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Additional Information

Educating engineers for the public good through international internships: Evidence from a case study at Universitat Politècnica de València.

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### **Abstract**

At Universitat Politècnica de València, Meridies, an internship programme that places engineering students in countries of Latin America, is one of the few opportunities the students have to explore the implications of being a professional in society in a different cultural and social context. This programme was analyzed using the capabilities approach as a frame of reference for examining the effects of the programme on eight student participants. The eight pro-public-good capabilities proposed by Melanie Walker were investigated through semi-structured interviews. The internship is an environment in which students can put into practice the knowledge they have acquired in undergraduate studies and to find practical relevance in what they studied. Occasionally, this also entails a critical questioning of what they have learned, a greater awareness of the limits of the contents of their studies and of the way things were taught, and interest in less explored issues that are closely linked to social justice. However, tensions can arise between the pro-public-good oriented perspectives of this programme, and a more instrumental vision. One way to overcome these tensions is to foster consideration of reflexivity, that is, the dynamic relationship between technology and society. To do so, the programme must create space before and during the internship, and upon the return of the students, to discuss and collectively reflect upon their lived experience. Additionally, it ought to engage supervisors in this educational

journey, both at the university and in the host institutions, and also involve socially committed organisations in this task.

Keywords: public good, professional and personal capabilities, social justice, internships, grant, Latin America, engineering studies, Global South

## **Engineering Education for the Public Good: An Unexplored Field**

The link between engineering education and the public good is an insufficiently explored field in studies of engineering education. Recent work has discussed the relevance of the global skills required for the engineer to face global challenges (Bourn and Neal 2008). Other authors have dealt with the importance of having engineers consider the social aspects of sustainable development related to issues of equity and just distribution (Cruickshank and Fenner 2007). Nevertheless, various studies demonstrate the low priority given to these issues in engineering studies. As Sheri Sheppard and colleagues (2008) highlight in their analysis of eleven mechanical and electrical engineering programmes in the USA, “students have few opportunities to explore the implications of being a professional in society” (Sheppard et al. 2008, p. xxii). This same problem exists in Spain.

Just as training in engineering has not given priority to the underlying social vision, studies on engineering ethics have not highlighted the importance of the public good.

This is reflected in the words of C.E. Harris (2008):

Engineering ethics has been more oriented towards protecting the public from professional misconduct by engineers and from the harmful effects of technology. However, some aspects of engineering professionalism, such as (1) sensitivity to risk, (2) awareness of the social context of technology, (3) respect for nature, and (4) commitment to the public good, cannot be adequately accounted for in terms of rules, certainly not negative rules. (Harris 2008, p. 153)

To address this problem, Kevin Passino (2009) suggests two strategies: 1) including education that will increase volunteerism among engineers and 2) increasing the participation of engineers in organisations focusing on engineering volunteerism. As he states: “experience shows that these activities provide significant motivation, knowledge of how to build on idealism, and a strengthened spirit of volunteerism in new engineering graduates” (Passino 2009, p. 578).

The same line of argument is provided by Barbara Moskal and colleagues (2008) and Carl Mitcham and Elaine E. Englehardt (2015) in their description and analysis of the Humanitarian Engineering programme of the Colorado School of Mines. Through an interdisciplinary collaboration, a sequence of courses has been designed and implemented to support engineering students in developing an understanding of the ethical, cultural, historical and technical dimensions of engineering work, both in the USA and abroad.

Nevertheless, probably one of the most relevant contributions to the relationship between engineering education and the public good was made in a special issue of the *International Journal of Engineering, Social Justice and Peace* (Kabo 2013). There, Caroline Baillie and Michael Levine (2013) make the case for a new paradigm of engineering ethics, which is based on principles of justice as articulated by John Rawls and Amartya Sen (Rawls 1971; Sen 1999). For Baillie and Levine (2013) two important points arise from their understanding of Rawls and Sen: balancing diversity and equity, and the importance of participatory engagement in engineering.

Here we follow the approach presented by Baillie and Levine (2013) and enlarge it with consideration of the development of specific human capabilities, intended to be a source of inspiration for teaching and learning in higher education (Walker 2006). This

proposal is based on seminal works developed by key authors of the capabilities approach (i.e., Nussbaum 2000; Sen 1999), which have been a source of inspiration for other authors, who have applied it to higher education (i.e., Boni et al 2012; Crosbie 2013; Walker and McLean 2013).

### **Key Elements of the Capabilities Approach**

Capabilities are defined by Sen (1999) as the substantive freedoms to lead the kind of life that people value. Functionings are the activities that people perform and that are *valued* by them. The capabilities approach emphasises the importance of assessment by the people, referring to both capabilities as well as functionings. It is important to understand the idea of capabilities as freedoms or opportunities. They cannot be simply desires, but must be something that can be put into practice. They include both material things (the capability is being nourished and the functioning is eating) and people's states (the capacity is having political convictions and the functioning is starting a hunger strike). Sen indicates that the most important thing is that individuals have the freedom and the opportunity (capability) to lead the kind of lives they want to lead, to do what they want to do, and to be who they want to be. Once they actually have these substantive opportunities, they may choose to implement those options that they value most.

Martha Nussbaum focuses on the capability approach and presents ten central capabilities for the functioning of human beings which are the fundamental requirements for a decent life, and which together, meet a minimum degree of social justice. A society that does not guarantee these capabilities for all of its citizens, at an appropriate level, cannot be considered a just society, whatever its level of affluence

(Nussbaum 2000). Nussbaum's list has been criticised and debated due to its universalist, non-context-sensitive character. However, we consider it a global, international and social justice-oriented position, given that the associated public policies would serve to increase the capabilities of citizens.

Another key element of the capability approach is its explicit reference to development as the promotion of human values. As a result, the development of society is a normative concept that differs from economic growth or social change. The standard definition of the dimensions of human development by the United Nations Programme for Development includes: 1) empowerment, understood as the expansion of the capabilities of people (real opportunities to achieve valuable ends) and the expansion of valuable functionings (valuable purposes achieved), and participation; 2) the equitable distribution of basic skills; 3) sustainability; and 4) the freedom of the people to enjoy their opportunities and achievements (Boni and Gasper 2011; 2012).

Furthermore, Pablo Penz and colleagues (2010), reviewing the evolution of thinking about human development, identified six groups of values that have been the basis for discussions of human development over the past fifty years: 1) welfare and human security, 2) equity, 3) participation and empowerment, 4) human rights, 5) cultural freedom, and 6) environmental sustainability.

Taking into account the above elements, for the purpose of the research presented here, public good is defined as the expansion of people's capabilities and functionings within a framework of respect for the core values of human development.

### **The Capabilities Approach to Higher Education for the Public Good**

The capabilities approach can be helpful in reimagining a different vision of higher education, one that goes beyond the goal of preparing people to join the workforce. While education can enhance human capital, people benefit from education in ways that exceed its role in creating human capital for the production of commodities. In Sen's argument, ultimately what matters is what freedom a person has (Sen 1999), and that is not consistent with a pure human-capital model. Even acknowledging the importance of a job for achieving social inclusion, an educational focus on employability and jobs says nothing about the quality of work, or whether people are treated fairly and with dignity at work (Boni and Walker 2013). A focus on capabilities implies taking into account the broad scope of the benefits of education which include enhancing the well-being and freedom of individuals and peoples, improving economic production, and influencing social change.

Taking inspiration from Sen and Nussbaum, there have been several contributions to reimagining the spheres of university work: the pedagogy and curriculum, research, and social engagement, as well as internal governance and, even, the physical environment of institutions (Boni and Gasper 2011; 2012). For example, Melanie Walker and Monica McLean (2013) discuss the characteristics of a professional committed to social justice, that is, what is known as a public-good professional. Concerning the curriculum, Nussbaum's proposal of the three capabilities for democratic citizenship (1997; 2006) has inspired several contributions to rethinking university curricula (i.e., Boni et al 2012; Gasper and George 2010; Walker and Mclean 2013).

Walker presents a list of eight capabilities: 1) practical reason, 2) educational resilience, 3) knowledge and imagination, 4) learning disposition, 5) social relations and social

networks, 6) respect, dignity and recognition, 7) emotional integrity and emotions and 8) bodily integrity. A detailed explanation of all of these capabilities is presented below.

This list should not be understood as a closed list, but rather, as Walker herself emphasises, as "a starting point for discussion about the capability approach and teaching and learning in higher education" (Walker 2006, p. 128). It is beyond the scope of this paper to discuss whether the capabilities presented by Walker could be considered capabilities or capacities, or even abilities. Furthermore, as mentioned earlier, there is considerable debate within the capability community on the legitimacy of these kinds of lists. These are controversies that cannot be addressed here. For present purposes, Walker's proposal can be understood as a source of inspiration and a practical proposal for introducing a different way of analysing and contributing to the improvement of Meridies, an internship programme for engineering students.

### **A Case Study: The Meridies Grant Programme**

This paper presents a case study that aims to explore the learning outcomes (in terms of capabilities) of engineering students who have been awarded a grant from the Meridies programme at the Universitat Politècnica de València which supports a two-to-five month stay in an international organisation, predominantly in Latin America<sup>1</sup>. Between 2007 and 2013, 83 students obtained a Meridies grant.

This programme is particularly relevant in the Spanish engineering education context, where there is a clear lack of other learning opportunities related to global and ethical

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<sup>1</sup> The countries involved in this programme fall into the more general category of countries of the Global South, a term widely used in the area of development studies to refer to countries characterized by middle or low human development as established by the United Nations Development Programme in the Human Development Report (2014).

issues in engineering. From 1997 to 2007, the Universitat Politècnica de València offered free elective courses to complement the core subjects of the engineering degree, including subjects related to ethics or development aid (Boni et al, 2012).

Unfortunately, the European Higher Education Area changed the structure of all degrees, and free elective courses have disappeared. In a few cases, some schools have introduced a subject related to professional ethics in the new degree programmes, but global issues are not always considered. The European context is different from others referred to in the previous section, such as the experience at the Colorado School of Mines. It is also different from what Passino (2009) proposed because, for the Meridies grant programme, engineering students need not be involved in a voluntary organisation. Participating bodies may include Non-Governmental Development Organizations, and also multilateral institutions, local governments and universities.

The student profiles vary, although the programme has three objectives: 1) that the students put into practice technical knowledge acquired through engineering studies; 2) that they become familiar with the nature of work carried out in the development aid sector<sup>2</sup>; and 3) that they develop solidarity with, and a commitment to, disadvantaged people. Meridies, therefore, has a mixture of instrumental and ethical goals, and this dual character is clear throughout the different stages of the programme.

The procedure is the following: every year in February or March, there is a public announcement with a detailed description of the task to be carried out and the skill-set needed. Normally, the description is technical and emphasizes the knowledge and skills

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<sup>2</sup> The development aid sector includes many public and private actors that are channelling economic, human and technical resources to foster the development of nations and people.

required of students. References to the eradication of poverty or other ethical concerns are not very common (i.e., in 2013, only three out of the 17 proposals mentioned this kind of goal. Further evidence of the prevalence of the technical emphasis are the criteria used to select students: 75% of the evaluation of the suitability of the candidate is based on the individual's technical knowledge and skills for the specific project, and the other 25% of the score comes from a student's letter of application, specific training in the development aid sector, or participation in voluntary organisations.

After being selected to receive a grant, the students must attend a 10-hour course (compulsory since 2010) on basic knowledge of the characteristics of the project in which they will be involved. Upon their return to the university, they also participate in a short event to comment on their experience and engage with other students who participated in the programme at other locations. In some cases, the teachers in charge of supervising students also participate in this dissemination activity. This happens when the project for which the student received a Meridies grant forms the basis of the final dissertation project. However, according to the information available since 2010, only a small percentage of these grants specifically contribute to the final dissertation.

## **Methodology**

The idea for this study began as a result of anecdotal feedback from students and the Meridies programme staff. The majority of the students reported an intense and life-changing impact of the internship. We explored those changes using the capability approach with three different aims: first, to explore these changes using a theoretical framework based on a pro-public-good idea of education; second, to make some

recommendations for the programme in order to enhance its capability profile; and, third, to identify some further avenues of research.

The eight capabilities for higher education proposed by Walker (2006) were considered useful and appropriate for the scope of this exploratory study. With these in mind, questions for the semi-structured interview were designed and the study participants were chosen. In 2012, eight in-depth interviews were performed (four people belonging to the 2008 programme, three from 2010 and one from 2011). All of them gave consent to be recorded during the interviews (see Appendix for a copy of the consent form) and anonymity is maintained in the presentation of the results. All the interviews were fully transcribed and translated into English .

The interviewees consisted of four men and four women, each with a degree in a different area of engineering (agriculture, industry, information and communication technology [ICT], environmental engineering, etc.) and one student of architecture. When they received the Meridies grant, five were students in the first course of their studies (normally a three-year course), two were students in their second course (normally a two-year course) and one was pursuing a master's degree. None of these students had received any explicit training in professional or engineering ethics during their studies, and this grant was the first opportunity to experience immersion in a different context, outside Europe.

The semi-structured interview began with open questions to try to find relevant moments of learning that had occurred during their engineering courses (e.g., questions like: What kind of abilities have you acquired? or Which moments do you especially value?). Following this, "negative" questions were posed to try to identify negative moments in their learning pathways. Then, questions related to the eight capabilities

were asked using cards with unfinished quotes like “in my experience, my idea of development is...” or “in my experience, as a professional I’m able to...” or “my abilities are...”, etc.

The second part of the interview consisted of questions related to the Meridies programme and also explored the influence of family, friends, and political or voluntary activism on their ethical vision.

The next section explicitly addressed the eight capabilities on Walker’s list, to see if the interviewee acknowledged the expansion of these capabilities during the experience.

Finally, the interviewer enquired into the limits perceived during their studies with questions like “If you became aware of a particular issue or developed a particular skill from your Meridies experience, why do you think you did not get it from your engineering studies?”

Rather than seeking generalisations, this qualitative methodology provided an opportunity to enhance and deepen the students’ experiences and reflections during and after their experience overseas. Nevertheless, the exploratory character of this methodology has limitations. Further research could expand on this study by including the perspectives of the teachers who supervised the students and the people from the organisations where the students carried out their internships. Furthermore, additional techniques, such as focus groups with students, could be useful. Currently, more ambitious research involving a broader range of respondents and methods is being

~~carrying~~ conducted at Universitat Politècnica de València

### **Professional Capabilities for the Public Good**

Walker's (2006) eight capabilities provide a framework for analyzing the results of the study presented here. Each capability is considered separately, except for emotional and bodily integrity which are grouped together as they received the least comments from students. As is apparent, many capabilities are interconnected.

*Practical reason*

“Being able to make well-reasoned, informed, critical, independent, intellectually acute, socially responsible, and reflective choices. Being able to construct a personal life project in an uncertain world. Having good judgement” (Walker 2006, p. 128-129).

The capability of practical reason is put into practice when the respondents applied for a Meridies grant in a conscious way and with clear motivation. For seven of the eight participants one of the main reasons for choosing the programme was practical: the end-of-degree project, mandatory undergraduate practical sessions, or the master's dissertation. Nevertheless, their interest in the grant arose, to some extent, from the possibility of experiencing new ways of working and new contexts, and thus being able to experience new personal and professional learning opportunities:

*I was willing to change, to prepare my thesis on an interesting topic abroad. I was a little tired of classic university topics, (...) the university is not designed for the topics we are interested in (...) and then I moved because I felt like having a change (FS1)<sup>3</sup>.*

Or, to also look for a different meaning in their technical training:

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<sup>3</sup> FS for female student and MS for male student, followed by the identification number of the respondent. Quotations from participants provided here are English translations of excerpts of the original Spanish transcript of interviews

*I went away to break new ground; this is the road I am interested in and I can give a certain meaning to architecture (...) my studies are aimed at building either for speculators or for the elite, it no longer made any sense (...) and I said to myself, I am going to try and do my final degree project in international cooperation, without any prior experience (FS4)*

In the case of this student, when she returned to Spain she became more interested and engaged in domestic social problems, apparently as a result of her overseas experience:

*I realised this when I came back: I prefer to work where I live. There are so many problems here, I am going to work on the problems here (FS4).*

As we shall see, on many occasions there is a strong link between this capability and others, such as the “learning disposition”:

*I wanted to learn, and to evolve, progress, and also to see what practical points my studies had, because I had studied but had not worked in anything related to the environment (...) It was a way to put into practice what I had studied and, obviously, to learn at the same time. (MS7)*

### *Educational resilience*

“Able to navigate study, work and live. Able to negotiate risk, to persevere academically, to be responsive to educational opportunities and adaptive to constraints. Self-reliant. Having aspirations and hopes for a good future” (Walker 2006, p. 128-129).

During the interview most of the respondents answered that, during the first years of their university life, they had learned only technical skills.

*In the first years I felt I was learning, academically, things that I did not want to learn or that I thought that I did not need. I was learning basic engineering*

*concepts (...) I saw my studies as a sort of mini-insurance in terms of finding a stable job and receiving a good economic remuneration. (MS6)*

This feeling of being unable to orient oneself in the academic world has given the Meridies programme a great instrumental value because it has been useful for the completion of studies:

*I did not know which topic I should deal with in my end-of-degree project, and I accomplished it with this. Then, it was very good for me, in addition to going to South America with certain benefits, , facilities, [and] also having a base from which to be able to undertake the project (MS5).*

Or to become a professional in the field of development cooperation:

*(...) the work as an engineer was the least satisfying for me. Going to the communities, talking to people, talking about the project (...) that was really rewarding. And if you offered me a lifelong job today, I can tell you that I would sign up for it (MS6).*

Educational resilience is also reflected in the ability to understand one's own previously lived reality, and in the ability to adapt to any context, as well as solving problems different from those found in their day-to-day lives:

*You do not go there to learn a language: you go there to learn another way of life (...) I was capable and learned to solve problems that I had never encountered here, about computerisation, transportation, etc. (MS5).*

During the time these interviews were carried out (in 2012), Spain was suffering one of the highest rates of youth unemployment in recent history. In this context, a recurring idea is the value attached to the opening of one's mind that this opportunity involves. The respondents view the possibility of emigration as an opportunity for them to

overcome the restrictions on practicing their profession in Spain. The learning acquired through Meridies is a factor that allows them to recognise the risks entailed by these types of decisions and ways of managing them. As with most capabilities proposed by Walker, there are strong links to other capabilities. In this case, some of the respondents established a direct relationship between freedom of movement and the ability to create and maintain social relationships in new contexts:

*I discovered that working abroad is possible, it can be done, it is not so different from working here, and I discovered that I am able to get by and provide for myself, (...) I have greater self-confidence to deal with different jobs, I am more self-confident about taking part in a work team, I believe it has contributed to my self-esteem (...) the courage to make this decision in the short and medium term, as I would probably not have thought about it if I had not been abroad (MS7).*

Lastly, although the programme may enhance the ability of students to orient their lives towards a better understanding of the public good, exogenous constraints may appear upon their return and hamper the practice of this capability:

*It is very difficult to be different in the society you live in. I came back with a series of ideas that I have not carried out and have ended up being, not identical, but very similar to the woman I was before I went abroad (FS3).*

#### *Knowledge and imagination*

“Being able to gain knowledge of a chosen subject –disciplinary and/or professional– its form, academic enquiry and standards. Being able to use critical thinking and imagination to comprehend the perspectives of multiple others and to form impartial judgments. Being able to debate complex issues. Being able to acquire knowledge for

pleasure and personal development, for career and economic opportunities, for political, cultural and social action and participation in the world. Awareness of ethical debates and moral issues. Open-mindedness. Knowledge to understand science and technology in public policy” (Walker 2006, p. 128-129).

Interestingly, the interviews prompted some respondents to understand their discipline and society differently. In particular, these students began to perceive the university not solely as a professionalising space, but rather as a space for integral growth, as a whole person. This is reflected in new learning interests through formal education and involvement in associations or groups, as well as the appearance of new interests in issues previously alien to them, such as public policy:

*You become aware, it is a shame to say so, when you are about to leave the university atmosphere, that university is a wonderful platform for all these kinds of things, to have a more civic attitude, a more social attitude, I get the feeling that I have taken this in right at the end. In the end I realised that we students really do have a voice (FS1).*

One’s own experience also helps to acquire a global view, which is reflected in a greater environmental consciousness:

*University does not help you to have social and environmental sensitivity (...) by reading, studying, knowing, travelling abroad (...) and being there made several important contributions to my environmental thinking (MS7);*

or in a greater awareness of a non-explicit curriculum in universities' studies which follows neo-liberal dogmas:

*There I saw genetically modified crops ... all those are ideas I had on my return (...) you realise that university is at the service of neo-liberal dogmas, and as soon as you say “Hey!”, you are a green, you are alien, you are immediately given a label (FS1);*

or in a wider view that allows them to understand the complexity of life and perspective in different countries :

*Now I also stop to think about other countries, how they are, how they live, what governments they have, how they do or don't progress (...) I believe I have always been interested in the world, but now I have more information and details (MS6).*

In this sense, most participants develop critical thinking with regard to the relationships between more and less developed nations and development cooperation, abandoning the patronising way of thinking they had prior to living in a less economically developed country:

*Previously I did not have an idea about [the reality of] development (...) and finally you realise that although development is inherently something good, the goals behind it are not so good (MS7).*

*What I have understood most is that there are places where (cooperation) is more useful, places where it is less useful, and places where it is not so useful (...) Not all development cooperation creates identical development (MS6).*

### *Learning disposition*

“Being able to have curiosity and a desire for learning. Having confidence in one’s ability to learn. Being an active enquirer” (Walker 2006, p. 128-129).

On their return, some respondents searched for training opportunities in social areas to acquire information on the complexity of development and of the relationships between more and less developed nations, in the belief that this knowledge is essential to becoming a professional with a wider worldview:

*I realised this, that there were things that did not work and made me do further training. It aroused my interest (...) Today I have much more information about cooperation, about working for the integration of the population (FS4).*

This “being able”, as experienced by participants, has promoted the ability to trust in one’s own ability to learn, highlighting the development of the importance of putting their knowledge into practice:

*I realised that I was even more capable of doing things than I had previously thought (...). Things like getting along by myself far away from home (...) things to do with my studies (MS8).*

Remarkably, the lived experience has been important for some students in order to understand their role as *learners* and not *teachers*:

*I would go back there (...) but not with the idea of teaching, but rather of learning. I think there I learned much more than I contributed. I was able to face the idea of asking things because during our university studies we did not learn anything about that topic; you have no idea of what they expect or how it is done (MS5).*

#### *Social relations and social network*

“Being able to participate in a group for learning, working with others to solve problems and tasks. Being able to work with others to form effective or good groups for

collaborative and participatory learning. Being able to form networks of friendship and belonging for learning support and leisure. Mutual trust” (Walker 2006, p. 128-129).

Something to highlight is the importance to many respondents of the opportunity to understand the benefits of working in teams:

*What I take with me from this life experience is working with a group of people and becoming friends with that group of people. And working as a group, leading the activities to be performed by each member, structuring them and undertaking them (...) speaking in a different way, being able to adapt to different social classes, people, the group you are talking to (MS6);*

Also, students gave value to the richness that arises from diversity and the importance of creating trust in personal relationships:

*They had a really calm way of working and I put pressure on them, and one day they told me, listen, we do not work this way (...) They asked me where I was from, what my parents' names were, what they had studied, what I had studied, what my sisters' names were (...) Once they knew me, there was a sort of mutual confidence and this allowed for different work to be carried out, (...) they told me that the work had to be done, but it was impossible if they did not know each other and what to expect, and I said to myself: “Aha!” (FS1).*

Furthermore, following the positive experience, some students decided to become more involved in groups:

*Now that I have almost finished my training I have learned more than ever about issues that I had never touched on within the university environment, how to work in teams, how to put your ideas forward, because on my return I started to be more committed to the university environment and, with several other people, we have created a group within the university (FS1)*

### *Respect, dignity and recognition*

“Being able to have respect for oneself and for and from others, being treated with dignity, not being diminished or devalued because of one’s gender, social class, religion or race, valuing other languages, other religions and spiritual practices and human diversity. Being able to show empathy, compassion, fairness and generosity, listening to and considering other persons’ points of view in dialogue and debate. Being able to act inclusively and being able to respond to human need. Having competence in inter-cultural communication. Having a voice to participate effectively in learning; a voice to speak out, to debate and persuade; to be able to listen”. “Safety and freedom from all forms of physical and verbal harassment in the higher education environment” (Walker 2006, p. 128-129).

This capability is one that is most closely linked to the Meridies experience as encounters and contact with different people and organisations leads to understanding and respecting differences:

*You also realise how people consider [the] Spanish abroad, how people treat you, how you treat people, things you find shocking, that grab your attention, things that are different. Your personal view is also broadened. (...) Rejecting behaviours usually stem from ignorance, and when you leave your usual environment, when you go to different places and mix with people different from your environment, from the point of view of language, religion, diversity (...) your compassion, justice, generosity are expanded. You are able to listen; you are able to understand. Rejection is no longer there because things are no*

*longer alien. It is something usual, something normal, something you understand (MS7).*

During their stay, different experiences made participants break with some assumptions previously taken for granted and they gave a different value to the contributions made by people with a different social status:

*When I introduced myself to the group of women, I commented that I was an engineer, that I was studying a master's degree... all of them listened to me without interrupting, and thanked me. Then I listened to their introductions and realised that when introducing myself I had not given any detail that might have been interesting for them or could make a contribution to them in the same way as they had made a contribution to me. They said their names and directly the problems they encountered on a daily basis. Then I realised that their time was really valuable because they had left their children in somebody else's care in order to go to the meeting and, for many, just travelling there had been costly. (...) As soon as the round of introductions was over I felt embarrassed and asked for the floor again. I apologised. I commented that I had not really introduced myself as they had introduced themselves to me. My education was immaterial in comparison with their daily struggle. I thanked them for giving me another opportunity and said that I really wanted to take part in the movement, because I obviously had so much to learn (FS1).*

*Emotional and bodily integrity*

“Not being subject to anxiety or fear which diminishes learning. Being able to develop emotions for imagination, understanding, empathy, awareness and discernment”

(Walker 2006, p. 128-129).

The emotional integrity capability was promoted during their stay in the different country in two main ways: first, they were released from a variety of personal constraints and, second, they learned about other ways of life, other customs and other practices. In relation to the former, respondents came to understand that they were able to pursue ideas and actions that they had never thought of before, and to overcome internal limiting factors, such as shyness:

*What I take with me is the fact that I am able to do things that I would never have imagined before (...) In the first place, having to lose my shyness, because there I had to ask everyone. Feeling completely alien, because you are pointed at, you are something to look at, but you have to leave that behind, because you are going to live there for a while and you have to try and become integrated (MS5).*

As regards new ways of living, respondents mentioned the possibility of understanding different ways of facing existing problems:

*I would take with me all the peace and quiet with which some issues are faced, issues that for me here would be overwhelming, the way they accept things in life, that was something that sometimes surprised me (FS1).*

Finally, as regards bodily integrity, some of the women interviewed clearly felt vulnerable and even unsafe when they were in the country they were visiting:

*One thing that I found very hard to accept there was my role as a woman (...) For example, going out in the street on my own, just for being a woman they exhibited a macho attitude and uttered macho comments, often denigrating, and other times treating me like a princess, which I do not like either. To me, seeing myself in that situation was something I had to accept, it was not me in the scenario (FS1).*

## **Conclusions and Recommendations**

We do not wish to over-generalise, and are aware of the limitations of the present study described in the methodology section. In addition, many of the observations mentioned here cannot be solely attributed to the Meridies programme. Nevertheless, we have indeed been able to observe the potential effects of immersion in different environments and contexts. Moreover, the capabilities approach makes it possible to explore the impact of the programme in terms of the students' personal and professional capabilities. As shown in the previous section, the instrumental dimension of education, linked to the improvement of one's professional qualifications, is mixed with the benefits of the process, and experienced in terms of personal learning. The experience enables students to put into practice, in very different contexts, the knowledge acquired in their undergraduate studies and to find meaning in what they studied. Sometimes this also evokes a critical response towards what they had learned, a greater awareness of the limits of the contents of their studies and of the way things were taught, and interest in less explored issues which are closely linked to social justice (environmental problems, inequalities in relationships between countries, poverty, etc.).

Being in different cultural settings is critically important. The students learned to understand and respect other cultures, and also to value other ways of doing things and other types of non-expert knowledge. On a more personal level, a programme like this provides an opportunity to overcome personal limitations, consider other professional opportunities, and to learn how to work in teams.

However, the Meridies programme has its limits and its potential could be expanded by introducing a capability perspective into the expected learning outcomes. The learning

goals for Meridies are a mix of fostering the technical knowledge acquired, exploring professional opportunities in the development sector, and raising public awareness on problems related to social justice. Additionally, the Meridies programme itself does not provide an opportunity to reflect on the motivations and impacts of such an experience on a personal level. Neither is there time set aside for dealing with the role of engineering in development, nor with global problems and all the issues related to the public good. At the same time, given the lack of real opportunity within the current Spanish context to expand engineers' capabilities, the Meridies programme is still a privileged space that needs to be preserved and improved. In fact, the results of this research have been shared with the staff in charge of Meridies through informal conversations to try to give recommendations to improve the programme.

First, the programme should explicitly enhance critical reflection among all those receiving a grant from the programme. As Baillie and Levine point out: "Although thinking critically about their actions will not necessary cause someone to be just, we maintain it is a necessary part of an ethical education for engineers" (Baillie and Levine 2013, p. 18). Focusing specifically in the development field, Peter Robbins argues "many of the challenges faced in [less developed nations] are as much social as they are technological, and therefore reflexivity is an important way in which engineers can engage with real problems in developing countries" (Robbins 2007, p. 100). How can recognition of the relationship between society and technology be enhanced in Meridies? We suggest working throughout the programme, and creating spaces for explicit consideration of the dynamic, bi-directional relationship between technology and society before, during and after the trip.

Prior to this, the 10-hour course on the general considerations of the programme should be complemented by other kinds of educational elements. The use of critical pedagogies has proved particularly enriching for the shaping of the professional identity of a social justice-oriented engineer (Boni et al, 2012). During the period when students are overseas, some critical observation and reflection could be done. The student's supervisors, both at the university and at the host institutions, are ideally suited to take on primary responsibility for helping students become social-justice engineers. Because this new role would require a significant and substantial change in perspective (from an instrumental and technical view to a more ethical and social justice-oriented one), it would be reasonable to start with a pilot programme involving some of the more committed supervisors.

Another strategy is to foster the exchange of ideas and reflections among the students during the period of their grants. Again, it is not an easy task because it is important to build a group identity before asking them to share their experiences and, even with this, success is not guaranteed. At minimum what could be easily achieved is to change the purpose of the elements of the Meridies programme that take place upon the students' return. Now it is conceived of more as a “dissemination activity” and a technical accountability mechanism: students are asked to send photos, make a poster presentation and write a short report. One possibility is to complement these activities with a collective reflection on their learning journey using, for instance, the list of capabilities suggested by Walker. Participatory and creative methods could be very helpful in that sense and easy to implement in a university environment (i.e., Greenwood and Levin 2007).

Our last recommendation addresses one of Kevin Passino's strategies (2009): it is very important to engage organisations committed to social change in programmes like this and this is feasible in the Meridies programme. For example, the Spanish branch of Engineers Without Borders could be one of the first organizations to be involved to highlight the potential for organisational engagement.

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