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Gendering 'the Millennials'. Analysing Staff Responses to New Student Profiles in Spanish ICT Higher Education

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ABSTRACT

This article reports on empirical research on the gendered culture of telecommunications and computer science education in Spain. It firstly summarises the evolution of the overall student population and its effects on tertiary level ICT education. A decline in overall work values, academic performance and student attitudes are identified as a shared concern among academic staff. The second part of the paper explores how this variation in student profiles can be interpreted from a broader perspective of generational shifts among young people less in terms of the empirical evidence of a homogeneous Net Generation, but rather in terms of a rising concern for educational reform in Science, Engineering and Technology (SET) education. I will argue that urgent calls for making SET education more attractive for today's young people emerges as a forceful ally to keep gender issues on the agenda of higher education reform.

KEYWORDS

Millennials; engineering education; Spain; gender, men and masculinities

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INTRODUCTION

This paper presents results from a two-year research project (2008-2010) that aimed to map the situation of women in ICT-related higher education in Spain. The project comprised of a comparative study of the underrepresentation of women among academic staff and students across six telecommunications engineering and computer science schools in Spain. The main argument of this paper engages with staff perceptions of changing student work values, attitudes and academic qualifications in Spain and embeds those perceptions within broader calls for pedagogical and curricular innovation in science education. This broader call for reforming science education suggests that the issue of 'disengagement', which has often been discussed as a characteristic of women's under-representation in science, engineering and technology (SET), is in fact now characteristic of the overall student population and its declining interest in SET careers. Thus, important arguments for reform are available from the gender and SET literature that could unite forces with science education. At the same time, concerns about making science education more attractive for today's youth is in turn a promising avenue for keeping gender issues on the agenda of higher education reform.

Scrutinising the position of women students and staff in ICT higher education in Spain involves taking into account several recent changes: the legal requirement to provide an equality plan; the pedagogical and curricular changes tied to the implementation of the Bologna process; the need for academic staff to respond to changing criteria of excellence; and, above all, the need for the universities to deal with a new profile of incoming students. As such, this paper focuses on the issue of how ICT departments respond to the perceived necessity of dealing with a new generation of incoming students that contrasts sharply with previous cohorts. A supposed decline in work values, lower academic performance, and personal immaturity of students threatens established notions of 'good' engineers, together with their 'solid', 'functional' knowledge and skills. The emerging responses collected in semi-structured interviews with department academic staff across the whole career ladder provide the opportunity to examine gender at work: how very gendered notions in relation to the education of future engineers (their curriculum and pedagogy), their future tasks, skills, and work values actually reinforce the masculine nature of these ICT careers and professions. As will become apparent, the potential to rethink ICT engineering in the light of a new and more demanding student clientele largely draws upon very traditional and conservative notions of engineering education.

The responses of academic staff to a new generation of students invites a critical reflection on how this trend affects gender equality concerns in engineering education on a larger scale. There are some indicators that a new type of student is entering tertiary education. Although the empirical evidence on the reality of a distinct generation is not conclusive (Bennett et al., 2008) it is a shared concern for university teachers, and in this sense makes a difference in the orientation of reform efforts and solutions proposed. We argue that the value judgements of the qualities of the new students should be analysed from a gender perspective since proposed solutions to remedy the situation strongly overlap with feminist approaches to de-masculinise engineering education. New students demand a response from faculty in terms of curricular content, but above all teaching methodology, which questions traditional and highly gendered ways of conceiving knowledge and its transmission. As a consequence, the reactions and calls for reform in order to address the wider and more diverse profiles of new students highlights the gendered culture in engineering.

Context of Spanish Higher Education in Technology

In order to understand the current situation and main concerns in telecommunications and computer science degrees in Spain it is also important to provide a brief outline of the overall evolution of the student population. According to the latest statistics published by the Ministry for Education (MEC 2010, p. 9), the expansion of higher education took place during the period from 1988/89 until 1999/00, when it reached a historic high of 1,589,473 students. Starting at the turn of the century, there was a pronounced decline of the overall student population by approximately -1.7% each year adding up to an accumulative loss of -11.7% between 2000/01 and 2008/9. As the report underlines, this decline was due to two factors: first, the dwindling of the population of 18-24 year-olds at an average rate of -2.3% per year and, secondly, the booming economy that offered abundant low-skill jobs independent of a higher education degree. The relevance of the economy and labour market situation for explaining the declining participation of 18-24 year-olds in higher education becomes apparent when considering the latest statistics (2009/10). For the first time the downward trend in student numbers is reversed, with the overall student population expected to grow by 2% in 2010/11 with respect to previous academic year. Nevertheless, when considering the different disciplines it is apparent that health sciences and humanities claim the majority of this increase, while sciences actually seems to continue its downward trend. It has lost 36.5% of its students during the last decade and -3.4% in the last academic year.

The change in the size of the student population is important because it is an indicator of student diversity found within universities. Although diverse reasons influence the increases and decreases in the numbers of incoming students (a theme that will be picked up in the discussion section of this article), its consequences have to be seen in relation to the *numerus clausus* or *nota de corte,* the pass mark. The possibility of entering university depends on passing an entry exam, the so-called *Selectividad* and the availability of study places. The more popular degrees require better grades in the access exam. However, declining student numbers for technical careers have resulted in the absence of any *numerus clausus* for computer science and telecommunication studies. At present any student who does not fail the *Selectividad* can start studying these degrees, which is in sharp contrast to the past when these careers were very prestigious and required a high access grade. As an example, the highest rated degrees in the 2007/8 academic year were biotechnology or medicine with a *numerus clausus* above 8.5 (10 being the maximum qualification) whereas the overwhelming majority of technical degrees required a pass mark of 5 (anything below 5 means failing *Selectividad* itself). Whereas in the past, the staff of technical universities were thus relatively regaled by 'good' students, at this moment in time they confront a much more diverse student population in their seminars with very different skill levels in mathematics and physics.

Although the overcrowding and corresponding diversification of the Spanish universities has been noted in general terms (de Luxán, 1998; Neave, 2001), the staff of technical universities have confronted a change in the profile of incoming students in a much more pronounced manner. As the study by Rodríguez et al. (2004) suggests, the effect of lower entry grades into tertiary education is especially felt in the experimental sciences, which are considered the 'hardest' (45.4% of approved credits[1]), compared to health sciences which is the 'easiest' (with an average of 67.8% of approved credits). In other words, whereas a higher influx of mediocre students may remain relatively unnoticed in other areas, it is in experimental sciences where they come to light the most. However, before going into greater detail into the discussion regarding this changing influx of students, the methodology and corresponding staff responses and reactions will be presented in the sections that follow.

Methodology

Project results are derived from six case studies involving qualitative interviews, group discussions, analysis of curricular plans and official gender equality documents of the participating universities. A total of 44 semi-structured interviews were conducted in the telecommunication and computer science faculties of the public universities *Universitat Polytecnica de Catalunya* (UPC), the *Universitat Politecnica de Madrid* (UPM), the *Universitat Carlos III* in Madrid, and the *Universitat Autonoma de Barcelona* (UAB). Interviews were conducted with 20 male and 24 female participants who were at different stages of their academic careers, including academics working on early career, temporary contracts and full professors (*Profesor Titular* and *Profesor Catedrático)*, some of whom also occupied administrative positions such as department heads and faculty deans. In addition, 2 Equality Officers as well as 6 administrative staff concerned with attracting new students were interviewed. The average interview lasted approximately 1 hour; the interviews were recorded, transcribed and analysed using ATLAS.ti software.

Eighteen group discussions with a total of 63 students of telecommunications and computer science were also held at the universities in Madrid and Barcelona. The groups included students studying at entry level as well as those studying in advanced semesters to capture both the concerns of new students as well as more persistent concerns. These were also analysed using ATLAS.ti software.
In order to map national trends in higher education and the gender distribution of students and academic staff in telecommunications and computer science, secondary data was drawn from statistical sources, such as the National Statistics Institute[2] (INS) and the Ministry of Education[3] and the information made available from universities websites.

The aim of our case studies was to facilitate our understanding of the gendered nature of departmental culture. They were not geared towards drawing generalisations for certain groups of university teachers, but rather to gain insights into how faculty confronts ongoing changes such as a new profile of incoming students or the Bologna process. As such, the collected staff opinion should not be taken as being wholly representative of the overall computer science and telecommunications faculty in Spain.

Significant factors emerge through detecting response-patterns within the overall space of possible attitudes and opinions –but not in terms of mapping staff responses to socio-demographic variables such as sex, age or position. In this sense we tend to see the homogeneity within faculty's attitudes towards the curriculum and pedagogy as a significant indicator of a pervasive masculine engineering culture that is precisely at odds with more varied and diverse accounts.

A note on terminology: in this article we will use the term 'engineering education' quite comprehensively. Although our cases studies were carried out in telecommunications and computer science departments, and thus concern only higher education in ICT (as opposed to other engineering disciplines), we nevertheless often refer to engineering education in general. Our case studies were focused primarily with the entry years of engineering education, which are quite similar across the different engineering branches. Introductory courses in mathematics and physics are usually shared no matter which engineering degree has been chosen. Thus the issue of curricular and pedagogical reform detected in our cases studies is not specific to telecommunications and computer science degrees, but engineering education in general.

GENDERING THE ENGINEERING CURRICULUM AND PEDAGOGY

The literature on engineering education in relation to its curricula and pedagogy is quite explicit on its gendered nature. The epistemology of the science curriculum, and by extension its teaching method, is strongly masculine coded. It starts from the universalistic conception of scientific knowledge as established facts and laws that are valid independent of time and place. Science strives for unconditional, unbound, context-independent truth that is within its reach through the correct application of the scientific method. One result of this idealistic understanding of science is a conception of knowledge as 'thing', that is as something that exists objectively and simply needs to be transmitted between a sender towards a receiver. The objective status of knowledge favours a pedagogy that is based on a simple transfer model of communication. As Osborne & Dillon (2008) maintain, the practice of teachers using this traditional approach will consist in little more than having students copy what's on the blackboard (or displayed via a data projector) in order to 'get ideas across' -while students sometimes then stubbornly refuse to 'get it'. Classical science and engineering disciplines are characterized in this sense by a 'narrow' curriculum that conceives knowledge largely as non-contentious and unproblematic, that is, as a well-defined body of facts and laws to be transferred to passive students via lectures (see Bagilhole & Goode, 1998). However, as the philosophers of science such as Kuhn (1962), Feyerabend (1975), or Foucault (1973) have argued, science is not objective and knowledge is always involved in struggles over power. Furthermore, feminist thinkers have analysed the deeply masculine nature of the universalistic notion of science and knowledge as well as its concomitant pedagogy (e.g. Haraway, 1988; Harding, 1986). Decontextualized knowledge and teaching methods favour a disengaged, instrumental world view that Wacjman (1991), for example, has linked with the masculine endeavour of control over nature.

Curriculum

Spanish engineering departments are probably not dissimilar from many other European and non-European departments in that the curriculum for the first years comprises of abstract and theoretical courses that aim to deliver the basic mathematical and physical tools. Since this knowledge constitutes the basic instruments of the 'engineering toolbox', it is largely perceived as necessary, self-evident, unquestionable. Little variation can be imagined in how the fundamental pillars of engineering education are set up:

> The fundamental courses cannot change much of their content. The mathematics and the physics during the first years won't change much [...]
>
> (Participant 20: Telecommunications, female *Prof. Titular*)

The idea of a basic and unchangeable curriculum during the first years of engineering education then provides the matrix for analysing problems such as the new incoming students. Since subject content is taken for granted, the underperformance of students is not viewed in relation to internal aspects of the program, but diagnosed as having external causes. In the Spanish case explanations of why academic performance of incoming students has declined were generally seen in terms of the deficiencies and/or changes that occurred with the restructuring of compulsory education in its modern form. Indeed, the Spanish Ministry of Education undertook a large scale modernisation of its educational system in 1990 with the introduction of the *LOGSE (Ley Orgánica de Ordenación General del Sistema Educativo)*[4] which among other things extended compulsory education from 14 to 16 years of age (Boyd-Barrett & O'Malley, 1995).

> ... the problem stems from secondary education, the problem is that the academic level has declined a lot, that the incoming students, sometimes get to us with a lack of knowledge which we supposed they would have … and there are many professors who resist teaching them these basic skills that they are supposed to have before entering the University.
>
> (Participant 5: Telecommunications, female *Prof. Catedrática*)

However, the general impression shared by the majority of staff interviewed that academic performance declined after the introduction of the new system is not necessarily confirmed by research. A study carried out in the year 2000 showed that differences in academic performance of university entry level students of the traditional system (COU) compared with the new system (LOGSE) was insignificant (Rodríguez et al., 2004). The important finding is that low performance in engineering is not due to worsening secondary education, but rather related to a wider and more diverse pool of students being able to access these degrees in the first place.

The reactions and explanations put forward by the staff interviewed seldom questioned their internal curricular design principles. The content of the courses appears as dictated by the laws of nature that form the unproblematic building blocks for the engineer's toolbox. Effectively, as Mahony & Van Toen (1990) have pointed out, the emphasis on mathematical formalism then easily operates as a form of occupational closure. Similarly, Becker (2010) succinctly remarks that introductory courses that establish the theoretical foundations are more often than not conceived as 'weeding out the weak', that is, of filtering for a quite narrow range of equally formalistic students. Contrary to popular belief, this 'weeding out' is not really effective in terms of singling out the more talented from the less talented students as the classic study by Seymour & Hewett (1997) suggests. Seymour and Hewett's US-based work involving 335 students in science, technology and mathematics showed that there was little to no difference in academic performance between 'switchers' and 'non-switchers'. At the same time, characteristics of the environment such as bad teaching or study climate that finally lead some students to leave were equally noted by those students that stayed on.

The insistence on abstract, highly formal entry courses that often become entry barriers is then further strengthened in the way new transversal competencies are judged. As stipulated by the Bologna process, engineers do not only have to know their mathematics, but also have to be equally capable of collaborating in teams and know how to communicate effectively, work autonomously, be flexible and creative (Marzo et al., 2006). Although staff responses in this respect were more varied in that several interviewees recognised the importance of social capacities and personal attitudes, for many these also interfered with the traditional skills and knowledge of engineering. As the following quote demonstrates, excellence is conceived in terms of managing social relations:

> ...another thing that I see as being essential for being excellent is managing social relations perfectly... you have to have something like sensitivity to capture what's going on around you... and not so much the capacity of designing new structures...
>
> (Participant 7: Telecommunications, male *Prof. Titular*)

Similarly, another professor interviewed maintained there is no problem in investing more time to make the change towards a more competence-based curriculum as proposed. However, he is not sure if this investment in time will be compensated:

> ... in the end it depends if the engineer that graduates now is a better engineer than those in the past who graduated according

> to the old study plan, and I'm not so sure that this is the case. I think his education will be much worse, they know less about programming, know more about working in teams but I'm not sure if this will function well, you know? If they know how to work in a group but do not know how to make useful products...
>
> (Participant 28: Computer Science, female *Prof. Titular*)

Thus, despite a certain recognition of the need to take more transversal competencies on board, in many cases this was constructed as interfering with the traditional and rather instrumental skills of the engineer. In general there was little willingness to welcome the emerging needs as an opportunity to reflect on the gendered nature of engineering (education) and question its masculine imprint.

Pedagogy

The masculine model of teaching has primarily been characterised by the authority of the teacher, the passivity of the students and a transmission model of communicating knowledge. De-masculinising this model would imply introducing more collaborative, hands-on, practice-oriented pedagogy right from the start. Not surprisingly, the literature dealing with the retention of minorities in SET careers has emphasised the positive effects of stronger student-staff interaction, experimental and inquiry-based learning approaches in conjunction with cooperative and collaborative learning activities (Pascarella & Terenzini, 2005; Cohoon, 2007; Wyer, 2003; Clewell et al., 2005; Hunter et al., 2007). To the degree that this new approach to teaching involves a more relational and caring outlook on student-faculty interaction it comes into conflict with the traditional, distanced, masculine model of content delivery. Teaching carries strong feminine connotations due to being considered a quasi-natural extension of mothering activities (Daniels, 1987; Williams, 1995) on the one hand, and due to its strong interpersonal grounding involving emotional and psychological ties with children on the other. However, it is now precisely the caring aspects of teaching that provokes a rejection among staff.

Firstly, the changes put forward in the context of Bologna in terms of transversal competencies have already been mentioned. Closely related –and therefore among the most polemical aspects– features the emphasis on continuous evaluation of students. Instead of a single final exam, teachers are obliged to guide students in a stronger way and give more feedback on their learning progress for the duration of a course. However, as several teachers claimed, too much guidance actually does a disservice to students in that it delays ‘maturity’. According to one respondent:

> ...if we hold hands as if we were still at school, in the end life will slap them in the face, ... instead of getting slapped here in the [engineering] school, they will get it later on in life... we will create 'light' engineers...
>
> (Participant 24: Computer Science, male *Prof. Catedrático*)

What this quote demonstrates is the tight association between a certain 'hardship' and engineering in particular. This hardship serves as a mark of distinction and forms part of the engineering identity as the following quote demonstrates:

> ...I still remember what my former Physics professor said to me –he said, once we'd got our degree, the companies will not contract us for what we know but for the capacity to suffer we had developed during our six years of studies– any company would value that –and I have not forgotten that since then, since 96...
> (Participant 6: Telecommunications, female *Prof. Titular*)

Even though this quote is probably an extreme example and not very representative, it nevertheless contains a grain of truth in the sense that hardship and a certain degree of suffering forms part of the engineering identity and is a silently acknowledged ingredient of getting a degree. However, one does not have to go to such extremes. In general, the more intimate relation that the new student-centred pedagogical model suggests between faculty and students is not especially embraced. Thus, according to one respondent, what provoked the most rejection among the department staff during the introduction of a new mentoring plan was precisely the necessity to attend the psycho-social and emotional needs of the students. As one respondent put it:

> ...I wouldn't say they are immature students but I see them being much more dependent upon the professor. … [...] I think in most cases they feel closer to the professor and they speak up to you and ask you things that sometimes make sense but sometimes you say, 'listen boy, I'm not your mother in order to solve your problems....'
>
> (Participant 6: Telecommunications, female *Prof. Titular*)

What these quotes demonstrate is a certain alienation towards the more emotional, interpersonal aspects of student-staff relations. In a way this is not surprising since these aspects contradict the predominant image of engineering as a rather rational, task-oriented, instrumental undertaking where the "female" qualities of caring and responsiveness are out of place. Of course, this rejection of the new responsibilities attached to the Bologna process also have to be seen on the grounds of the additional and contradictory strain it lays on university staff. The additional supervision does not come with additional resources in terms of time (or staff hired) and stands in direct conflict to the priority placed on research versus teaching. Staff would have to invest more time in teaching activities that could otherwise be spent on research and publications, the primary criteria according to which their excellence gets recognised. However, although the reasons for a more critical attitude towards pedagogical innovations might be varied, this does not undermine our findings that the more 'feminine' caring aspects of teaching are far from being embraced. As we argue, the rejections documented during the major part of the interviews consolidate a very masculine understanding of teaching where success is primarily defined through endurance and hardship –qualities that the current student population apparently lacks.

DISCUSSION: RECEIVING A NEW GENERATION OF STUDENTS?

Contemporary European higher education has to confront many changes. Globally, there is the Bologna process towards a common higher education area. Curricular content, teaching methodology and credits are standardised to enable mobility of human resources and cross-country transfer of tertiary educational degrees. Part of this convergence process is an emphasis on transversal competences that foreground the communicative and social attitudes of future professionals as well as their technical know-how. Generic competences such as team work, collective problem solving, autonomy and motivation have become crucial for a complex world of work characterised by ill-defined problems, contradictory information and dynamic processes (Westera, 2001). Secondly, more and more universities appear to be immersed in an international competition for excellence and talent. Resource constraints in combination with an increase in the importance of 'knowledge economy' press universities –as many other parts of society– to define their stakes on the international market of higher education and research. Excellence initiatives, a concern with quality or listings of university rankings, are but a few of the most common indicators of this restructuring process.

At the same time as our research demonstrates, Spanish engineering higher education confronts an important shift in terms of a more diverse body of students that questions accustomed ways of teaching and organising subject content. As the analysis of our empirical material showed, the lack of experience of students is largely interpreted as a generational issue tied to the modernisation of the Spanish educational system in 1990. There appears to be a shared understanding among faculty that students are more immature, less willing to work, and worse prepared upon entering higher education institutions. Indeed, independent from the particularities of the Spanish situation, the international literature across several disciplines warrants some plausibility to this impression of a shifting generation (see below). The idea circulates, especially in the educational context, that the technological revolution underway is seriously affecting the living experience of young people, with deep consequences for their expectations towards teaching and learning. To the degree that possible solutions to this situation are framed by universities in terms of changes in the curriculum or teaching methods, the response patterns and solutions have to be understood as highly gendered. The necessities of a new generation of students and the concomitant adjustments from tertiary level institutions are an important ongoing struggle where gender concerns of engineering education are to be re-negotiated.

Discourses on Youth Generations

As a short overview of the literature suggests, there are several competing terms that claim to identify a distinct generation. Depending on the discipline, the Generation Y (following Gen X from 1965 to 1980 roughly) lasts from 1980 to the year 2000 and has also been labelled 'Millennials' (Howe & Strauss, 2000, Pedró, 2006); Generation Me (Twenge, 2006); Net Generation (Oblinger & Oblinger, 2005; Tapscott, 1998); or Digital Natives (Prensky, 2001a, 2001b). Despite the variety of concepts that indicate small differences in the precise dating of the temporal boundaries, there is a shared vision that above all the technological revolution is substantially affecting the living experience of young people. Young people born from the 1980s onwards are surrounded by all types of digital technology, be it cell phones, video games, iPods, cameras or laptops. Amongst other things, this constant immersion and exposure to technology is claimed to have profound effects on their educational expectations.

The new learning style of the Millennial generation
The continuous exposure to Information and Communication Technologies (ICT) is affecting what young people expect in relation to learning and teaching. Authors such as Prensky (2001a) even argue that the exposure to ICT is rewiring the brains and changing the cognitive skills of the digital natives who are used to accessing digital, non-print information, who prefer visuals to text, feel at ease with multitasking and at odds with linear processing of information. As Pedró (2006) remarks, this new cognitive style of the digital generation goes seriously against expected behaviour patterns and supported practices by formal educational institutions, which are based on long attention spans, reflective activities and focusing intensely on only one activity typically involving text. In other words, the immediacy of an always turned on communication is diametrically opposed to the traditional educational mindset that conceives "teaching as telling, learning as listening, and knowledge is what is in books" (Cuban, 1993, p. 27).

The empirical evidence on a distinct new learning style that includes technological use and expectations towards the curriculum and teaching practices is however mixed. As Jones et al. (2010) have recently summarized, evidence of radically different study patterns are scarce. There seems to be a considerably higher degree of diversity within the population of students than the common term of a shared generation suggests (Bullen et al., 2009; Kennedy et al., 2010; Nagler & Ebner, 2009; Bennett & Maton, 2010). However, even if the empirical evidence on a homogeneous generational shift is not a 100% conclusive, what matters is the fact that staff participating in our case studies perceive a change in student profiles. But even if it is a distorted picture, it nevertheless affects them in their daily work. As such, the image of 'worsening' students is effective without considering the empirical diversity or its real causes; it calls for action.

The psychological traits of Generation Me
Characterizing a generation of students involves more than mapping their access and usage patterns of ICT. Educational policy and curricular design have long recognized that 'attitudes' are one central component of education, together with knowledge and skills. Consulting the work of Jean M. Twenge, the evidence on how the attitudes of young people have changed is more conclusive. Her work documents major psychological shifts of the Generation Me in the US and its implications in the world of work (Twenge, 2006). A distinctive trait of Generation Me is its stronger individualistic and self-focused way of life. This reflects broader sociological trends of the individualisation of society (Giddens, 1991; Castells, 1997) which Twenge and others argue manifests itself on a psychological level in the form of heightened sense of entitlement, assertiveness, self-esteem, or narcissistic traits, but also in the form of stress, anxiety, poor mental health and lower self-reliance (Twenge & Campbell, 2001, 2008; Ng et al., 2010; Deal et al.,

2010). The Generation Me is characterized as having high expectations regarding their future and professional aspirations while exhibiting weaker self-reliance, and an increase in narcissistic traits manifest in terms of overconfidence, self-centeredness and lack of empathy. In concrete terms that means that Generation Me expects more for less. The general feeling is one of "the world owes you something" (Twenge, 2009) and there is the expectation of plenty of leisure time (the value of work-life balance is on the increase in work values, see Twenge et al., 2010) while still feeling entitled to more money, status, or good grades in the sphere of education. While it would certainly be of interest in the context of the present article, the literature consulted did not report specific trends within the Generation Me segregated by sex.

Declining interest in science and technology
Narrowing the focus of the generational changes more specifically down to Science, Engineering and Technology (SET) careers, a further indicator of a generational shift emerges that affects SET education much more directly in that it stipulates a decline in overall student interest in these subjects.

Findings by the OECD suggest that although student enrolments have increased throughout Europe in absolute numbers, the relative share of students choosing to study SET subjects has actually declined. An increasing proportion of the whole student population chooses not to go into SET careers (OECD, 2006, 2008). This is true for both women and men, thus not affecting the well-known underrepresentation of women in SET fields, which remains within a range of 10%-30%. Female graduates in engineering and computing actually declined by 3% from 1993-2003 (OECD 2008, 38). Using data based on international comparisons on the attitudes of young people towards science and technology the ROSE project suggests possible explanations (Sjøberg & Schreiner, 2010; Schreiner & Sjøberg, 2007). Student interests are an important indicator of the attractiveness of SET and thus possible future enrolment figures. A central finding establishes a surprising relationionship between the level of development of a given country measured in terms of the UN Index of Human Development (IHD) and young people's attitude to SET: the more advanced, the less willing young people are to engage with SET. This trend is more pronounced for girls – they are usually less willing to become a scientist or to work with technology compared to boys within the same country. Norway, which tops the IHD, also has the worst student attitudes to science! Statements such as "I would like to become a scientist" or "I would like to get a job in technology" show negative correlations of -0.94 and -0.91 respectively to the level of development of the country (Sjøberg & Schreiner, 2005). In other words, despite the centrality of technology for the development of a society, or possibly because of it, students lose interest in SET.

Gendering the Millennials
The accounts presented regarding changes in youth generations allowed us to incorporate the situation and staff responses in Spain into a more varied account. The overcapacity of technical careers in combination with an overall decline of the student population suggests specific socio-historical reasons as to why the faculty encounters such a different type of student in their classes. Once reserved to a relatively elite group of students, the lowering of the entry grade

enabled an in-stream of lower-achieving students. Given the evidence of attitudinal changes of Generation Me and the overall decline of interest in science, one could speculate that even with a rising student population and *numerus clausus*, the 'problem' of a new, more varied audience for tertiary education is likely to continue. Particularly in science, technology and engineering, faculty will have to confront in one way or another –either through new learning styles, new work values, or motivational issues– a different student profile that puts the spotlight first and foremost on the possibilities of pedagogical reform.

Thus, the results of the ROSE study has been especially picked up from a science education perspective since the way science is taught has been singled out as one of the most important factors to counter the decline in student interest (EC, 2004; 2007; Osborne & Dillon, 2008). Similarly, it is clear that the attitudinal changes described by Twenge and collaborators pose a serious challenge to faculty. The often-cited need for immediacy of the Millennial generation not only refers to the availability of information, but also to academic and intellectual outcomes. How students can nevertheless be motivated and retained in what has been described by one of our respondents as a "long-distance effort" career is a major challenge for rethinking content and pedagogy. Once again, more inquiry-based teaching and a broadening of the curriculum towards its direct application in real world problems stand out as good candidate strategies for achieving these aims. Finally, the new information and communication technologies suggest first and foremost a more collaborative approach to learning that is concomitant with the emerging 'participatory culture' according to Henry Jenkins (2009).

Upon scrutinising in more detail the proposed reform of teaching methods and curricular design in order to enable SET disciplines in particular to respond to changing student profiles, it becomes apparent that there is a strong overlap with feminist concerns to overturn the masculine culture of engineering (education). Similar to the recommendations from the science education perspective, the feminist literature on diversifying engineering education involves the promotion of student-centred, collaborative, interdisciplinary, inquiry-based reforms. These elements have been singled out not only to benefit minorities but all students in terms of improving the learning experience and integration into the university (Knoll & Ratzer, 2009; Prieto et al., 2009; Mills et al., 2010; Sagebiel & Dahmen, 2006). For example, we know that those programs that managed to break out of too narrow, formalistic, or instrumental conceptions of engineering seem to have a higher chance of attracting more women and other minority students (Wistedt, 2001). Equally, the promotion of research activities at the undergraduate college level has been described as beneficial by furthering collaboration between student and faculty, and thus promoting a tighter socialisation/integration of students into university life (Seymour et al., 2004; Hunter et al., 2007).

In other words, there is a certain correspondence in how science education and feminist critiques of the masculine culture of engineering suggest moving forward. The emphasis on a more inquiry-based, interdisciplinary and collaborative approach is the common theme that unites both discourses. As in other contexts, satisfying the demands of women (minority) in SET education signifies providing higher quality education that benefits the entire student population (see for example Butovitsch Temm 2008). This means that how staff react to Generation Me in all its manifestations and variants has to be understood in terms of its gendered departmental culture. Generation Me becomes a new front-line where the rethinking of the masculine culture of engineering and technology takes place. Last but not least, this also implies that the discussion of generational shifts is an important opportunity to re-introduce and maintain gender equality on the university reform agenda.

CONCLUDING REMARKS

The evidence reviewed suggests that the incentives and even pressure to reform teaching methods and student-faculty relations at tertiary institutions is acute, not just in Spanish telecommunications and computer science schools. In order to address the changes in student profiles in terms of attitudes, work values, interest in SET and even new learning styles, pedagogical approaches need to be rethought. However, this is not a neutral process. It is above all not a gender neutral process. As the previous discussion showed, the preference for abstract knowledge in combination with a teacher-centred, transmission-oriented teaching model breathes the authoritarian air of the classical masculine academy. Introducing more collaborative, interdisciplinary, student-centred learning approaches in a way threatens to 'soften' and 'feminise' established 'hard' engineering skills and knowledge. The major challenge in this respect is first of all to recognise that the universities and departments are part of the problem. As shown by our research, there is a clear tendency to 'outsource' the causes and explanations for the underperformance of students to the shortcomings of secondary education. Seymour & Hewitt already remarked that there is little incentive to change one's attitude as an engineering department towards student attrition as long as it is "...believed to be caused, on the one hand, by wrong choices, under preparation, lack of sufficient interest, ability or hard work, or on the other, by the discovery of a passion for another discipline" (1997, pp. 391-392). Our analysis showed how the cause of the underperforming students tends to be clearly located by university staff as lying outside of the university and in schools. Thus, the chances to rethink engineering education clearly depended upon the willingness and capacity of the university administration and teaching staff to perceive themselves as part of the problem. As argued previously, this is especially hard to achieve due to the objective, factual, instrumental approach to knowledge and the often high status and prestige of the institutions (see here also Wistedt 2001). There are few incentives to question internal practices in relation to student attrition –even though as Tinto's model (1994) of student retention suggests, the overall internal factors of a given department or institution are far more vital for student retention and success than the student's own capabilities.

The quest for gendering the Millennials is therefore an issue of much broader scope. There is a real concern among faculty to address and cope with new incoming student profiles. This was one of the most common ideas voiced during all of our interviews. However, as other areas of feminist critique have shown, the struggle of defining the problem, which by implication frames the horizon of envisaged solutions, becomes a central matter of concern (Bacchi 1999, 2000).

How administration and staff conceives the problem at hand determines to a large degree how its solution will be approached. Locating the problem primarily outside of the university implies that little will be done to change the masculine culture of engineering departments. Here, the masculinity of engineering shows itself precisely insofar as one's own culture is perceived as unquestionable, unproblematic, and immutable. In this sense, to a large extent the reactions towards new student profiles determines a critical reframing of the masculine culture along a gendered analysis. There is a strong call for action, however not necessarily towards shifting departmental internal practices.

At the same time, since this sense of a sliding landscape in terms of student capacities, knowledge and skills exists, it also provides a major opportunity to keep gender issues on the horizon of higher education reform. This won't happen on an exclusive basis as a general sense of having overcome gender equality issues is apparent (Sanders, 2010), but rather in conjunction with the question to improve the quality and excellence in teaching. Since there is a strong overlap between the quality of teaching at large and a less masculine approach to education, the Millennials provide an important entry door for mainstreaming gender into higher education reform. Reforming engineering education implies gendering the Millennials.

ENDNOTES

1 100%= all students achieving a pass mark in all assessed work.
2 http://www.ine.es
3 http://www.educacion.gob.es/educacion/universidades/estadisticas-informes/datos-cifras.html
4 The “Organic Act on the General Organization of the Education System” approved in 1990 replaced the previous “General Act of Education” from 1970 and established the modern structure of the education system. The educational stages were structured according to infant (3-6 years of age), primary (6-12), secondary (12-16), Bachelor (16-18), vocational training and adult education. In addition it foresees to compensate for educational inequities and provision of special education needs and defines factors to monitor and enhance the quality of the education system.

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