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Stéphane Flament, Klara Kövesi

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# WHAT DO OUR STUDENTS KNOW ABOUT THE FUTURE CHALLENGES OF SUSTAINABILITY?

## ENGINEERING STUDENTS SUSTAINABLE DEVELOPMENT AWARENESS IN FRANCE

**S. Flament<sup>1</sup>**

Normandie Univ. UNICAEN, ENSICAEN, CNRS, GREYC  
Caen, France  
sflament@ensicaen.fr

**K. Kövesi**

ENSTA Bretagne  
Brest, France  
klara.kovesi@ensta-bretagne.fr

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### ABSTRACT

There is no doubt that sustainable development (SD) education is crucial for achieving the UN Sustainable Development Goals (SDG) and we believe that engineering students are important actors for developing SD actions. However, we have few information about how engineering students think about SD issues. The papers aims to investigate engineering students' sustainability awareness in the prism of the SDG. This is a key point in order to design well suited multi- or transdisciplinary curriculum in engineering education so as to develop their awareness of the key role they have to play. We applied an online quantitative survey to French engineering students at first year master level just before starting their specific courses in SD and entrepreneurship. This survey covered different dimensions: SD awareness, SD perception and actions towards SD. Our **primary** findings show that engineering students mostly associate SD to environmental and economic aspects related to technology (e.g.: renewable energy, low energy consumption, recycling or zero waste) and pay less attention to social aspects like social responsibility and partnership. They consider SD is very important at the global and national level but less important in their professional or personal life. They are reluctant to integrate SD actions in their everyday practice mainly because of

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<sup>1</sup> *Corresponding Author*  
S. Flament  
sflament@ensicaen.fr

lack of convenience or financial constraints. There is thus a room for raising their awareness about the central role of engineering in SDGs achievement and their understanding about the social impact of engineering. It would also be worth putting more emphasis on social responsibility in their engineering curriculum.

## **1 INTRODUCTION**

In 2015, the United Nations introduced 17 Sustainable Development Goals (SDG), including challenges of poverty, inequality, climate change, environmental degradation, peace and justice; for creating a better and more sustainable future for all by 2030. These complex and interconnected sustainability challenges are closely related to engineering disciplines and give numerous new perspectives to the engineering profession. Without any doubt, engineers will play a fundamental role in achieving these sustainable development goals. As a consequence, sustainability awareness of engineering students who will become engineers in some years is essential for meeting these goals successfully. We would like to investigate what do engineering students know about SDG challenges and what are their SD perception and actions.

## **2 LITERATURE REVUE**

There is a growing number of study in educational literature about students' sustainability awareness in general but less in engineering education in particular. This is quite surprising given the central place of engineering body in sustainability development.

What does knowing and understanding sustainability mean? For Carew and Mitchell [1, pp. 352], an expert-like understanding of sustainability is 'to have factual and theoretical knowledge of sustainability, the ability to apply that knowledge appropriately to contextualized decision-making, and be adept at judging the ethics and sustainability of one's decisions and decision outcomes'. They make a clear separation between the elements of content knowledge (declarative knowledge as the factual knowledge relevant to discipline and theoretical knowledge as the abstract form of declarative knowledge) and structural knowledge (including procedural knowledge, conditional knowledge and critical thinking). There is a learning hierarchy to acquire sustainability understanding: the acquisition of structural knowledge could start only after the successful acquirement of content knowledge. Accordingly, the inclusion of content knowledge as an essential prerequisite of the structural knowledge, should be very important in the engineering curriculum.

According to Azapagic et al. [2], engineering students have a relatively low level of knowledge and understanding about sustainable development and have difficulties to associate sustainability development with engineering practice. Even so, it is encouraging that they have a positive attitude towards sustainability development. Another interesting finding is that they consider it important at their personal level even if it concerns mainly the future generation.

In line with these findings, the empirical study of Kagawa [3] confirmed that students associate the concept of SD with the environment in a unidimensional view rather than applying a multidimensional view including his economic and social dimensions. Concerning sustainability changes in their personal lifestyle, they privilege consumer actions like using of public transportation, changing purchasing habits, recycling or

saving energy or water. Similarly to previous studies [4, 5], Nicolaou et Conlon [6] found that engineering students have a deficient knowledge and understanding about sustainable development, more particularly about the social dimension of it.

### **3 METHODOLOGY**

For answering our research question, we carried out a quantitative online survey with closed questions. This survey covered engineering students at Master level in electronics and physics engineering in a French public engineering school. In our initial research design, our intention was to survey engineering students in two steps:

1. For a first time, just before starting their specific SD courses and
2. At the end of their courses, for measuring changes in their sustainability awareness.

Finally, due to unexpected circumstances (exceptional school closing due to world-wide pandemic), we were able to complete only the first survey but not the second one. The courses that were designed partly in flipped classrooms could not take place in a proper way actually during the lockdown. For this reason, our adjusted objective for this survey is to investigate the initial sustainability awareness of the engineering students.

In total, 73 engineering students (composed of 22% female and 78% male students) completed the online survey just before the beginning of their first SD courses developed in the framework of a French national working group of sustainability education [6]. Before the beginning of the survey, students received detailed information about the objective of the survey, the applied confidentiality policy, the storage and use of data as well as the possibility of withdrawal.

Our online survey included the following questions about students':

- knowledge and understanding of sustainable development (four questions),
- previous sustainability education (three questions).
- perception of sustainability (two questions) and
- attitudes towards SD (two questions).

All questions were designed as closed questions for facilitating the data analyses. Before launching our online-survey, we made a pre-test with 10 students (separate from the 73 students mentioned before), asking their feedbacks, allowing us to improve our survey design.

Initially, we planned to make advanced statistical analyses on collected data. As we have a limited sample size and numbers of data, we opted finally to analyze our data with descriptive statistical analyses.

## **4 RESULTS**

### **4.1 Sustainable development awareness**

When asking to students how relevant they would consider the importance of taking economic, or environmental or social actions toward SD, we found that 87% of surveyed students considered these actions either important or very important.. This is a promising result showing students understanding of the importance of SD in their

current and future life, even if there are strong differences when their perception of SD is analysed deeper in details, as will be shown in section 4.3.

Concerning their source of information, it was not surprising that surveyed students' main source of information about SD is Internet. Education was at the second place, next to the media, which is encouraging from our educational view.

*Table 1 : Source of information considered as significant*

A certain teacher	Parents, Siblings	Friends, acquaintances	Education	Media	Internet
33 %	41 %	56 %	69 %	69 %	90 %

Regarding their SD education, 71% of the surveyed students considered it was a basic one, which took place indeed mainly during primary and secondary school. Only a very little percentage of students (5%) attended specialized courses on SD in general, or during higher education. This is confirmed by their poor knowledge of SDGs as shown in table 2.

*Table 2 : Percentage of engineering students who have some knowledge or know a little bit about SDGs.*

SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
%	33	41	42	55	49	59	53	32	33	48	39	53	50	27	27	34	21

*SDGs definition: 1 No Poverty, 2 Zero Hunger, 3 Good Health & Well Being, 4 Quality Education, 5 Gender Equality, 6 Clean Water & Sanitation, 7 Affordable & Clean Energy, 8 Decent Growth & Economic Growth, 9 Industry Innovation & Infrastructure, 10 Reduced Inequality, 11 Sustainable Cities & Communities, 12 Responsible Consumption & Production, 13 Climate Action, 14 Life Below Water, 15 Life on Land, 16 Peace, Justice & Strong Institutions, 17 Partnerships*

From Table 2, we observe first that the SD knowledge of the surveyed students is quite restricted. With the exception of quality education, it is focusing on environmental aspects like climate actions, clean water, and clean energy. Second observation is that SDG 9 (industry, innovation and infrastructure), which should highly concern engineering students, is poorly known, even 29% of them never heard about it. Other surprising result is that SDGs 1, 5, 8 and 10, which are social aspects of SD, are also quite poorly known. We also noticed that SDG 17 (partnerships) is the worst known SDG, even 48% of students never heard about it. These last two observations are somehow surprising for engineering students who are taught to collaborate, co-create and share their work.

Finally, our last but encouraging observation is that engineering students are inclined to develop their SD knowledge and understanding: 80% of surveyed students consider that SD education for engineering students is important or very important.

## 4.2 Sustainable development perception

Our findings depict an important discrepancy in the surveyed students' perception about the importance of SD in the society, as shown in the table 3. On one side, at the macro level of the society, surveyed students considered SD as crucial for the world-wide society, and relevant only at a country-level. On the other side, at their individual level, they give smaller importance of SD for their professional life and even less for their personal life. This low consideration of SD at their individual level is also contradictory to the fact that SD is considered as crucial for future generation. This is as if they were not aware that they are bound to become key actors of SD achievement.

*Table 3 : Rating of the importance of SD*

Personal life	Professional life	Country	Society world-wide	Future generation
23 %	30 %	53 %	66%	75 %

## 4.3 Actions towards sustainable development

Regarding engineering students' day-to-day actions and engagements at their personal level towards SD (like transportation, energy and water consumption, waste management or purchasing habits) our findings are not really encouraging and confirm the low importance of SD for the students at their personal level.

The most common action, for nearly all surveyed students, is collecting waste selectively. This is not surprising as it is obligatory in France. At the second place, all kind of actions for decreasing their energy consumption. Which is consistent with the fact that 60% choose an environmentally friendly transportation.

We observed a lack of engagement concerning surveyed students' purchasing habits (66% never or occasionally buy energy-efficient devices, 64% never or occasionally buy products with an environmental label, 56% never or only occasionally reduce the use of disposable product and 52% never or occasionally buy local products). This lack of engagement in their purchasing habits seems to be contradictory to their environmental awareness but could be explained by the fact that simple convenience or financial reasons are the main reasons preventing them from living in a more sustainable way. This is consistent with our finding that 49% of surveyed students have the feeling that the conditions to have an environmentally friendly lifestyle are not easily available.

## 5 CONCLUSION

As the main conclusion of our study, our findings confirm that surveyed French postgraduate engineering students have a limited knowledge and understanding of SDGs. As a matter of fact, many of SDGs are totally unknown to them. In line with previous studies [2,3,6], they associate SD to its environmental and economic aspects and ignore social aspects like responsibility or partnership that should be very important for practicing their future engineering profession.

They are convinced that SD is fundamental for our planet and for their own country but have a lack of awareness of its impact in their professional and personal life, in contradiction with the results of the previous studies [2, 6]. Conforming to this, they have limited SD actions and engagements at their individual level in their everyday life. However, this low level of engagement could be partially explained by convenience or by their limited financial conditions.

Our findings are very encouraging from an educational perspective. This is confirmed by the strong interest of the students in having not only basic SD education focusing on the acquisition of declarative knowledge but also more extended and comprehensive SD education. The inclusion of social aspects of SD, more specifically social relationship and responsibility, in multi- or transdisciplinary SD education framework would be interesting.

The limits of the present study include the relatively low sample size, the limited engineering disciplines (the surveyed engineering students are studying electronics and physics engineering), the educational level (only postgraduate students) and finally the lack of a second survey after their SD courses.

Future research conducted on more representative samples of engineering students from different engineering domains, but also involving students from different curricula such as management, law, etc., and from different countries are in perspective. As well as, a second survey at the end of specific SD courses should be carried out for assessing the influence of these courses on the SD awareness of the students.

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