs, are more likely to pursue technology and ICT-related occupations (Meszaros et al., 2007; Zarrett and Malanchuk, 2005).

In this sense, research in Spain confirms that during secondary education young women hold more negative attitudes towards computers than their male counterparts (Ruiz-Ben, 2001; Sáinz and López-Sáez, 2010; Sáinz et al., 2009). However, and despite the fact that young women have more negative attitudes towards computers, they are less negative than their male peers about computer scientists' lack of social skills and self-centred character (Sáinz and López-Sáez, 2010; Sáinz et al., 2009). In addition, and in line with other studies in the US context, for both young women and young men holding positive attitudes towards computers and computer scientists was associated with higher interest in pursuing technology-related studies (Sáinz and López-Sáez, 2010).

Furthermore, those students with positive attitudes towards computers have a better achievement in computer-related classes than those with negative attitudes towards computers (Fetler, 1985). Empirical research even suggests that the use of computers during leisure time is also associated with higher enrolment in computer-related activities and studies (Durndell et al., 1990; Shashaani and Khaliki, 2001). In that regard, there seems to be a connection between computer game playing in childhood and comfort with computers and later choice of computing careers (Natale, 2002).

Simultaneously, self-competence perceptions shape occupational aspirations and study choices (Bandura, 1997; Bandura et al., 2001; Eccles, 1987, 1997). Literature about this subject confirms that young women report a lower self-concept of technological competence than their male counterparts, even though they outperform young men in those competences (Cooper and Weaver, 2003; Sáinz, 2007; Zarrett and Malanchuk, 2005). In this regard, research in Spain has observed that female secondary students report lower computer skills than their male counterparts. Participants with lower self-concept of computer skills are less likely to pursue ICT and technology-related studies than those with higher self-concept of computer skills (Sáinz, 2007; Sáinz et al., 2009).

In general there is evidence to show that young women also seem to value less positively than young men computing and technology-related studies as an option to be pursued in the future (Sáinz, 2007; Zarrett and Malanchuk, 2005). Consequently, young women decide to opt out of studies associated with technology. However, the research covering Spain specifically is not so clear cut: female students do not always see computing classes as less useful for their future study topics. The Spanish data certainly seems to be congruent with the fact that computing skills are treated as generic in the Spanish education system.

*Moderating role of contextual variables of gender differences in computer attitudes*
In this sense, some research has also incorporated a group of overriding variables within the context of Spain in order to further analyse how these variables moderate gender differences in young people's computer attitudes. These contextual variables are the following: socioeconomic position of the student's household; the mother's occupation; the place where the student lived (rural versus urban settings) and the study areas student has chosen in post-compulsory education.

When considering the influence of socioeconomic factors and the mother's occupation, it is observed that this factor is a moderator of gender differences in computer use. Consequently, young men and young women from higher socioeconomic households use computers more frequently than young men and young women from intermediate and low socioeconomic households (Sáinz and López-Sáez, 2010). The level of gender differences in computer use is stronger among young people from upper socioeconomic households. On the other hand, the mother's occupation also moderates the relationship between computer attitudes and gender. Thereby, young men whose mothers work outside the

home hold a more positive vision of computers, together with more positive beliefs about computers and computer science professionals than young men with unemployed mothers. In contrast, young women whose mothers do not work outside the home hold more positive beliefs about computers and computer science professionals than young women whose mothers are employed outside the home (Sáinz and López-Sáez, 2010). As there is no clear explanation on how to interpret these findings, more research should be carried out in order to address this topic.

Where young people live (rural versus urban settings) has been also taken as a moderating variable. Students living in rural areas seem to use computers less frequently than students living in urban areas (Sáinz et al., 2009; Sigalés et al., 2007). Simultaneously, those students living in rural settings use computers more frequently at school than at home, whilst young people living urban locations use computers more frequently at home than at school. Students living in rural areas seem to be more positive towards the usefulness of computers for their future professional development than students living in urban areas (Sáinz, 2007). On the other hand, young women living in rural areas hold more positive attitudes towards computer science professionals' social skills than young women living in metropolitan areas. Nevertheless, young men living in urban areas hold more positive attitudes towards computer science professional's social skills than young men living in rural areas (Sáinz and López-Sáez, 2010). These differences in the rural and urban settings may be associated with different leisure habits that young people develop in both settings and with the differences in the assignment of male and female attributes. As social skills are more salient in rural than in urban areas, young women living in rural settings value computer science professionals' social skills more positively than do the rest of their male and female peers.

Concerning the influence of the type of studies chosen in post-secondary (post-compulsory) school (*Bachillerato*), young people enrolled in the technology track hold more positive attitudes towards computers and computer scientists than students enrolled in other subject areas (Sáinz et al., 2009). These students were also less likely than students enrolled in the other tracks in post-secondary schooling to consider computer scientists as geeks or as isolated people who use computers for the main purpose of earning money (Sáinz and López-Sáez, 2010).

Longitudinal research on gender differences in computer attitudes has also been conducted with students who are in transition from the last course of compulsory education to the first course of post-compulsory education. In this study, students report more positive attitudes towards computers and computer science professionals when they are enrolled in junior secondary education than when they are in higher secondary education (Sáinz et al., 2009).

An investigation of young men's and young women's differences in self-concept of computer ability across time observed that whilst young women' self-concept of their computer ability decreased over time, young men' self-concept of

computer ability increased a year later, when they were enrolled in the first course of higher secondary education (Sáinz and Eccles, 2011). Over time it was also observed that living in urban areas, belonging to intermediate income households and holding a high self-concept of computer ability, were all factors that increased the chances of pursuing ICT-related studies. Thereby, students living in urban areas with an intermediate income household and with a high self-concept of computer ability are more likely to pursue ICT-related studies (Sáinz et al., 2009).

**Are Parents and Teachers Positive Towards ICTs?**
Parental encouragement is strongly and positively associated with young people's attitudes towards computing (Shashaani, 1994). Young men are more likely than young women to receive more encouragement from their parents to improve their knowledge about ICT (Vekiri and Chronaki, 2008). With regard to the type of ICT use that young men and young women report receiving support for, more young women report that they have received encouragement to use computers for learning purposes (such as for doing their homework) and for communicating with other people. Young men report having been encouraged to use computers for their own sake and because they can play and have fun with computers. Sometimes, however, more young men are discouraged from using computers because of their overuse of them for play (Sáinz, 2007).

Not only is parental support influential for the ways in which young people use ICTs generally, but it has also been found to be crucial in the decision-making process of choosing studies and occupations and in shaping attitudes, habits and uses. Young men are more likely than young women to receive more encouragement from significant others (parents, teachers, school advisors or peers) to pursue technology-related studies (Cussó, 2007; Creamer et al., 2001; Eccles et al., 1999; Sáinz et al., 2009; Zarrett et al., 2006). Young women, on the other hand, are more likely to report encouragement for pursuing studies related to humanities or health and social sciences. Advice to pursue ICT and computing-related studies has been found to play a major role in the prediction of those studies (Sáinz, 2007; Sáinz et al., 2009; Zarrett and Malanchuk, 2005; Zarrett et al., 2006). In addition, being encouraged by significant people to use computers helps students to develop interest in IT and consider IT as a future career option (Meszaros et al., 2007).

Similarly, parents and teachers hold misconceptions about different occupations and the most appropriate studies for young men and young women. They share these misconceptions with their children and students, expressing them via opinions, judgements or behaviours. Some parents seem to reinforce the belief about computer scientists' lack of social skills and geek attitude, even reporting that they wouldn't like to choose computer science as a study option if they had to decide on what type of future studies to pursue (Sáinz et al., 2011). Consequently, young people hold incorrect and inaccurate beliefs about ICTs and ICT-related occupations (Sáinz et al., 2009). On the other hand, parents and teachers are role models for young people. Women are more likely than men to

start using a new technology because people they like and respect are doing so (Venkatesh and Morris, 2000).

In terms of controlling their children's computer use, young people aged between 16 and 18 have a higher independent use of the Internet than young people aged between 12 and 15 because they can negotiate the type of use they make of the Internet with their parents. In general terms and with respect to the rules at home regarding Internet use, young men report more rules related to the frequency of Internet use, whilst young women (especially those with aged between 12 and 15) report limits on the websites they visit and the type of people they get in touch with on the Internet (Aranda et al., 2009).

A qualitative research study on Spanish parental attitudes towards their own and their children's use of ICT observed that parents who do not consider themselves as skilful as their children at using the new technologies are reluctant to use ICT. Some parents exaggerate the actual competences that their children have while using ICT. Most of them consider it necessary to impose controls to prevent their children from overusing ICT or from accessing adult websites: for instance, by setting limits on their talk time or by putting access filters on certain websites, etc. (Sáinz et al, 2009).

On the other hand, some researchers speculate that some secondary teachers have lower computer skills than their students. This aspect has not been sufficiently documented in the Spanish context. However, the aforementioned qualitative study shows that there are teachers who seem to be reluctant to use computers and other ICTs in their teaching. In contrast, there are teachers who have positive attitudes towards incorporating ICT tools into their lessons. They also consider it necessary to motivate their students using new innovative activities and materials. Teachers of technology-related subjects seem to value more positively the advantages of ICT to support their teaching strategies than those teaching history or other non-technological or scientific subjects (Sáinz et al., 2009). On the other hand, some teachers recognise that their students are born in an information society and for this reason they are competent users of the different technologies. Additionally, some teachers are sceptical about how knowledgeable some young people are of computing.

A recent study involving interviews with 2,162 secondary teachers in 350 educational centres representative of all primary and secondary schools in Catalonia (Spain), shows that secondary teachers' computing skills are predominantly self-taught and internet use in the classroom is not a common practice (Sigalés and Mominó, 2004). 71.2% of teachers report that they never connect to the Internet in the classroom. 10.8% reported that they connect for one hour per month, 12.3% between 2 and 5 hours and only 3.2% more than 5 hours per month. Among younger and older teachers there is no difference in Internet use in the classroom, despite the fact that younger teachers are often more experienced at using the Internet than older teachers. Consequently, it can be concluded that younger teachers reproduce the practices of older teachers. Teachers in vocational training courses use the Internet more frequently than

other teachers, which could be attributed to the high technological content of these types of courses (Sigalés and Mominó, 2004). Laudo and Mominó's (2005) study also finds a strong association between teachers' use of ICTs in the classroom and the general predisposition to respond flexibly to their pupils' diverse learning needs; these are both much less in evidence among secondary school teachers than among primary school teachers, and among men than among women teachers. This seems to be quite specific to Spain: it suggests that pupils have more exposure to ICTs in primary education and vocational training than they do in secondary education.

## DISCUSSION

As most of the existing literature about the topic comes from North American and other non-Spanish speaking western countries, a combination of Spanish and non-Spanish literature and research has been merged in order to analyse the most relevant arguments related to the lack of interest of young women to pursue ICT-related studies. For this reason, the present paper is an attempt to bridge the gap in the lack of studies about this subject carried out in Spain. Consequently, a group of contextual variables has been gathered in order to argue their moderating influence on gender differences and similarities in attitudes towards ICTs. These contextual variables characterize the Spanish background and provide us with a new research avenue into the study of gender differences and similarities in attitudes towards ICTs and the pursuit of studies through this specific period of the life course (the secondary and post-compulsory secondary years).

The literature and empirical review carried out in this paper shows that young men and young women make different uses of ICTs. Some of the studies conducted in the Spanish context are not representative of the Spanish population, but they can shed light onto some of the deterrents to women's interest in pursuing ICT-related studies. In general terms, the literature in the field seems to indicate that young women have a different approach to ICTs than young men, but not because young women do not use them or have no interest in them. The tracking system described in the introduction together with parental and career advisors' influence seem to be the most important moderating factors of gender differences in attitudes towards technology within the Spanish literature.

The gender gap in the use of ICTs in the Spanish context is associated with the type of use adolescents make of ICTs and not with their access to ICTs. Nevertheless, and in line with other authors, being exposed to computers and ICTs and holding positive attitudes towards ICTs are not enough to develop interest in entering a computer or an ICT-related career (Deyoung and Spence, 2004; Meersmith et al., 2008). In addition, young women's low interest in pursuing technology and ICT-related studies seems to be associated with their lower perception of ability and to more negative attitudes towards technology.

As observed in the review, there are some explanatory variables within the Spanish educational and non-educational settings that seem to moderate the

existence of gender differences in computer attitudes and the pursuit of studies. These contextual variables may contribute to shape the differential pattern of career interests and aspirations observed in young men and women.

However, the influence of young people's parents' and teachers' beliefs and misconceptions about ICTs should be taken into consideration when analyzing young men's and young women's differential approach to ICTs (Vekiri, 2010). If parents and other influential people do not encourage young women to pursue computer-related studies, they will hardly have a positive self-perception of their abilities in the field and will show no interest in pursuing computer-related studies. Simultaneously, if young women are expected to pursue a people-oriented study programme or career, some of them will fulfil such an expectation and will be reluctant to choose careers incongruent with the prescriptive social roles (such as ICT-related studies).

Similar to other educational systems, in the Spanish system the use of ICTs for teaching purposes starts in primary education and continues into secondary education. This means that primary school students have relatively high exposure to computing. However, the rigid structure of the secondary system with its tracking system blocks students' opportunities to move to different subject areas from those taken in *Bachillerato*. This conditions students' study choices, particularly those of students enrolled in non-technological and scientific tracks, mostly women. If girls normally opt for humanities and social science studies at Bachillerato and university level, they find it very difficult to choose technology related studies at a later stage of their education. As in other countries, the low status of ICT-related subjects in the secondary curriculum, together with the uninspired use of ICTs by teachers in the classroom, may condition teachers' and pupils' appraisals of the relevance of ICTs for the formal educational system.

So there is a problem in Spanish ICT education. On the one hand, more innovative teaching strategies are needed to meet the learning needs of a new generation of young people growing up in an information technology based society. However, the need for such strategies conflicts with the rigidity of the existing secondary educational system and of some of the teachers who do not see the need to deploy ICTs creatively in their teaching activity.

Apart from the fact that the empirical evidence obtained in the Spanish context corroborates research conducted in other contexts, there are many lingering questions to be raised as a result of the analysis in this paper. Is it really necessary to increase the access of women into ICT-related studies? Does the ICT field provide women with better opportunities for professional and personal development than other female-dominated fields, such as nursing or humanities-related professions? In comparison to other sectors and fields, do women in this sector have more opportunities for making life and work compatible? Why are technical degrees less attractive than other university studies for young students?

In conclusion, the current paper provides an original contribution to the life course approach, focusing on the deterring factors to young women's pursuit of ICT-related studies and careers within the Spanish context. The early academic decisions that Spanish secondary students make prevent them from engaging ICT studies at a later stage of their education. Although young people can currently be considered as digitally competent, few of them (especially young women) decide to pursue ICT-related studies, a field that offers many different opportunities for men and women.

## FUTURE DIRECTIONS

Although the main focus of this paper is on why young women are not interested in ICTs and technological studies, we should keep in mind that young men are increasingly losing their interest in enrolling in technological studies (see Müller, 2011). This also raises several questions, such as: Is there a balance between the efforts to pursue technological studies and the benefits that students can get from them? Does the labour market compensate for the efforts invested in pursuing technological studies?

In general terms, more research is needed to analyse the direct link between the use of ICTs and the pursuit of ICT-related studies. This avenue of research is still open as there are many gaps about the association between involvement in different leisure activities (not only related to ICTs) and study choices congruent with them. Consequently, further research with young people with specific interests in pursuing ICT-related studies should be carried out in order to know more about the relationship between attitudes towards ICTs and ICT-related career choice. For this reason, the inclusion of some context-specific variables in the study of this topic may also shed light into the study of gender differences in occupational aspirations and career choice.

In addition, more longitudinal research should be carried out in the field in order to analyse the origin of gender differences in self-perception of ICT-related abilities together with differences in attitudes towards technology. This type of research should pay special attention to specific transitions of the educational system, such as the transition from primary to secondary education and later from the transition from high school to university studies. Within the Spanish educational context, the transition from compulsory education to higher secondary education is an interesting educational stage to gain knowledge about how the pursuit of traditional and non-traditional male and female studies and occupations in Spain take place (Sáinz et al., 2009).

Further empirical research with vocational training students who have chosen computing in either junior or senior level should be carried out in order to gather evidence about the gender gap in the field and the reasons why those students have decided to opt out of university studies in computer science. What are the differences and similarities between the programs offered in vocational training and the ones offered at university? Do the aforementioned training programs fit the needs of the current labour market in Spain? Furthermore, more cross-cultural research should be developed in order to systematically study this

phenomenon in countries with educational systems that are similar to, and different, from Spain.

As some of the studies on teacher use of ICTs lack a gender perspective, more research should also be conducted in order to analyse the current competences that female and male secondary teachers have in ICTs and how their use could improve their teaching practice. The effect of the lack of female role models mastering tasks related to technology and ICT lessons on students' aspirations and conceptions of technological studies should also be the scope of future studies carried out with students enrolled in different educational levels. Furthermore, longitudinal research is also required in order to analyse parental and career advisors' influences on the decision-making process of choosing a career through the different stages of the life course. These extra research insights would contribute to a better understanding of how girls and women engage with ICTs throughout the life course.

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