THE 'A-STEP 2030' PROJECT AND ENHANCING ENGAGEMENT IN ENGINEERING EDUCATION

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ABSTRACT

The 'A-STEP 2030' project involves academic partners from Denmark, Finland, France and Ireland, with additional key inputs from Belgium (SEFI and BEST) and Sweden (Universum). The results were extracted from an extensive data-base of students' preferences in making future career choices, what they are willing to learn, what skills needed to be improved, and how they perceive the engineering profession and their ideal future employer. Particular note was taken of the similarities and differences between engineering and humanities students, male and female engineering students and students of different generations. Additionally, a survey of 16-year-olds was made, to improve the understanding of the younger generation. Students' own considerations were collected from symposia organised by BEST. The authors are writing this from their role as external advisers and the activity project leader. The results show interesting diversity.This gives a sound foundation for the next stage of the project, where attractive modules for engineering education will be created. These and other interesting emerging results will be discussed in the context of "How are the values and career goals of diverse students reflecting the future needs of education to establish a working life with sustainable goals?".

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1 INTRODUCTION

1.1 Motivation

Attractiveness of engineering education is a key element when we are trying to share a wide understanding of the effective methods with which to build sustainable global futures [1] & [2]. Continuing growth of welfare facing the United Nations 17 Sustainable Development Goals (SDG) needs advanced engineering solutions and extensive knowledge from people with diverse background. But how to attract people who have deep doubts, expectations that engineering drives the world to wrong direction - or that engineering is too difficult and boring.

1.2 Action

To define steps for more attractive engineering education the 'Attractiveness' working group of SEFI decided two years ago to establish a project combining research, surveys, workshops, focus groups and communication amongst the engineering education society and in working life. The aim of the project was to create concrete activities, tools, materials and methods to help the educators with their work.

The first step was to convene motivated partners. It was understood that to find innovative solutions diverse partners were needed. The core set of partners included a company undertaking research of students' motivation, appreciation and expectations, four academic institutions who were providing engineering education, a European organisation for engineering education and a European organisation of engineering students.

The second step was to create a project proposal - and finding a source of finance for it. Fortunately ENSTA Bretagne was able to offer a grant to enable the project partners to work together with the proposal [3]. This made it possible to obtain Erasmus + funding and to start working.

2 METHODOLOGY

2.1 Roles of diverse partners

The base of the methodology of the project was to define how to guarantee that a breadth of knowledge and diverse opinions would be included - and thus the work would not be done amongst the "believers".

The solution had several steps.
- Firstly, to understand the whole background, the university researchers had to undertake a literature review and build the academic framework for the project [4].
- Secondly to understand the present situation, statistically relevant data of students from all of the participating countries was needed. The company, Universum has

collected opinions from tens of thousands of students - and it was decided to use the data concerning engineering students and for comparison students of humanities [5].
- Thirdly the statistical data needed to be analysed by several stakeholders. This included a large number of focus groups with students, industrialists and academics in different countries, together with workshops and reviews by the advisers [5].
- The fourth step was to collect ideas about competences and ways to develop them to feed the fifth step, where different pedagogical solutions would be defined and some concrete courses created.
From these steps the project plan was put together and divided into three activities, each involving all the partners (figure 1).

Fig. 1. The project plan showing the three key activities and the tasks within them, leading to dissemination outputs. All activities involved all partners to greater or lesser degrees

Additionally to the project partners, the plan included several advisers. The role of the advisers has been to view the plans, expected outcomes, methods, success of dissemination and especially to ask questions. This paper is written collaboratively by two advisers, representing important stakeholders, and having actively participated to the flow of the project together with the leader of the activity 2.

2.2 Metodology of activity 2

EU mapping of future engineering work, in the context of the values held by engineering students of today, was undertaken by a Universum study. The questions relating to this mapping were selected by all the project participants. These were:

1. Which of these career goals are most important to you?
2. How would you rate yourself in the following skills?
3. Which of these employer attributes are most important to you?

For each question, the differences between male and female engineering students, engineering and humanities students and students from generations Y (born between 1980 - 1995, age 23 - 38) and Z (born 1996 - 2001, age 17 - 22) were investigated in six target countries. These results were analysed in each of the countries and the differences/similarities between the countries compared.
Furthermore the Board of European Students of Technology organised two symposia with results that provide guidance to universities and other stakeholders as to what they can do in order to improve the diversity. Finally, in activity 2 an online survey to high school pupils with an approximate age of 16, was made to collect information about their values, interests, and expectations related to the Sustainable Development Goals (SDGs) and to their future. The leader of the activity 2 had the responsibility to assemble these results and create the intellectual output 2.

3 RESULTS

3.1 Outcomes from activity 2

From figure 2 it can be seen that students' career goals are quite similar. The biggest difference is in the goal "To be dedicated to a cause or serve a greated good", in which humanities and female engineering students had a much greater appreciation of this goal than male engineering students. The same difference can be seen in the goal "To be a technical or functional expert", in which male engineering students were more enthusiastic on these issues than female engineering students and much more than humanities students. "To have a work/life balance" was the highest valued career goal within all student groups. At the same time as the students valued a strong good work/life balance, they stated that their weakest soft skill was "Time management". The other weak soft skill for all students was "Integrity". In "Communication" skills there still seems to be room for development with all students, even though humanities students trusted themselves more regarding this skill than did engineering students. Engineering students thought that their strongest soft skills were: "Problem-solving", "Responsibility" and "Teamwork", while humanities student considered their strongest soft skills to be: "Responsibility", "Positive attitude" and "Adaptability". In "Responsibility", the younger generation Z appeared to make a somewhat better showing than the older Generation Y. [5]

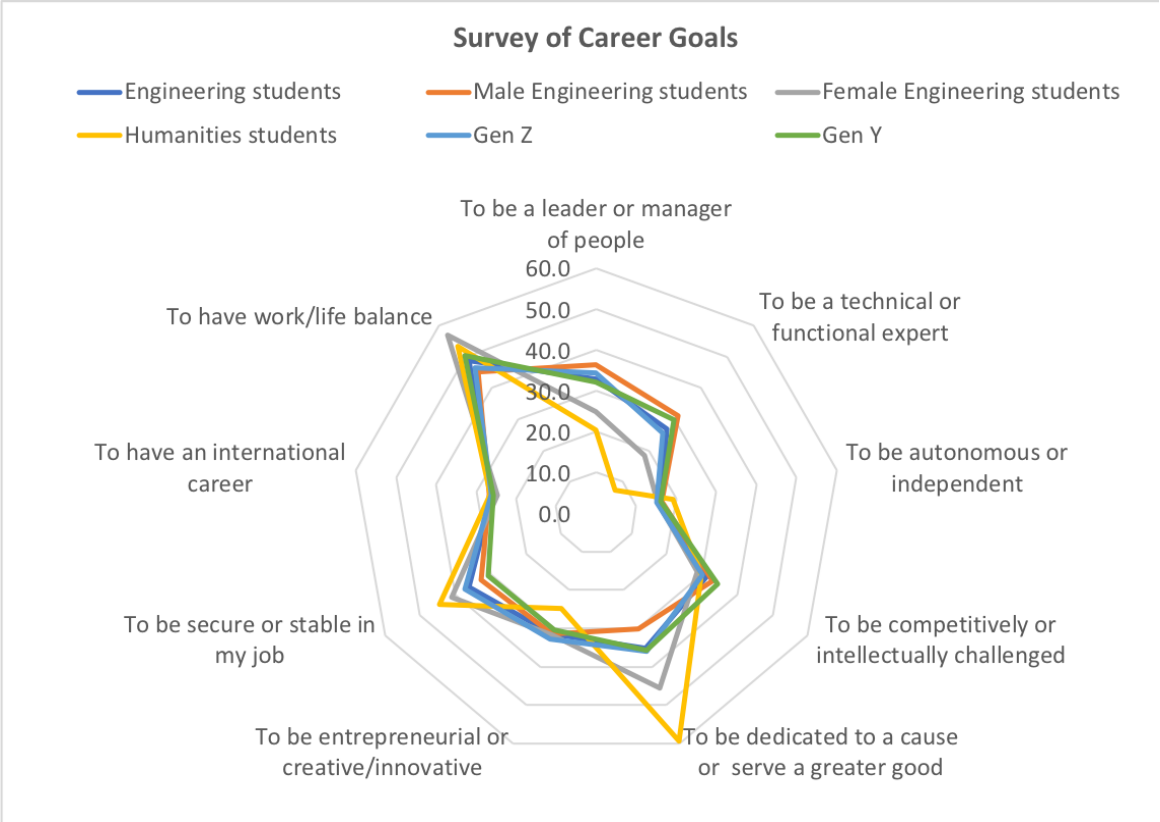

Fig. 2. Result of survey of career goals of averages of six groups, namely: engineering students, male engineering students, female engineering students, humanities students, generation Z (at current age of 17-22 years) and generation Y (at current age 23-38). The figures are shown as percentages of how many of the replies set that goal amongst the 3 most important.

It can be said that there is a general tendency among students in all countries now to accord more importance to issues surrounding environmental and social responsibility when compared to economic issues, which was certainly not the case in the past. Both humanities students and female engineering students place a particularly elevated value on these environmental and social responsibility issues, rating them highly regarded in both their career goals and employer expectations. For example, all humanities students considered the career goal “To be dedicated to a cause or to feel that I am serving a greater good”, and having “inspiring purpose” to be the most important.

A largest difference between engineering and humanities students can be seen in their expectations of their future employers. From figure 3 it can be seen that employer attributes “Inspiring purpose”, “Ethical standards”, “Corporate social responsibility” and “Commitment to diversity and inclusion” were much more important attributes to humanities students than to engineering students. With both humanities students and also female engineering students raising “Gender equality” into very important work attribute, which was not the case for male engineering students.[5]

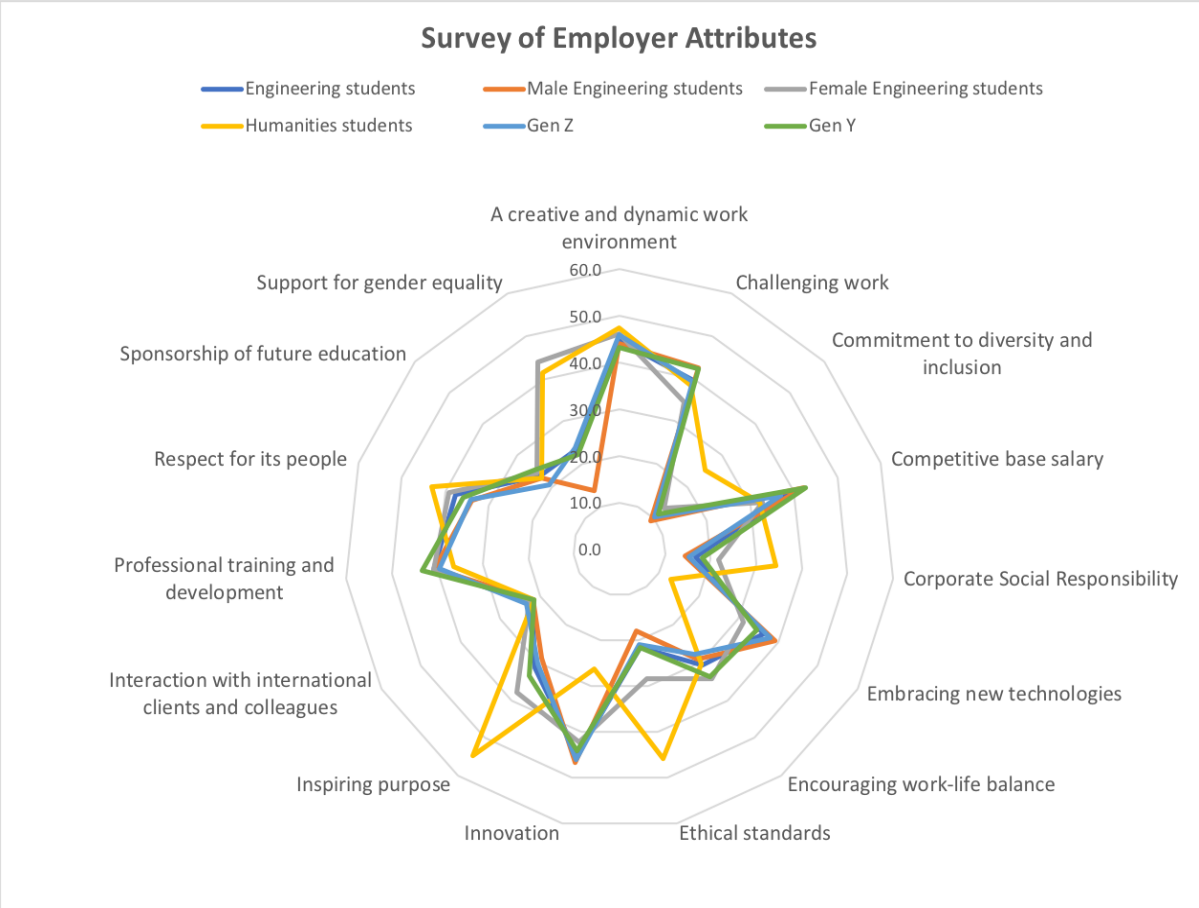

Fig. 3. Result of a survey of attractive employer attributes of the same six groups, namely: engineering students, male engineering students, female engineering students, humanities students, generation Z (at current age of 17-22 years) and generation Y (at current age 23-38). The figures show percentages of how many of the replies set that goal amongst the 3 most important.

The results of the on-line-survey for 16-year-old students' correlates with the findings of the Universum study (EU mapping of future engineering work in connection with the values held by engineering students of today). The pupils demonstrated a high degree of awareness of SDGs and were much more willing to promote sustainable development. The most important SDG for them was "Good Health and Well-Being". Also, more than 60% of pupils had selected "Quality Education", "Zero Hunger" and "Climate Action" among the three most important SDGs. According to their answers, most of the pupils were willing to work in groups, ready to apply technology, and prepared to solve challenging problems in multicultural environments.[5]

3.2 Conclusions

To address the students' wish to have a good work/life balance attention during their education will need to be given to improve their time management skills, which they identified as their weakest soft skill. Engineering students' strongest soft skills "Problem solving", "Responsibility" and "Team work" form a very good basis for solving big, global environmental, social and economical problems. The results could be even

better if humanities students' highly valued employer attributes of "Inspiring purpose", "Ethical standards", "Corporate social responsibility", "Gender equality" and "Commitment to diversity and inclusion" could be combined with these.

Comparing the outcomes of the activity 1 about the required competences for the future to respond effectively to the UN SDGs the conclusion was reached that there is no conflict in the preferences of the students, both in engineering and humanities as well as 16-year-olds. These results are in strong agreement with the results of a recent study completed by Finnish researchers [6]. The majority in all the groups studied expressed the desire to have a purposeful job and the feeling of serving a greater good. Competences for such jobs are very much based on those of engineering. These different results are convincing in showing that engineering education and solutions need to be "marketed" in a clear way to show they are essential for future sustainable development of the globe. Still too often, engineering and technology subjects have to face the reputation for being difficult and leading inevitably to more pollution and other problems.

To improve the reputation and reach a more diverse source of potential students to apply for engineering studies, the STEM subjects need changes in the nature of their education. The focus of the education should be less in teaching and more in learning in a way that the issues have a more direct connection to the understanding of the challenges of the future. While the content of the STEM studies might remain much as it is currently, the pedagogical methods need to be developed in a way that the non-technical competences will be developed simultaneously. By using more real life examples or case studies, experimental methods, project and problem based learning and working in teams, the variety of skills and competences could developed more effectively and concurrently than it is today. As part of this it is important that all the necessary competences are measured and thus made more visible in the evaluation process of students.

4 SUMMARY

The results of the activity 2 are strenghening the vision of a need for flexible learning methods and a stronger connection to working life. Attractive projects, where diverse students are solving real problems together in a well guided process, would in addition to the development of technological competences, lead to an enhancement of competences. These might be to manage time, work-life balance, communication and an understanding of environmental, social and economical circumstances in life cycles of products and services for human use. This should form a strong starting point for activity 3 led by Aalborg University an institution which has a reputation for its pioneering application of the Problem-based Learning (PBL) approach.

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REFERENCES

[1] Schrey-Niemenmaa, K, and Jones, M, (2019). **'***Qua Vadis' Engineering Education?,* Proc 46th SEFI annual Conference September 2019, Budapest, Hungary https://www.sefi.be/wp-content/uploads/2019/10/SEFI2019_Proceedings.pdf pp 990- 998.

[2] Soeiro, A., Nørgaard, B., Schrey-Niemenmaa, K.A., Sjoer, E., Kalman, A. and Jones, M.E., (2018), Engineering Students' Expectations About Skills And Competences For Jobs Versus What Is Expected By Companies And Organizations. What Is The Need For Continuing Education After Graduation (An European Overview)? Proc. 15th World Conference on Continuing Engineering Education", Monterrey, Mexico. http://www.iacee.org/world_conference_2018.php chapter 6.

[3] EU Erasmus project proposal (2018) 2018-1-FR01-KA203-047854.

[4] Beagon, U., Bowe, B., Kövesi, K., Gillet, C., Tabas, B., Nørgaard, B., Spliid, C. and Lehtinen, R., (2019). "SKILLSFOCUS 2030: A Model of Skills and Attributes needed for Engineers to achieve the SDGs." Intellectual Output 1 of the A-STEP 2030 project". pp. 1-13.

[5] A-STEP 2030 project Report 4 (2020) "Report on the Prioritisation of Skills and Competences Required by Future Engineers as part of A-STEP 2030 project". pp. 1-70.

[6] Mellanen, A, and Mellanen K, (2020), Hyvät, pahat ja millenniaalit, miten meitä tulisi johtaa, (Good, evil and millennials, how we should be led?) Atena Kustannus Oy, atena.fi. ISBN 978-952-300-606-5