Supporting Gender Equality in Science Technology and Mathematics related choices of careers

Abstract

The study "SESTEM"(Supporting Equality in Science Technology and Mathematics related choices of careers) addresses the wide problem of gender imbalance in STEM. The low uptake of Science, Technology and Mathematics (STEM) constitutes a research and policy concern world wide for some time now. In the EC, while the related benchmark appears to have been achieved, there is evidence to suggest that the problem on access and retention of females in STEM remains an unresolved issue. Likewise we lack tools so as to allow to reflect on good practices in supporting choices making for careers in STEM by girls. It focuses on issues related to gender differences across various items such as family, school, school guidance, careers.

Gradually, as the pupil, then the student, goes through the various stages of the educational system, many factors are involved in his/her decision to choose STEM or not and to persist or not in this choice. The lack of female role models, gender stereotypes in textbooks and mass media and teachers' expectations regarding the results of their female students in science subjects are not likely to encourage girls to study mathematics, engineering and science. Despite the academic success of girls, they are underrepresented in STEM pathways and therefore women are less likely to pursue careers in STEM. To explain this underrepresentation of girls in STEM, we look at external factors such as school, family and labour market, which can generate a differential socialization. But we also consider internal factors, such as individual strategies of female students, differences in motivation, interests, self-esteem, etc.

We explore how, from primary school, a gender division of knowledge is taking place. We also consider the mechanisms of “self-censorship,” “self selection” of young girls who make “reasonable expectations” and are moving into jobs that seem more compatible with family life (a concern that is not often found among boys). Our contribution to the discussion is to provide points of comparison from various countries on these issues.

SESTEM reviewed documentation from the European Commission, as well as from national policies, and identified four target groups: pupils, parents, students and teachers, hence the importance of highlighting this triangulation factors: family, school and individual.

Based on this approach, SESTEM developed a position in respect to: the construction of sexual identity within family and school, the family influence on education, the importance of orientation and career choices, the gender differences in the educational system, the different interactions between teachers and students, the images and gender representations through children's literature, toys, or TV, the role of information on career choices, and once entered the labour market, the place given to women in science and research.

In this document, SESTEM introduces the project itself, presents a review of the key discussions taking place in Europe focusing on gender and student’s motivations regarding orientation and career’s choices, with suggestions derived from the results of the project. We hope this document will inspire a productive discussion in this community.
1. Presentation of the study SESTEM: Supporting Equality in Science Technology and Mathematics related choices of careers

SESTEM is built on the premise that the study of the uptake of STEM studies by girls and their retention in the field can benefit from investigation into the triangulation of family-individual and school (secondary and tertiary) factors. Under this scope, SESTEM aims to conduct four interrelated comparative studies engaging students, pupils, parents and teachers (both secondary and tertiary levels). Both **qualitative** (in depth interviews, conceptual mapping, tandem based dialoguing and review into existing literature) and **quantitative** (collection and analyses of data from across the Member States using on-line survey methods, and meta-analyses of existing statistical data) methods are being applied. SESTEM, through its studies aims to deepen understanding into the process of decision making in career choices, the process of enhancing school-family collaboration in support of girls' engagement in STEM and into the contextual, cultural and social conditions that support retention of women in STEM related fields of studies, especially beyond the level of a Bachelors' degree. The consolidation of studies results will define a set of composite indicators (complemented with parental and teacher good practice guidelines) for monitoring progress towards achieving equity in STEM. The project's tangible outputs are to be localized in Greece, France, Germany, England, Spain and Poland. It is envisioned that project in the short term will have an impact on parental-school collaboration and on the long term on increasing girls retention in STEM.

The project objectives are:

- To increase understanding into the process that impedes upon girls' uptake of science, technology and mathematics studies. Such an understanding can be instrumental in promoting equality, personal fulfillment, and thereafter employability.

- To deepen understanding into the factors that promote/impede upon the uptake of STEM related areas of studies from a school orientation. The articulation of an indicator system fosters both the quality of provisions and the transparency of the prevailing conditions within the systems of education.

- To promote transparency and raise quality of Educational Systems, through the comparable data gathered from the undertaking of the four studies and the treatment of their results in a comparative manner into indicators and subsequently to good practices.

- To generate comparable data (across the participating Member States) which is in turn considered under a unified analytical framework.

- To investigate national policies under the Education and Training 2010 perspective.

- To support policy development by supplying it with evidence-based research results translated into a system of indicators. This is achieved through the comparative analyses of data at the national and target group levels.

2. Context of the study

2.1. The weight of gender stereotypes

Whilst coeducation was established in the early 20th century, it was not until the 1950s and 1960s that a large number of girls could access the different educational levels (primary, secondary, and higher education). Even then, education institutions were viewed as responsible for promoting gender stereotypes through the curriculum content, pedagogical practices, and institutionalized gendered practices (promotions of staff, the gendered nature of teaching subjects, the feminization of primary teachers, and so on), gender stereotypes still have direct and indirect effects both on the educational offer and on careers and social positions available when female students complete their studies. Studies also suggest that student/teacher relations differ according to the gender of the latter in terms of teaching interactions and outcome or performance expectations. Gender inequalities remain with the educational staff, both in teaching and management posts, and thus maintain gender-based hierarchical gaps for equal competences (Giannini Belotti, E. 1974). Finally research emphasizes that the recognition of gender still remains a challenge in most educational systems, and that important gendered work, such as caring for others, is not sufficiently recognized or valued. How to explain that in the 21st century, orientations and career choices of girls are still under the influence of gender?

Today, although the majority presence of women in universities is remarkable, the very slow growth of women's representation in traditionally male disciplines, particularly in STEM, encourages seeking the causes and factors of that under-representation. To describe the situation of girls and women in STEM, we shall identify factors related to such gender stereotypes, the influence of family, school, or the girls and women's representations concerning studies and careers in STEM (Duru-Bellat, M., Jarousse J-P., Labopin M-A., Perrier V. 1993). The gender-based socialization is often put forward to explain the differences between girls and boys. This
concept is transversal to various spheres and to study socialization, it is necessary to take into account the historical, sociological, cultural or psychological context. After clarifying briefly the different "spheres" that influence differentiated socialization of girls and boys, we shall focus specifically on two important institutions: family and school.

These gender stereotypes participate in the construction of individual’s identity, who defines him/herself in relation to social expectations traditionally attributed to her sex (Marro, C. & Vouillot, F. 1991). Such stereotypes of masculine and feminine are conveyed and/or reproduced by anyone, and in particular in education.

Thus, these gender stereotypes define a set of roles and tasks very different according to the sex that impregnate strongly enough individuals. This differentiated socialization also partly explains the differentiated orientations between boys and girls (Duru-Bellat, M. 1994). The girls, more sensitive and attentive to the communication, "would be naturally "more inclined to letters; boys, more moving, more "rational", "less sophisticated" would be more inclined to science. Obviously this gender socialization and stereotypes ends up creating those tastes among boys and girls and impregnate also teachers in their guidance and in their orientation decisions

2.2. Family environment: the mobilization and educational parents’ aspirations

We are witnessing a strong mobilization of parents in children's education. Certainly, attitudes toward school differ by social background, but all give it a great importance and develop great expectations toward it. Most families attach importance to academic achievement, developing a relation more individual and more strategic with school.

A recent study of IPSOS / DIF27 on "Parents and the gendered representations of jobs"1 sheds light on the perception of parents of children 6 to 17 years about the career in general and the link with gender stereotypes . The purpose of this study is to "understand if parents believe that certain criteria in choosing a job are more important to consider for a girl than for a boy (and vice versa) and whether some sectors job providers were currently more recommended to one or the other (and vice versa). The conclusions of this survey are that the important in choosing an occupation for fathers and mothers, for a girl as for a boy, is the "balance between work and private life". But regarding to the flexibility of working hours, there are differences. It is quoted in 44% of cases for a girl and only 19% for boys; for a lot of parents, it is important that a girl can adjust her working hours so she can take care of her home and her children. Furthermore we can see that the traditional gendered division of trades is still present. Parents' answers are different depending on whether the question is about a girl or a boy. Services sectors remain associated for parents with "girl's occupations", while those in building, industry and energy are frequently perceived as "boys’ areas". Representations of gendered occupations remain, we shall return to this point later, when we shall examine the representations of sectors and professions by young people themselves.

These judgments and expectations of parents are related to the image children develop of themselves and their own skills. Occupations cited by parents for their child's future career reproduce the very strong labour market segmentation. Despite parental declarations, that go in the sense of an education’s equalization, differences persist from an early age: there is indeed a gender-based socialization. The parental answers in early childhood are often differentiated by sex of child: some qualities are preferred for girls (patience, calm verbalization...) while others are encouraged for boys. Moreover, games and books are very gendered and reproduce in part the gender division of social roles.

In addition, parents have the greatest influence on academic performance. Research shows that a positive environment at home, positive attitudes toward education and toward school and high expectations of achievement have a significant effect on the children’s performances, and this, whatever the social backgrounds.

2.3. School environment: the different practices and attitudes of teachers

The educational institution perpetuates gender stereotypes because teachers have different expectations and practices toward boys and girls. It is very common, for example, to hear that boys are "naturally" good at maths, while girls are more gifted for literature and art subjects. Today we know that there are mechanisms in school, at work daily in classrooms, which may contribute to making distinctions between pupils.

They have consequences on how pupils invest the various disciplines and on how they perceive their competence in these disciplines. The verbal interactions between teachers and pupils and the relation between these interactions and the teachers’ judgments focus on the academic "value" of pupils are a good example of

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these mechanisms. All of these interactions and these expectations shape different behaviors among girls and boys. Differences in attitudes of parents and teachers are valuable indications of that differentiated socialization of boys and girls, but the weight of gender stereotypes also passes through the image, the representations.

2.4. Stereotypical representations and images of disciplines and professions

Several studies show that children are confronted with a vision of a segregated labour market where women are underrepresented and confined to circumscribed areas (Epiphane, D. 2007). Gender-appropriate behaviors of children are stimulated and reinforced positively or negatively by parents and other stakeholders of socialization. It is the case at school where the teaching practices contribute to the construction of gender inequalities. Pupils receive through the manuals, programs and interactions with teachers a lot of information on appropriate behavior for their sex. The mixed education that is currently practiced in schools, far from being neutral, enhances the male gender.

Indeed, the current status of the labour market gives an image almost identical for all countries of the world, that is to say, a feminine connotation to the service trades where the insertion is more difficult and the salaries lower, and a concentration of men in the technical and industrial sectors where integration opportunities and income are much more favorable. These studies help us to understand what factors or characteristics of the trades influence girls and boys’ stereotyped representations (Phipps, A. 2008).

Studies about the representation of jobs according to their status of masculinity, femininity, or prestige have shown clearly the gendered differences of the representations. The girls mark their preferences for care's jobs or social ones, while boys prefer the scientific and technical professions mainly characterized by a high pay. The studies emphasize that at a very early age, there are already stereotypical perceptions of the professional world and gender patterns.

Investigations have therefore found that the girls would care very young about the problem of work-family balance, which would influence their professional projects, although they are still vague and abstract. The boys, for their part, would regard the work as a central element of their lives and would take little account of aspects of family life in their choice of training and career opportunities. Research findings suggest that girls, even when they are considering or choosing a career scientist or non-traditional, continue to have stereotypical representations of the professional world and conform to traditional patterns of gender role. Even when girls say they have abilities equal to those of males to access to technical professions, they generally declare they envisage a "feminine" trade. Moreover, when girls get into scientific areas in order to access to scientific careers, they do not come with the same representations and show greater difficulty in identifying with the scientific model. Presumably the girls have to deal with institutional and cultural barriers that do not meet their male schoolmate. The gender division of the work also models young people’s gendered professional representations which, in turn, influence their career choices as a boy or a girl. From this point of view, the training courses play an important social role for adolescents.

Both in reality and in fiction (books for children, television etc.), women are often represented in a very stereotypical way: inserts almost exclusively family, domestic activities, very traditional and little varied professional roles. The result of this is a lack of female examples valued and rewarding for the girls. Indeed, it is exceedingly difficult for a young to project him/herself in a professional world usually reserved for the opposite sex and to consolidate in his/her choice, it is necessary to have models of his/her own sex. The importance of models has also been demonstrated in career choices for young girls: the presence of a female scientist in the family (mother, aunt or older sister for example) can raise the presupposed incompatibility between women and science (Ferrand, M., Imbert, F. y Marry, C. 1996). In particular STEM professions are seen as male domains and the image is still more stereotype-oriented in advantage of men.

Boys and girls have different motivations about their future: this difference has a direct impact on the choice of studies and professional careers. The boys usually opt for schools and courses that they see as providing prestigious and paying jobs and. Girls move away from scientific careers because they are much more motivated by a need to help others (social utility) through other school courses (law, health, psychology ...). In addition, girls are also dubious about the compatibility between work and family life, perceived as very difficult to achieve in occupations such as engineers or scientists. We note, in fact, that part-time and career breaks are more frequent for women. The girls would feel that these adjustments would be particularly inconsistent with jobs in the STEM fields. In spite of a real progress of women in certain scientific fields, women scientists would be still little visible, ignored by the media and still presented as marginal. The small number of feminine models would remain one of the factors explaining the indifference of the women for the sciences and the technologies as well as their hesitation to make a commitment in these
domains. Girls would also get more doubts and tend to undervalue their own skills, and so to doubt of their abilities to undertake such studies, what is less observed among boys.

**The image of STEM influence the interests and tastes by sex**

Women tend to want to return to human values and social utility in their profession. The science is still represented as a field of practice away from social, human and ecological concerns, it would always be perceived as a strict and abstract discipline, leaving little room for imagination. For many women, the technical aspects, seen as cold and mechanical, dominate the multidisciplinary and convivial aspects of science (Mendick, H and alii. 2008).

2.5. The various influences, from family to teachers, from personal factors to labour market

The environment plays a crucial role in the development of personal identity. Thus, the relationship with parents, their occupations, their relation to work, their work-related values influence the career of the young positively or negatively. Careers guidance decisions are influenced not only by the professional representation of teenagers and parents, themselves shaped by the existing gender division of jobs and training, but also by the personal identity of each, based on sex roles and stereotypes. The existence of socially visible scientific women is a powerful factor, allowing girls to project themselves into a different future.

At school and at university, the girls choose more literature and humanities, boys predominate in science and engineering. Girls are more motivated and more ambitious but their professional project already announces a disinterest to the sciences. This is therefore a "self selection" of girls. But what does this self-selection mean? The overestimation of the men’s capacities, the anticipation of the future by the girls (their social roles), the aversion for competition explain the career choices of girls and boys. This aversion of girls for mathematics and science is built by the society and is based on stereotypes.

The last decades have been characterized by many changes in gender relations and in the very foundations of the family, decline of marriage, growth in births outside marriage and marital breakdown, and disruption of feminine behavior by extension of women’s work, rising age of women at first birth, decreased birth ... not to mention the symbolic changes, affecting gender identities and norms of gender relations (Segalen, M. 2000). At the same time, the family roles of men and women redefine themselves: while women invest the

workplace, men become more involved in family life, especially with their child. All these developments and the improvement they have implied in the social status of women, however, did not lead to an equitable distribution of responsibilities and functions between men and women in domestic life.

As we saw it previously, the girls and the boys are differently educated in the family and at school, and this differentiated socialization is going to lead them towards different jobs and professional spaces. It is not the training of the girls who is the major determiner of the division of labour between the sexes, but the girls adapt their school investment to what waits for them in the professional life. Thus, these different orientations according to the sex would also result from an anticipation of the labour market (Marry, 2004; Laufer, 2005). The girls anticipate their future professional position and making it, turn in girls’ sectors where they consider that they can find then more easily some work. If the women turn in particular to letters, towards the sanitary and social studies, etc. it is a way of anticipating their future position in the labour market. If the women go towards some sectors, it is because they anticipate their family roles. For example: the fact of teaching allows at the same time to have a salary but also to get time to bring up children. For the men, it is the opposite because they invest less the domestic sphere.

2.6. Underrepresentation of women in scientific and technical careers

The feminization of the working population did not lead to a big mixed working world. The segregation, vertical and horizontal, remains a structuring feature of the labour market. The parity is very present, the women represent near half of the active population but this one does not rhyme with mix nor equality 2. Men and women do not divide up in the same spheres, the same sectors of the economy. The women remain concentrated in sectors and feminized jobs. The horizontal and vertical integration remains a dominant feature of the distribution of the feminine and male jobs in the major part of the countries of the European Union. The possibilities of access to higher jobs in the hierarchy remain complicated for the most part of the women.

The science is not presented as a feminine job and it has a deficit of image towards women. The school and family environment is often little favorable to the access of the girls to the scientific sectors. It is often suggested to them to prefer the jobs by the law or by the health. The

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2 European Commission (2006), SHE Figures - women and Science Statistics and Indicators
women are less attached to the notion of power and management. Numerous actions aim at demythologizing the sciences and at fighting the prejudices which take away or divert the girls of the scientific and technological careers.

In all fields, the number of female PhD graduates has increased much more rapidly than the number of male PhD graduates, even in life science where women already form a majority. But, in all three sectors and in nearly all countries studied, the proportion of male researchers exceeds that of female researchers.

2.7. Obstacles and barriers to women’s carriers

Lack of female role models
Another aspect which can positively influence women in the progress of their career is female role models (Mariotti, F. 2002). Female role models are very important in male-dominated disciplines out of different reasons. Firstly, they can encourage and provide confidence to students and also encourage women researchers following a career in these disciplines. Introducing young women to successful role models can be a good way to enhance their chances of success.

Work-life balance
One of the main reasons why women do not progress in their career in the same way than men is often related to the difficulty of work-life balance. Emphasis on steady and continuous research activity especially in science in technical disciplines is one of the key elements. Any breaks or delays in the academic career are generally seen as obstacles, as the lifetime and research-time of a scientist are supposed to be harmonized (Solga, H. & Pfahl, L. 2009). Different studies (e.g. ETAN and WomEng) point out how difficult it is for women to meet this demand of a steady and continuous career when planning a family.

Pay gap
In a major part of Europe, the equality of salaries between men and women does not exist. The women remain significantly less paid than the men. These gaps also result partly from the educational guidance of the girls which leads them towards the functions which are considered “natural” for them, as the communication or the human resources. The gender pay gap is a component of all gender inequalities, in research as well as in other occupational sectors. The gender wage gap is in a sense the final and most synthetic indicator of the inequalities between men and women that structure the labour market. The gender differences regarding the income are also present in STEM professions.

2.8. The actions and policies implemented in Europe on the theme of gender and STEM

Since 1996, the strategic approach of the Commission in the field of equal opportunities between women and men is the “mainstreaming”, that is to say the integration of equality of opportunities in all major policy areas. With a few exceptions, all European countries have, or plan to have, gender equality policies in education. The primary aim is to challenge traditional gender roles and stereotypes. European countries apply different measures to reach this goal such as vocational guidance, gender-sensitive teaching or curricula revision. However, European schools today are far from using all potential means to eradicate traditional gender roles. What boys and girls can and should do in their future professional (and personal) lives is still very much shaped by traditional concepts of gender roles.

In connection with the main aim of challenging gender roles, countries usually focus on three main areas. Firstly, there are policies centering attention on the hidden curriculum and school climate, mainly to combat gender-based harassment in schools. Another policy priority is to enhance the representation of women in decision-making bodies in the education sector. Finally, a limited number of countries identify the objective of counteracting gender-based attainment patterns. Policy frameworks in Europe range from no policy action to a broad definition of problems. Government initiatives that aim to inform parents about gender equality issues and involve them more closely in promoting gender equality in education are rare.

The average patterns of girls’ lead over boys conceal important differences among certain groups of boys and girls. Socio-economic status remains the most important factor explaining student achievement; thus it is important to consider family background alongside gender when supporting children who are under-achieving.

Many young men and women in vocational schools and general secondary education still opt for career choices reflecting traditional gender roles. Better vocational guidance is needed to address this issue and for career advisers to be more gender aware and thus more able to challenge stereotypes which exists in school cultures and among students and employers.

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3 For this we have taken the recent work done by Eurydice; “Gender Differences in Educational Outcomes : Study on the Measures Taken and the Current Situation in Europe” <http://eacea.ec.europa.eu/education/eurydice/thematic_studies_fr.php>
Although interesting individual initiatives and projects exist, overall national strategies to combat gender stereotypes in career choices and initiatives aimed at boys are lacking.

Policies on higher education focus mainly on increasing numbers of women in maths, science and technology (mst)

Women represent the majority of students and graduates in almost all countries and dominate in education, health and welfare, humanities and arts. Men dominate in engineering, manufacturing and construction. Around two thirds of countries have gender equality policies in higher education. However, almost all these policies and projects target only females in order to increase their numbers in engineering and science. On the other hand, the proportion of women among teaching staff in higher education institutions declines with every step on the academic career ladder. However, only about a third of the countries have implemented concrete policies to address this problem.

Most countries with gender equality policies in higher education have the primary goal of combating horizontal segregation and the gender imbalance in the choice of academic discipline by women and men. There are two main policy instruments aiming at changing the traditional choices made by women (and sometimes men). Firstly, educational or vocational guidance is provided in secondary schools. Secondly, there are awareness-raising projects involving higher education institutions. These projects can be initiated or financially supported by ministries or governments. In most cases, their aim is to attract more women to the fields of science, mathematics and computing as well as to engineering, manufacturing and construction. The most common practices include the organization of university open days or the granting of special awards to female students.


The SESTEM Project first provides information about the state of art and the results of the qualitative research activities which were divided into four studies with pupils, parents, teachers in STEM, and female graduate and post-graduate students in STEM. There is a focus on gender and student’s motivations regarding orientation and career’s choices.

The research, designed to reveal gender elements, has three dimensions: the individual, based on personal aspects such as educational biography and values; STEM, based on motivation, abilities and external influences; Consequences, based on obstacles as well as facilitators related to STEM studies. These findings provide a basis for the quantitative study, giving preliminary reflections on possible actions that could be developed to reverse
the situation, articulating indicators for supporting policy reflection and guide good practices mainly in teachers’ and parental support to girls towards choices of careers in STEM and related fields.

It aims to deepen understanding into the process of decision making in career choices, the process of enhancing school-family collaboration in support of girls’ engagement in STEM and into the contextual, cultural and social conditions that support retention of women in STEM related fields of studies. Such an understanding can be instrumental in promoting equality, personal fulfilment, and thereafter employability.

The findings of the qualitative research conducted support the main hypotheses of the research that placed high importance on the socio-cultural environment as a major influential force on the career choices of youngsters and the progress of women studying in STEM fields.

Interest in STEM was often associated with early exposure to practical activities at home, and with inspirational figures. Overall, pupils reported that both parents and teachers were supportive of their decisions about school subjects and careers, and could be helpful, but were not directive. Peers played little part, other than to be supportive of individual choices.

In terms of school subject and career choice, many pupils had firm ideas about their intended trajectory which were only marginally influenced by careers advice. For these pupils, work experience was an important element in confirming or modifying their early ideas about career directions.

Aspects of STEM careers that were seen to be attractive include: interesting and rewarding jobs where one can make a positive difference to the world; adequate financial rewards, and job security. Aspects that were seen to be unattractive were: long hours, and the problems of establishing a good work-life balance; perceptions that STEM workplaces were ‘masculine’ and that it is hard for women to fit in and progress in their careers.

In general, the four studies present very common results. While there has been improvement, stereotypes and traditional associations regarding STEM careers or types of work that they permit still prevail.

Stereotypes that influence the social imaginary and characterize Engineering and Technology studies as masculine and health or environmental careers (with a “more social” component) as feminine were found to be widespread and strongly affect the career choices of girls and boys in different ways. Female pupils were generally not aware of obstacles or stereotypes where female students were more aware of them. The findings also suggest that there are still many obstacles that need to be removed for women to achieve equal opportunities and evaluation in STEM. These barriers are gradually built within the socio-cultural environment and are often presented in the frame of the family, educational institutions and mass media that often act in complementary ways. For instance, the role of teachers as a role model was found to be very influential. The obstacles were mainly centered around the traditional role of women and mainly found to act more negatively on women coming from immigrant and lower classes.

In general, all groups observe obstacles with regard to a career in STEM especially for women like the lack of acceptance of women in STEM fields, the lack of female role models, stereotypes of STEM, the under-representation of women in STEM studies and a lower self-confidence of girls in STEM classes regarding their abilities. Further, general barriers are the demanding study in STEM and the change from school level in STEM to university. One important point is the lack of knowledge about occupations and career options possible.

The effect of school should be aimed both at students, as well as on their environment and parents who have an earlier influence on the development of the interests, attitudes and career aspirations of children.

According to these findings, the implications suggested - by the moment- to enhance equal opportunities for boys and girls in the choices of STEM careers are the following ones.

For parents
Parent don’t know about new specializations or careers possibilities; current associations to useful careers usually correspond to traditional studies in which women’s and men’s roles are more classically defined. It is then important to involve families in this process and provide them with information, especially mothers and girls, where communication has been seen to be closer.

A key goal for parenting should be the development of ‘confident femininity’ – a world view where all options are open to girls and women, where competencies are not ‘gendered’. Seminars and group discussions should be organized in parent associations on gender equality and assisting children to deal with the obstacles they meet in their studies. Moreover, teachers reported that parents have low participation in schools. Information about these new careers and trainings must be disseminated to parents, especially at public schools where is perceived less parents’ involvement.
For educational institutions (teachers, schools and universities)

In schools there seems to be a lack of information regarding careers and future professional options intended to reduce classic gender associations. Most of the pupils don’t know what does a study or a job in STEM exactly mean. Therefore, it is necessary to give more information about current STEM-job profiles to pupils. While some interviewed parents and teachers say that the situation has changed, they recognize that some stereotypes still remain. According to the findings of this study it is essential to reveal the needs for industries, enterprises, and professional associations in order to develop information about possibilities and jobs specializations to young people and then to facilitate more women in STEM.

It should be emphasized that there is a significant lack of information and knowledge on the trades existing in STEM. To address this gap, it would be desirable to set up meetings in the classroom with professionals, especially women (such as scientists and engineers). It is crucial that pupils, students and parents have information of new studies and job opportunities; otherwise, young people will miss important opportunities for their future, including options that break occupational stereotypes. They need to know about specializations and career opportunities. It is necessary to promote awareness of the realities of today’s academic and work environment; for example, through lectures, outings, academic fairs etc. In this way girls and boys can become informed about academic, professional and labor market opportunities and the competencies required. Moreover, it is important to explain new careers and vocational training possibilities in order to go against stereotypes. To exemplify this, development of a topic of interest through the upper secondary research project has been for many students and pupils interviewed a key moment of motivation to determine their future studies and career path.

Teachers have an essential role at upper secondary level; they allowed them to have more information and to be encouraged and supported, so they should provide career guidance with gender equality issues. They should learn to identify obstacles and support pupils who face obstacles to follow the career of their choice and to promote equal values to boys and girls and supporting their talents and abilities should be addressed in educational institutions.

Efficient and realistic guidance and career counseling should be available to young people with up-to-date information on careers and the prospects of each academic field as well as tangible solutions to deal with the crisis and unemployment. Contact of secondary pupils with the university and the workplace are missing: practice, outings, and talks are needed. The results of research show the urgent need to organize meetings with people who have achieved success in STEM, during which students would learn about the potential place of employment and areas where they could specialize. Some parents are in a position to provide such experiences; parent-school collaborations should be encouraged. Work experience in areas where pupils are considering courses and careers should be an important part of schools’ careers advice programmes.

There should be more practical classes, based on real and current examples: internships, work or enterprise contacts are highly valued. Then the improvement of the contact with experts in many different academic fields is much needed. Pupils and students should know how the STEM world develops at the practical level of work. Ultimately, more information and communication is needed to go against stereotypes (through seminars, workshops, schools websites, internal communications, etc).

Discussions with teachers or school pedagogues, cooperation with colleges and high schools, or with the employment offices and the school career offices seem to be useful. The participation in science competitions, in exhibitions, in visits of laboratories are rather rare in schools. More information on these events would be needed so that schools can propose to the pupils this kind of activities, and more exactly for example science competitions aimed at girls, who remain much underestimated.

Some teachers mentioned, that although there are lectures by university students, in some case ex-pupils, it would be good to have these events more frequently with both men and women professionals participating, in order that pupils see that there are specializations possible without a gender bias.

The use of female role models in STEM to enhance the self-confidence of girls and attract more women in these fields is necessary. This can be achieved through school visits at research institutes where female researchers are leading the tour and by presenting cover stories of successful women in STEM in the classrooms. Gender equality training should be provided to teachers in order to identify and eliminate gender bias in their teaching and behavior. It would be relevant to reinforce the awareness of the teachers on this issue, both during initial training and in the course of career, by proposing seminars, meetings and specific activities to practice in classroom.
In conclusion, it is necessary to promote clear and realistic models in schools and universities to make pupils and students more informed, free from prejudices and stereotypes, and in this way to help them in their future choices. At the same time, it is necessary to increase awareness of careers, traditional and new ones, in relation to the jobs available today. Many careers that are not associated with traditional female roles but that actually currently offer different options can be done perfectly well by women; there are no obstacles perceived concerning skills, abilities or interest.

All kind of strategic action or face-to-face initiatives should be supported by social networks like groups in facebook, twitter or a blog.

Finally, it is advisable to implement school programmes starting at early ages in order to counterbalance socio-economic, family and mass media influences at the time of beginning to build a career interest and choices.

**For policy makers, industry**

It is important to continue the policies of promoting gender equality and to fight against stereotypes of underperformance of woman that affect the decision to study in the area of STEM. Obstacles to choosing careers in STEM and existing stereotypes may be overcome by establishing a network of women who have had success in STEM, and who would be willing to share their experiences in this area, answer the questions and identify possible career paths after graduating university. Industry and policy makers should continue with policies that encourage gender equity at occupational and labor levels.

The findings of this study point to the urgent need for industries, enterprises, and professional associations to communicate possibilities and jobs specializations to young people and academic and training institutions. There is a significant lack of information regarding careers and future professional options intended to reduce classic gender associations. For example, in these days there are many engineering specializations outside the typical stereotype that may be considered more "feminine" or multidisciplinary; however few people know about this. **We are left with classic images and stereotypes by a lack of information.**

Industry should show “the feminine or social” side of STEM careers (multidisciplinary fields), for example biotechnology, communicate and explain new occupations, for example those related to Internet, social networks and technology. Such occupations are those with higher demand from the Industry and therefore they offer higher salaries, even more than several traditional and prestige ones. Apparently, most of boys and girls don’t know this, in a context where they are very interested in work projections and salaries.

**4. Issues to discuss**

During the next three weeks -from 22 November till 12 of December 2011- we propose to discuss relevant aspects that came out of the work done in SESTEM, aiming to get new insights and valorize practices that will help stakeholders to implement actions for promoting the participation women into STEM careers.

To help on the discussion, SESTEM suggests the following issues that will be further supported by displays taken from European data and the SESTEM survey:

1. What are the **gender stereotypes** you have observed in your country, and what are the consequences of this situation in terms of career choice? In practical terms, how to fight stereotypes and underrepresentation of women in STEM?

2. Both girls and boys’ **self-confidence is a crucial aspect for the career choice** in the STEM field. How to provide confidence and encourage girls on these disciplines? Which should be the role of parents on this aspect? Is the introduction of successful feminine profiles as role models, enough?

3. What kind of **educational strategies and institutional actions** can be proposed to increase the incorporation of women in these fields:
   - **At school/ universities** *(which practices should we promote on teachers?)*
   - **At family level** *(how we can work/guide them?)*
   - **At industry/ market** *(are the description of expected competences; or showing “the feminine or social” side of STEM careers, good solutions?)*
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