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Christelle Didier

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CHRISTELLE DIDIER

**AN ETHICAL AND SOCIOLOGICAL VIEW
ON WOMEN ENGINEERS AND ON THE ROLE
INTERDISCIPLINARY COURSES CAN PLAY
IN ATTRACTING YOUNG PEOPLE, AND WOMEN,
TO ENGINEERING EDUCATION**

How can we make studying engineering and technology a more attractive option to young people? How can we attract more women and therefore improve the balance between male and female engineers in society? These are the two questions this conference intends to address. Among the solutions, the organizers of the Helena conference have chosen to focus on engineering education as a means of solving two “problems”: firstly the underrepresentation of women in engineering; and secondly the lack of interest expressed by young people in science and technology – and the shortage of graduate engineers for business companies in the future. The hypothesis proposed for these two days of exchanges and discussions is that more interdisciplinary training in engineering education might be one answer because it would appeal more to young people, and especially to women. The aim of the conference is to share the best practices in education, evaluate their effectiveness, gather students’ experiences and discuss other ways of attracting women to the field of engineering.

This presentation will be developed in four parts. In the first part, I’ll discuss the question of social injustice in connection with the underrepresentation of women in engineering. In the second, I’ll discuss the issue of the lack of interest in science and technology shown by young people and the shortage of engineers in the world. I will seek to look at these problems from both an ethical and a sociological perspective and explain why the issue of the small number of women entering into engineering and the issue of young people’s choices as regards their professional orientation need to be studied separately. In the third part of my presentation, I’ll look at the role interdisciplinary teaching can play, from an ethical perspective, in engineering education. In my conclusion, I’ll go back to the question of the need for engineers in the world. Rather than going into further discussion as regards the general complaint about the “shortage of engineers” expressed regularly in the media by business companies, professional associations and engineering schools’ deans, I’ll present my insights as regards the role engineers could and should (morally) have to play in achieving the United Nations Millennium development goals.

INTRODUCTION

How can we attract more young people to engineering and technology studies and how can we attract more women also and therefore begin to redress the imbalance between male and female engineers in society?

These are the two questions this conference intends to respond to. Among the solutions, the organizers of these two day-discussions chose to focus on engineering education as a means of solving these “problems”: the first one being the underrepresentation of women in engineering; the second one being the lack of interest shown by young people in science and technology, and the eventuality of a lack of graduate engineers for business companies in the future.

The hypothesis proposed for these two days of exchanges and discussions is that more interdisciplinary training in engineering education might be one answer because, it would appeal more to young people, and especially to women. The aim of the conference is to share the best practices in education, evaluate their effectiveness, gather students’ experiences and discuss other ways of bringing more women to the field of engineering.

WHAT IS MY BACKGROUND?

I first trained as an engineer, studied two years in preparatory classes (*classes préparatoires aux grandes écoles*: CPGE) and one year in an engineering school of higher education, which was supposed to last for three years as is the standard in France. I left this school before graduation at the beginning of the second year. It was meant to be a one-year break for me to rethink my orientation. But, it turned into a longer break, since I never went back to an engineering school – well never again as a student.

I was a very idealistic young woman. I wanted to change the world and to make it a better place to live in. I thought, at that time of my life, that engineering education was not the right place to achieve my goal.

Instead, I worked as a social worker with illiterate young French people, traveled quite a lot in Europe and in India. When I returned to France, I was determined to go to university and study education in order to understand better the reasons why young people who were born in my country, and educated many years here, were not able to read and write in their mother tongue. Later, I met a graduate engineer, who was also a Jesuit father, called Bertrand Hériard Dubreuil. He was trying to introduce “engineering ethics” into engineering education in France. He was back from the US where he had discovered this field of research and teaching. He proposed that I choose this unusual topic, engineering ethics, for my research in education. I had to write a long dissertation to complete my master’s degree.

I accepted out of curiosity and as a kind of challenge because I thought that engineering and ethics were two incompatible fields of interest.

Unexpectedly, this research project was a revelation for me and a few years later I wrote a doctoral thesis in sociology on “engineering ethics and the French engineers’

ethos". It has been now 16 years that I have been developing engineering ethics, combining a sociological and philosophical approach, in France and abroad in various international research programs.

FROM WHAT POSITION DO I SPEAK TODAY?

My presentation will be that of a curious observer, from the outside, of engineering education. Although I am very close to a few engineering schools in my university and in my country, I am a faculty member of none of them. I am working as a researcher in a multidisciplinary ethics center and give courses, conferences and lectures in various engineering schools in France. I am not an expert of engineering education but rather an expert of the engineer' culture and value. I am also concerned by business ethics, corporate social responsibility and sustainable development. Of course, engineering education is of great interests to me, because it is a major factor in professional socialization.

The subject of women engineers has also always been of great interest to me, not only because I could have been one of them, not only because I have had the experience of being among the few female students in a large class of predominantly male engineering students, but also because it is an important issue for society as a whole and because it is, sociologically and ethically, a fascinating subject. I consider that the situation of women in engineering is very revealing of the whole profession, its culture and values.

Interdisciplinary teaching in engineering education is an area I have also been following and studying a great deal because of my interest in ethics, human and social sciences, social responsibility and humanitarian engineering. But I must say that I had never focused my attention on how appealing non-technical topics may be to students. It may be that my experience as a lecturer in ethics has not always given me this impression. While some students appear to be interested in the presence of ethics in their program (which they mostly discover once within the curriculum), many are not very willing and just don't see the point. It has sometimes demanded from me a huge amount of energy to gain the students' interest in a topic which they see as a moment of recreation from the 'real thing', i.e. 'hard science', mathematics, physics, fluid mechanics, materials' resistance et cetera... and which they also consider less useful - or appealing - than other soft topics such as personal development or management.

My presentation will fall into four parts:

1. In the first one, I'll discuss the question of social injustice in connection with the underrepresentation of women in engineering.
2. In the second, I'll discuss, from a sociological and ethical viewpoint, the issue of the lack of interest in science and technology shown by young people and the shortage of engineers in the world.
3. In the third part of my presentation, I'll question the role of interdisciplinary teachings in engineering education.
4. In my conclusion, I'll return to the question of the need for engineers in the world and on the role engineers could and should have in achieving the United Nations Millennium development goals formulated by the UNESCO at the Millennium Summit in 2000.

1. SOCIAL INJUSTICE AND THE UNDERREPRESENTATION OF WOMEN
IN ENGINEERING.

The underrepresentation of women in engineering education and in the engineering profession is an indisputable fact. Another fact is that while the presence of women in engineering has grown since engineering education opened its doors to female students, very cautiously at first, their percentage has remained stable these last years. This rate may differ from country to country. The year girls were accepted into engineering education may also differ. But, there seems to be a general tendency all over the world which makes it hard to believe that a gender balance will ever be fully reached within the engineering profession. My question is: "to what extent should this underrepresentation be considered as an ethical question? What does it tell us about social injustice towards women?"

There was an obvious social injustice when girls who could have studied engineering – and would have liked to – were literally excluded from scientific education. The first engineering school to convert to co-education in France did so in the 1920s, while the prestigious *Ecole Polytechnique* waited until 1972.

The social injustice is less obvious but is still present today when a girl is explicitly or implicitly discouraged from choosing an orientation that would be more suitable (sic) for a boy, or when, for example, less money is allocated by her family to her than is to her brother on tutoring to help her succeed in science.

This injustice is even less obvious when it is linked to the dearth of images of women engineers (and inventors) found in the official history of science and technology. This is partly due to the fact women engineers and inventors have been rarer than men, which is a fact I do not contest. But this lack of representation is also due to the fact that women inventors and scientists have not been sufficiently acknowledged by historians.

So, there are many reasons, from the most obvious to the least obvious, from

external pressures to renounce a desired career to internal auto-censorship, many reasons that explain why women were and are still today less numerous than men in the engineering profession. Obviously, allowing girls into engineering education was a first step, a necessary one, but does not suffice in achieving a gender balance in engineering.

Two other important facts are to be kept in mind.

THE INSUFFICIENT “WOMEN-FRIENDLINESS” OF BUSINESS

The first fact to keep in mind is that the drop-out rate of women engineering students after their graduation is higher than that of their male colleagues. For some of them, this renouncement may occur soon after their graduation, for others it occurs after their first or, more often in France, after their second child. The difficulties, still present today, for women of having a career and bringing up children – who are of course very often also their husband’s children – lead them to give up, because of the lack of support from their partners (often engineers themselves) and from their companies (despite the diversity programs that have been set up these last ten years).

Things are changing, but they are changing slowly.

I would like to say a few words about company policies even though I know it was the topic of the last HELENA conference. In the field of business, companies have shifted from an equal opportunity approach (based on affirmative action since the 70s in the US) to another way of dealing with gender imbalance, called ‘diversity’. Diversity policies concern women as well as ethnic minorities and disabled people (just as affirmative action used to do). But the philosophy, should I say the ideology, of diversity is rather different. Instead of wondering what a company can do for people, it focuses on what people (discriminated people) can do for the company.

The diversity policies developed more recently in Europe, mostly through American companies that have been set up here. Today, the great majority of North American companies who seem to care about women’s careers are, in fact, motivated by business motives and not by the promotion of equal opportunity and people’s rights.

Indeed, many studies have now shown that the more women in the higher position in a company, the better the economic results for this company. It is a good thing that managers have realized that diversity is good for business. But just as I do not believe that being ethical always pays, I think that achieving equal opportunity remains an issue even when it does not pay. “Pink washing”, just like “green washing” (when ecological issues are at stake) is not the right solution.

So, the issue of women in engineering is not only a problem of orientation after high school, neither is it solely a question of inner and external obstacles. It is also a problem of “women-friendliness” within the workplace. If companies want women engineers to stay, a few things still need to be changed in the companies’ policies as well as in the corporate culture. Whitewashing will never convince, and be efficient, in the long term.

By the way, the concept of “pink washing” which I thought I was inventing for this lecture, following the model of “green washing” does already exist in the US where it is used to describe companies who show off their care for women through an involvement in Charity linked to breast cancer issues in order to appear “women- friendly”.

DIFFERENT LEGITIMATE DESIRES?

There is another fact to keep in mind which has to do with the gender specificity of career interests and choices. Women seem to be more attracted to topics such as human biology and agronomical sciences, men to mechanics and information technology. This appears as a fact today in many countries.

It has not always been so and I do not believe that this cannot change. This gender bias may need to be analyzed and explained. But it needs also to be taken into account as it is today, and looked at with some caution. In the field of engineering, the percentage of women is high in biological engineering while it remains low in most fields. My question is: should it be so radically different?

Ethically, I would defend any project that intends to reduce internal and external obstacles to the right of women to choose as freely as possible their professional orientation, be that to become an engineer or a doctor of medicine. I would also defend any corporate program that intends to enable all engineers (women and men) to find a better balance between their personal and professional lives and succeed in both. But, I would be slightly wary of programs that seek to help only women engineers (who are seen as mothers) to cope more easily with their domestic and educational tasks, or with companies who try to attract women by being active in a charity fighting against breast cancer (the actual meaning given to “pinkwashing today in the US, as I said before).

But I do not see much ethical justification in the percentage of women in mechanical engineering being the same as that of men, no more than I would see any ethical reason for the military to be 50% male and 50% female. It may be that even if we could end all the internal and external obstacles (which I hope we can do one day but which is still Utopian), women may still have different choices.

By the way I need to say that I do not consider that boys are completely free in their career choices either. They too suffer from social pressure, but not the same. They are more influenced by social pressure that pushes them to go to sciences (even if they are good at literature and love it). In the very hierarchical educational system we have in France a boy who is good at Maths has to go to *Classes préparatoires* for an engineering education and take the most prestigious competitive exams. Then he “has” to choose among the schools he can enter the one whose rank is the highest, and which is not always the one he prefers. How would anyone (I am talking about boys here) dare to say that his dream is to become a Maths teacher in secondary school when he happens to be able to enter Polytechnique?

2. THE LACK OF INTEREST SHOWN BY THE YOUNG GENERATION IN SCIENCE AND THE SHORTAGE OF ENGINEERS

Let's say a few words about the lack of interest of the young generation in science and the shortage of engineers. From a sociological viewpoint, the two questions "Why aren't there more women in engineering?" and "Why do young people not seem to be interested enough in engineering?" are two very different questions.

While the underrepresentation of women in engineering is an obvious fact – although there are various explanations – the lack of interest of the young people in science and technology is a much more controversial statement. While the media seem to listen and spread the alarmist statements coming from business world and from the field of education, scholars who study this question do not assert in such stark terms this lack of interest in the sciences.

For example, the latest Eurobarometer shows that interest in science has not decreased among young people: it is stable and rather high. Concerning the interest of young people in the news, it appeared that while 'soft news' (culture and entertainment) proved to be the most popular, interest in science and technology is nevertheless high: two thirds of the young people interviewed for the last Eurobarometer are attracted to these topics. They also appear to be very interested in the "new inventions" in all European countries. Various surveys conducted in France also show that the image of science has been stable among the young generation and their parents. As far as France is concerned, the prestige and the financial reward of holding an engineering title remain rather attractive.

From an ethical viewpoint, two other questions need to be asked. The first one is "why should there be more women studying engineering?". The second one would be: "why should there be more young people studying engineering?". While the first question leads to a moral discussion and while the answer might entail ethical justification (which I have sought to develop during this presentation); it is obviously not the case as far as the second question is concerned unless one can prove that this shortage of engineers is first of all a reality (which may be true but is not agreed upon by all) and second that this shortage is a moral problem. It may be the case, but it is not obvious to me, at least not at this point of my presentation.

Although it is often presented in the media as a major economic problem, like other skeptics, I am not fully convinced because I consider that an economic problem is not always a moral one. To take a provocative example, the fact that a company which designs and makes landmines goes bankrupt may be considered as a rather good piece of news for an ethicist.

3. WHY SHOULD THERE BE MORE INTERDISCIPLINARY COURSES? AND WHAT FOR?

While the conference's organizers see in interdisciplinary courses, non-technical education such as human and social sciences, as a means of attracting more students to engineering education, I would rather ask the question: How could such courses be of benefit to both engineers-to-be and to society as a whole?

I conducted research a few years ago on the curricula of the first French engineering schools. This work showed that the desire to educate a "complete engineer" has been widespread for a long time in French engineering education. Philosophy was already taught long ago at the prestigious *Ecole Polytechnique*, law at the *Ecole Centrale*, social economics at the *Ecole des Mines de Paris*. More than a century ago, at least in the few top schools, nontechnical education had undoubtedly its place in the curriculum. Of course, this was not the case everywhere but only in the top schools.

In the 50s many interest groups in France (unions, professional associations) agreed upon the inclusion of more interdisciplinary teaching in engineering education, but their motives were not the same. For the national union of employers, engineers needed to be better-skilled in economics, in order to improve productivity. For the major labor trade unions, the aim of social training was to enable engineers to improve the workers' social conditions. The senior-level employees' union considered that engineers needed to have a better understanding of what the "human factor was and develop a wider general liberal education". Some catholic movements argued in favor of the inclusion of traineeships in factories as a way of reducing the mutual ignorance that leads to class conflicts.

After a lot of thinking since the mid 80s, the French accreditation body for engineering education has expressed its wish that humanistic training be better-addressed in the programs. But it has not set out any formal requirement. Only recently, it created a commission in charge of clarifying the teaching goals of Human and Social Sciences. Simultaneously, a network of students who are members of "Engineers Without Borders" has been leading a national discussion on the introduction of human and social sciences in engineering education, in order to help engineers become "citizens of the world". As you may guess, I agree with such a goal for a broadening of engineering education: contributing through science and technology to build a better world.

The inclusion of interdisciplinary teaching is not a new question and it is important to keep in mind that it is a controversial one because transmitting human and social skills can imply different goals – even antagonistic ones (i.e. improving productivity vs. preventing class war or improving the relation between workers and engineers).

Therefore, I will be very interested to listen to the presentations during this conference that will try to see if offering more of such content in the programs will enable us to attract more young people to engineering and also more women. But, as an ethicist, I have other reasons to wish that more interdisciplinary teachings be proposed to all engineering students. However, I would be very happy if teaching

programs which are conceived in such a way as to help engineers become “citizens of the world” happened to attract more young people, and more women.

Let’s hope that more interdisciplinary teaching can indeed attract more young talented people to engineering, and more talented women, not just because of its current image but also because a more balanced education will make better engineer-citizens, and therefore a better world... and, with hope, make them happier

Conclusion: Why does the World need engineers? What kind of engineers does the World need? How many women find careers that fit better with their engineering abilities?

What are the fundamental needs of our world and of the future generation? The UN Millennium development goals may give us a few insights. What is needed for a better world is engineers who are aware of social issues and who are able to respond to the challenge of development and sustainable development.

At the Millennium Summit in September 2000, world leaders passed the Millennium Declaration which formally established the Millennium Development Goal: “halving extreme poverty and hunger, achieving universal primary education and gender equity, reducing under-five mortality and maternal mortality by two-thirds and three-quarters respectively, reversing the spread of HIV/AIDS, halving the proportion of people without access to safe drinking water and ensuring environmental sustainability.”

I will conclude with a quotation from the first UNESCO report on engineering and development published last year, and coordinated by Tony Marjoram. This quotation is by Irina Bokova, director general of Unesco, who wrote the foreword of the report. She says: “The Report shows that the possible solutions to many of these issues, challenges and opportunities are interconnected. For example, a clear finding is that when young people, the wider public and policy-makers see information and indicators showing that engineering, innovation and technology are part of the solution to global issues, their attention and interest are raised and they are attracted to engineering. The Report is an international response to the pressing need for the engineering community to engage with both these wider audiences and the private sector in promoting such an agenda for engineering – and for the world.”

Thank you for listening

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*Christelle Didier,
Ethics Department,
Catholic University Lille
Lille Economie&Management*

Born in 1967. BS Electrochemistry Engineering, Master of Education, PhD in Sociology. Professor, Ethics Department, Engineering Ethics Team. Catholic University of Lille, France. Member of Lille Economie&management (CNRS). Co-author of Ethique industrielle (DeBoeck, Brussels, 1998), author of Penser l'éthique des ingénieurs (PUF, Paris, 2008) and Les ingénieurs et l'éthique. Pour un regard sociologique (Hermès, 2008) Research areas: engineering ethics, including historical, cultural and gender perspective; sustainable development and corporate social responsibility.