



WHAT ABOUT SUSTAINABILITY? INVESTIGATING ENGINEERING STUDENTS' SUSTAINABILITY AWARENESS AND ATTITUDE

M Nakad¹

Faculty of Engineering, University of Balamand
Koura, Lebanon
ORCID: 0000-0002-9390-1240

K Kövesi

ENSTA Bretagne
Brest, France
ORCID: 0000-0002-4036-6475

Conference Key Areas: *Sustainability and Sustainable Development Goals*
Keywords: *Sustainability awareness, Engineering education, SDG*

ABSTRACT

Engineers have a growing contribution towards attaining the Sustainable Development Goals (SDGs). Thus, graduate engineering students' awareness and attitude will be crucial for dealing with these complex societal challenges. The purpose of this study is to investigate the sustainability awareness (SA) of engineering students from a developing country in comparison to that of those published from developed European countries. It also aims to explore engineering students' attitudes and willingness to consider sustainability challenges as an important part of their future professional role. We have conducted a quantitative

¹ *Corresponding Author*

M Nakad

mantoura.nakad@balamand.edu.lb



online survey (n=253) with the participation of engineering students from different majors at Bachelors and Masters levels. The data concerning students' awareness and attitude underwent quantitative statistical analysis and was compared to that in the literature. The data was analyzed using SPSS to investigate differences and similarities between majors and validate its quality. The findings show good levels of SA and lower levels of knowledge in SDGs among engineering students compared to that presented by European studies. Thus, a gap in SDGs' awareness exists between students from developed and developing countries. However, students' positive attitudes and willingness to be involved in SDGs' practices were remarkably high in understanding the leading role of engineers toward achieving the SDGs. Our results confirm engineering students' motivation and strong positive attitude for resolving sustainability issues in developing countries despite challenging lifestyles. Our findings could be further used by engineering faculties in developing countries to minimize the gap and enhance future engineers' contribution towards a more sustainable society.

1 INTRODUCTION

Engineers are commonly acknowledged as having a critical and increasing role to play in achieving the Sustainable Development Goals (SDGs) and are required to promote the principles of sustainability [1, 2, 6, 7]. The role of future engineers is not only related to the emergence of technical progress, but they are also required to lead solving complex social and environmental problems [6]. To accomplish this mission, it is essential to train graduate engineers to acquire new sustainability competences. This is considered one of the major challenges faced by engineering education institutions [7]. Consequently, there is an ongoing transformation in all developed countries for implementing sustainability competences' development in engineering curricula. However, this is not the case in developing countries, where the education for sustainability is in its early stages with starting reforms [8, 9, 10]. In this situation, engineering students' sustainability awareness (SA) and their attitudes to SDGs play an important influence on the implementation of these reforms.

In our study, we investigated engineering students' SA from the University of Balamand (UOB), Lebanon, a developing country in the Middle East, and compared the results to that of those published from developed European countries.

Additionally, we investigated the engineering students' attitude and willingness to consider sustainability challenges as an important part of their future professional role. Hence, the key research questions (RQ) addressed in this study are:

RQ(1): What is engineering students' understanding of sustainable development and SDGs?

RQ(2): What is engineering students' attitude towards considering sustainability challenges?

RQ(3): To what extent engineering students are aware that their profession has a fundamental role in achieving SDGs?

2 LITERATURE REVIEW

SA is defined as the process of expanding humans' ecological consciousness and their knowledge of the environment's importance as well as its fragility [1]. This definition shares similar goals with those of the engineering profession as it involves the ability to consolidate theoretical and structural knowledge through application, interaction and decision making, in favor of the biophysical environment and its problems [1, 2]. Thus, limiting and mitigating against present and future damages respectively.

According to Flament and Kövesi [3], the French engineering students' SDGs awareness as well as their insight and efforts on sustainable development (SD) is relatively limited. They confirmed that these students acknowledge the fundamental role of SD but "have a limited knowledge and understanding of SDGs". Also, French engineering students mainly focus on the environmental and economic factors of SD and often ignore the social aspects [3]. Nicolaou and Conlon [4] observed that, similar to the French study [3], with respect to three Irish universities, final year Irish engineering students have deficient knowledge of sustainability and mainly relate SD



to environmental challenges. Thus, their knowledge of the economic and social pillars of SD is equally limited.

Regarding engineering students' attitude towards sustainability, Hamón et al. [5] focused on analyzing students' SA and learning taking into consideration three dimensions: knowledge, attitude and behavior [5]. They have found that Spanish science and engineering students showed the highest levels of knowledge and readiness in the three dimensions comparing to students from other faculties. They concluded that the students could become more aware of SD following the implementation of sustainable practices at their universities.

Concerning the question whether the engineering students are aware that their profession has an important role in achieving SDGs, we have convergent results in the academic literature. French engineering students understand the global and national importance of these SDGs, but they do not consider it as an integral part of their future professional practices [3]. Similarly, it was found that Spanish engineering students highly consider SD practices with respect to their personal life [5] and not much in their professional one. As such, they lack awareness of the crucial role their profession has toward reaching the SDGs.

3 METHODOLOGY

3.1 Study context

To answer our research questions, we have conducted a quantitative online survey at the Faculty of Engineering at the University of Balamand in Lebanon, a country that has endured hardship for over three decades. Lebanon socioeconomic problems are very much associated with the civil war that had stretched from the mid-1970s till the mid-1990s, which has meant that any SD implementation has been challenging. Many attempts have been put in place to implement SD in Lebanon and to adhere to the UN 17 SDGs through many Non-Governmental Organizations (NGOs) and by infusing the information in university curricula. The latter remains low in visibility despite all 8 QS ranked Lebanese Universities' efforts to adhere to the notion of SDGs. The University of Balamand is a young university, founded as recently as 1988, established on solid infrastructure with a relatively important student body of 4500 students. Its senior management team is undertaking a concerted effort to include SD in its scholarly activities, teaching, research and community services. We investigated engineering students' SA, attitudes and professional view which is facing detrimental environmental (inefficient waste collection/disposal, lack of water supply/storage), economic (lack of local production and industry, hyperinflation of local money) and social (missing social security, religion discrimination) problems.

3.2 Participants

For our sample selection, we have targeted engineering students at (1) Bachelor of Science (BSc), (2) Bachelor of Engineering (BE) and (2) Master of Science (MSc) levels.

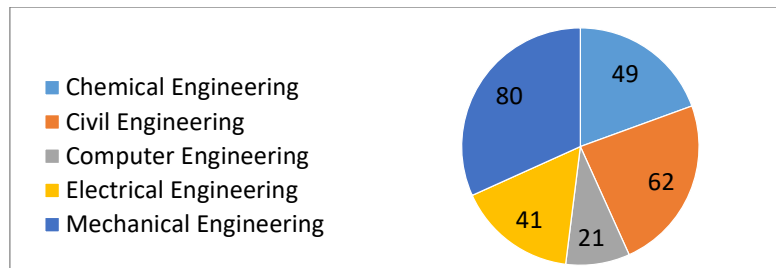


Fig. 1. Repartition of the surveyed engineering students by major

We sent out the survey to all engineering students of the faculty (total of 761) and received 253 completed surveys. We obtained a very satisfactory answering rate of 33%. We have 31% female and 69% male student participants of different majors that are considered as representative for the engineering faculty. As shown in Fig. 1, the Mechanical and Civil engineering departments have registered the highest participation of 31.6 % (80) and 23.7% (60) students respectively knowing that they have the highest number of students in the faculty.

3.3 Data collection

For our survey design, we exclusively used closed questions in line with the European questionnaires investigating the following three topics: (1) sustainability understanding and awareness, (2) attitudes to SDGs and (3) the role of engineering profession in achieving SDGs.

In the surveys introductory section, we have presented the ethical considerations of our study, i.e., detailing its objectives, confidentiality policy, participant's anonymity, data storage and handling.

We have conducted a pre-test of our survey with 15 students in order to collect their feedbacks. We then finalized the survey design by taking into consideration their comments and suggestions for improvements. The final version of our online survey was disseminated to all engineering students via email.

3.4 Data analysis

For our data analysis, we used SPSS software. At first, we have conducted a descriptive statistical analysis and then checked the quality of the survey, with regards to different tests: factorability, Kaiser–Meyer–Olkin (KMO), communality and dimensionality. The results were highly satisfactory with $KMO \geq 0.8$; they highlighted that the survey is well designed, the questions were distributed without any redundancy and the participants' number is statistically acceptable. In conform to the survey's validity; we have completed a more detailed data analysis, with crossed tables to analyze the results with respect to different majors, study levels and genders.

4 RESULTS AND DISCUSSION

4.1 Level of awareness

We first displayed the level of SA among students concerning their understanding of the general sustainability concepts at different study levels. 27.1% of the BE undergraduate students selected that they are unsure of what SD means while 25.4% were neutral of the statement. However, the MSc graduate students are more aware about SD than their undergraduate counterpart. Only 15.2% MSc students selected that they are unsure of what SD means.

We further analyzed the level of awareness of engineering students per department. We can observe important differences, as shown in Fig. 2, between engineering students of different majors. Our findings show that 61.94% are familiar with the general concept of SD and only 36.94% have heard about the SDGs indicating a lack of awareness of SDGs.

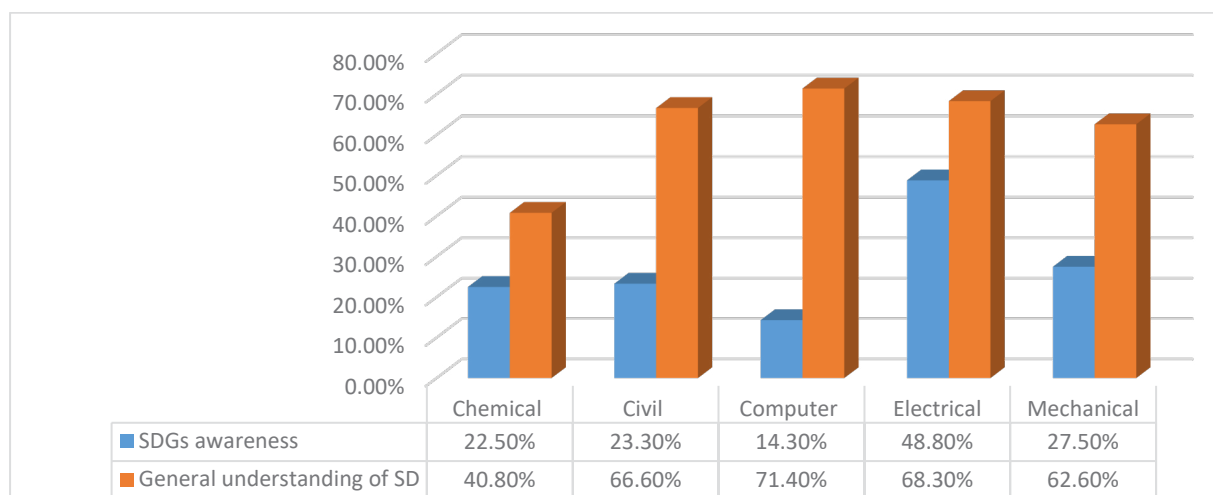


Fig. 2. Engineering students SDGs awareness and general understanding

To our surprise, the Computer and the Electrical engineering students show the highest level of SD awareness, with 71.40% and 68.30% respectively. Additionally, those majoring in Electrical and Mechanical engineering are the most aware of the SDGs, with 48.80% and 27.50% respectively. Even though, in the engineering faculty, the SD oriented projects are more active in the Civil and the Chemical engineering departments.

In contrast to the European findings in the literature, our results show a relatively good level of awareness in basic SD concepts (61.94%) and considerably lower levels of knowledge in SDGs (36.94%). In Ireland, 65% of final year engineering students could not define sustainability nor had a very vague understanding of the concept [4]. French engineering students showed better overall knowledge of the SDGs [3] and 73% of the Spanish students selected that they are familiar with the concepts of sustainability [5].

French engineering students mostly linked SD to environmental aspects with less emphasis on economic aspects and almost disregarding the social pillar [3]. In the present study, the emphasis on environmental aspect is as high as that found in France. In our results, 72.3% agreed that sustainability is more importantly related to the environment, 64.4% agreed that it is related to financial issues and 56% agreed that it is about social/cultural issues. As such, the Lebanese students acknowledged the importance of the economic and social aspects in SD too with more emphasis than the French study [3].

4.2 Attitude

Our results indicate engineering students' strong positive attitudes and willingness to engage in activities related to sustainability and its challenges. As per our analysis, 65.7% of the students are willing to help to achieve more of the SDGs. However, 28.6% of these students were unsure how to contribute. Similarly, 42.7% of Spanish engineering students' showed readiness for participating in the university's SD initiatives and 70.5% were motivated to learn more about such activities [5].

Moreover, in our study, 70.7% of the engineering students showed interest in attending workshops, courses or seminars on SD. Nearly similar to the results obtained for Spanish engineering students [5]. This confirm that engineering students in a developing country, with challenging situations and life conditions, are still motivated and eager to change their country's current circumstances. This high level of positive attitude reflected in students for each major is given in Fig. 3.

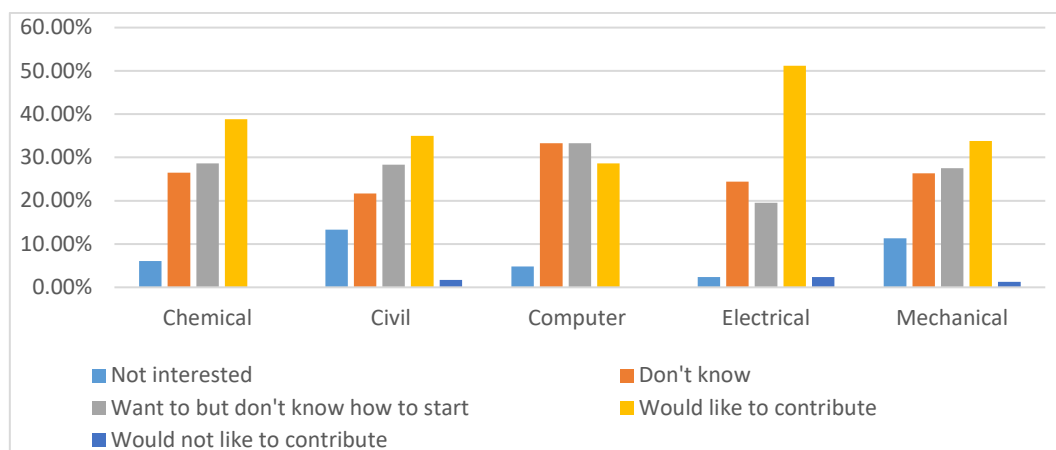


Fig. 3. Engineering students' attitude toward participation in SD initiatives

As shown in Fig. 3, 51.20% of the Electrical engineering students would like to contribute to SD initiatives, the highest amongst all other departments. Additionally, on average, 29.4% would like to contribute however do not know how to start.

4.3 Engineering profession role

Furthermore, our results show clearly that engineering students understand the importance of their responsibilities and they are very aware that their profession has a key role in achieving the SDGs.

Table 1: Engineering students' awareness towards their profession role in achieving SDGs

Q: Engineers are key players in achieving SDGs	Agree & Strongly agree	Neutral	Disagree & Strongly disagree
BSc	74.5 %	20.5 %	5.0 %
BE	81.4 %	10.1 %	8.5 %
MSc	94.0 %	6.0 %	0.0 %

As shown in Table 1, graduate students are more aware about the correlation between their profession and the SDGs than undergraduate students. In general, 83.3% agreed that engineers are key players in achieving the SDGs. However, we can see that engineering students do not have much confidence in their country, where 45.7% think that their profession in this particular country does not prepare them nor encourage them enough to apply essential SD practices.

5 CONCLUSION

The results confirmed the existence of a gap in engineering students' SDGs awareness between developed and developing countries. Similar to previous findings [3], the Lebanese students at the University of Balamand related SD to the environmental pillar as a priority. In addition, they acknowledged the importance of the economic and social aspects in SD more than the French students. They also showed positive attitude towards participating in future SD initiatives but do not know where to start. However, unlike other students from developed countries, they do consider their profession a key player in achieving the SDGs but have no confidence in the support of their country.

Our analysis highlighted the motivation and readiness of engineering students towards achieving the SDGs, despite the country's limitations and their perception of lack of support. For academic considerations, these promising results can be used to guide the implementation of SD education in different majors and for different levels, for minimizing the gap between developed and developing countries and spreading SA at a national level. Additionally, the results can assist in guiding an education for SD tailored specifically to improve the SA levels nationally and encourage the country's participation. Furthermore, it can help direct the universities' education goals to raise students' self-confidence levels and highlight their leadership role in initiating such SD practices and in building a better country.

In this study we have faced some limitations. We have surveyed engineering students from only one university from a developing country. The response rate was acceptable but a higher return would have provided a better picture.

Future work considers studying the SA of engineering students in different developing countries and comparing to students from multi-disciplinary domains.

ACKNOWLEDGEMENTS

We appreciate the support of the Faculty of Engineering at the University of Balamand, especially the Dean, Professor Rami Abboud for his encouragement, support and inspiration. In addition, we wish to thank the students for their cooperation, the instructors for their time, the GIS Center and Dr Amal laaly for her help in the data analysis.

REFERENCES

- [1] Raymundo M.G., Matheus C., de Moraes Hoefel J.L. (2019), Awareness of sustainability issues. In: Leal Filho W. (eds) Encyclopedia of Sustainability in Higher Education. Springer, Cham.
- [2] Kövesi, K., Tabas, B., Gillet, C., Beagon, U., & Bowe, B. (2020), Sustainable development competencies for achieving the SDGs: Engineering students and industry requirements. In Proceedings of the 48th SEFI Annual Conference 2020: Engaging Engineering Education, <http://sefi.be/wp-content/uploads/2020/11/Proceedings-2020-web.pdf>
- [3] Flament, S., & Kövesi, K. (2020), What do our students know about the future challenges of sustainability? In Proceedings of the 48th SEFI Annual Conference 2020: Engaging Engineering Education, <http://sefi.be/wp-content/uploads/2020/11/Proceedings-2020-web.pdf>.
- [4] Nicolaou, I., & Conlon, E. (2012), What do final year engineering students know about sustainable development?, *European Journal of Engineering Education*, Vol. 37, No. 3, pp. 267-277.
- [5] Hamón, L. A. S., Martinho, A. P., Ramos, M. R., & Aldaz, C. E. B. (2020), Do Spanish students become more sustainable after the implementation of sustainable practices by universities? *Sustainability*, Vol. 12, No. 18, pp. 7502.
- [6] Brad, T., Beagon, U. and Kövesi, K. (2019), "Report on the future role of engineers in the society and the skills and competences required for engineers", First Project Report, A-STEP 2030 project, pp. 1-40.
- [7] Beagon, U., Kövesi, K., Tabas, B., Nørgaard, B., Lehtinen, R., Bowe, B., Gillet, C, Spliid, C. M. (2022), Preparing engineering students for the challenges of the SDGs: what competences are required?, *European Journal of Engineering Education*, pp. 1-23.
- [8] Abu-Goukh, M. E., Ibraheem, G. M., & Goukh, H. M. (2013), Engineering education for sustainability and economic growth in developing countries (the Sudanese Case, *Procedia-Social and Behavioral Sciences*, Vol. 102, pp. 421-431.
- [9] Segalas, G., Ferrer-Balas, D., & Mulder, K. F. (2008), Conceptual maps: Measuring learning processes of engineering students concerning sustainable development, *European Journal of Engineering Education*, Vol. 33, No. 3, pp. 297-306.
- [10] Sawitri, D. R., (2017), Education for sustainable development: How early is too early?, *Journal of Computational and Theoretical Nanoscience*, Vol. 23, No. 3, pp. 2559-2560.