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Myth-busters at work: development of engineering identity and employability through student research

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Abstract

For many (aspiring) engineering students, the prevalent image of engineering identity is still unilaterally dominated by technical skills. This bias serves not only to dissuade female prospective students but also to erode student motivation for non-technical courses such as communication and other employability skills. As an unfortunate result, also for the employer, many starting engineers experience a gap between their own and the workplace's expectations. This paper reports on a didactic approach that has the students actively research the workplace realities, and more particularly the importance of communication skills as perceived by professional engineers. On the basis of their own, partly self-directed research efforts, students uniformly conclude that communication skills are in fact of great importance for engineers. The indisputable scientific evidence, both quantitative and qualitative, that they gather themselves turns out to be a powerful incentive for students to recalibrate their understanding of engineering identity.

Keywords: *Engineering education; professional identity; employability; engineering curriculum; communication.*

1. Introduction

The field of engineering is notoriously diverse, allowing for myriad career options across multiple domains and in several positions. Yet, at the core of what the engineering identity is still all too often perceived to be is a surprisingly unilateral insistence on technical skills, culminating in a stereotypical representation known as the engineering "nerd myth" (Beder, 1998; Brunhaver et al., 2018). This essentially masculine myth, disregarding the many social dimensions integral to engineering, serves to discourage women from identifying with a career in engineering (Faulkner, 2007). Another harmful consequence of this myth is that engineering students tend to experience a lack of motivation for course topics that are non-technical, such as communication and teamwork skills, the importance of which for employability has nevertheless been underscored emphatically in, for instance, the Future of Jobs Report by the World Economic Forum (2020). The gap between expectations and the first real-life experiences in the engineering workplace, as described by researchers across several economies (Dias, 2011; Kövesi & Kalman, 2020), has lead many young engineers to switch jobs within the first six months of employment (KU Leuven, Antwerpen, et al., 2016), leaving both the engineer and the employer, who has invested in recruitment and training, with a sense of frustration and disappointment (Trevelyan, 2019).

The development of an engineering identity that is based on a sound and more nuanced understanding of the realities of the workplace, is positive for both motivation (Frymier & Shulman, 1995; Hock et al., 2006) as well as for employability and job satisfaction (De Coen et al., 2018; Yorke, 2006). Increasingly, universities recognize the importance of bringing engineering students into contact with the workplace; however, these interventions often have an incidental character, functioning as curricular add-ons (e.g. a company visit or a one-day shadowing internship) that fail to integrate meaningfully with the core curriculum. Moreover, these interventions tend to position students in the passive role of observers. This paper reports on an alternative approach, in which the students become active, in-depth researchers of the workplace realities - with a focus on the importance of communication skills, in this particular case - and report on their findings in a written paper as part of a designated course in the curriculum. The proposition is that this approach helps students build a well-informed understanding of workplace expectations and a more accurate sense of their future professional selves, while simultaneously developing important engineering competencies such as research and writing skills.

2. Methods

This section describes the setup of the second bachelor course "Statistics+", which is part of the curriculum of industrial engineering education of the joint program of KU Leuven and Uhasselt at Campus Diepenbeek. As part of this course, students are asked to investigate

whether communication skills are important for professional engineers, and if so, which skills are primarily important. Students are encouraged to explore several qualitative approaches (e.g., interviews with engineers, focus groups, and literature reviews) facultatively in conjunction with a mandatory quantitative approach in the form of a survey, which is uniform for all students. The pivot of this survey is a questionnaire developed by the teaching staff using Google Forms, which students are invited to send via e-mail to professional engineers in their wider circle of acquaintances. Since 2012, when this approach was initiated, 2430 engineers have completed the questionnaire. Data are collected in Excel and consequently analyzed, also using various statistical tools, by students. On the basis of the findings of their qualitative and quantitative research endeavors, students write an academically formatted paper answering the main research question – are communication skills important for engineers? – and a self-composed additional research question focusing on specific communication skills and/or correlations with the sector of employment, position, age, gender, or size of the company. This additional research question allows students to invest their personal interests and career plans in their research projects. Students interested in construction engineering, for instance, could investigate which foreign languages are most important in that sector. Throughout the process, students are supported in classes focusing on, on the one hand, statistics, and on the other hand, research and writing skills.

This paper also reports on a small-scale survey, based on a questionnaire sent to 72 students who took the course Statistics+ in the autumn of 2022. The questionnaire evaluated whether the approach was successful in achieving its didactic goals. The questionnaire was completed by 36 students.

3. Results and discussion

The (unsurprising) answer to the main research question that students arrive at is that professional engineers indeed perceive communication skills to be very important. With very few exceptions, students report that their qualitative research efforts, typically interviews, mainly serve to reemphasize the fundamental points that the questionnaire results make quite definitively: that engineers, on average, spend a significant portion of their workday communicating (Fig. 1) and that they perceive their communication skills to have a very significant impact on their career path (Fig. 2).

Of course, it is not these conclusions in themselves that are the crux of the matter, but rather the fact that the students themselves reach them on the basis of largely self-directed research. In fact, many students end up arguing for the inclusion of more communication classes in the curriculum based on this evidence. Alternatively, they may offer valid and useful suggestions for new communication topics to be included in the curriculum or for fine-tuning specific

curricular pathways in function of domain-specific sectors. The two examples below are included to demonstrate the potential of the student papers for curricular optimization.

a. In a 2021 student paper, students studied the recent evolution of the perceived importance of virtual meetings (VMs) compared to face-to-face (F2F) communication (Fig. 3)1. They concluded that the COVID-19 pandemic served to accelerate an already incipient trend towards an increasing use of virtual meetings, while this rise did not detract from the importance of face-to-face communications.2 These students remarked, and quite astutely so, that in our current curriculum, classes on oral communication (e.g. meeting, negotiation, and presentation skills) are restricted to face-to-face settings while such activities are likely to play out quite differently in virtual settings (e.g. diminishing impact of body language). They recommended that the communication classes should include a focus on virtual environments in the future. Teaching staff is currently developing course materials to follow up on that suggestion.
b. In another paper, students investigated the relationship between the perceived necessity of mastering certain foreign languages and some common sectors of employment for engineers (construction, electromechanical sector, chemistry, and electronics-ICT). As Fig. 4 demonstrates, English is by far the most important foreign language in all sectors3. French is generally speaking the second most important language, with a marked outlier in construction engineering. In the electromechanical engineering sector, however, German is the second most needed foreign language. On the basis of these findings, the students recommended that English should be a compulsory class for all specialisations in the engineering program at our Faculty; that French should be compulsory for students in construction engineering; that German should be compulsory for students in electromechanical engineering; and that French, German and a proficiency training course in English should be elective courses for all students in the master's degree. These findings were discussed with the curriculum designers of the Faculty, who proceeded to change the curriculum accordingly.

[1] The question relating to virtual meetings was added to the questionnaire in 2015.

[2] In the updated graph shown here, including the 2022 results, the perceived importance of virtual meetings seems to be decreasing again, very tentatively suggesting that the COVID-19 conditions may have been a stronger driver for the rise than other factors (ecology, mobility, cost benefits…). Of course, this remains to be confirmed by data and research in the coming years.

[3] Fig. 4 shows the graph updated on the basis of the most recent survey results.

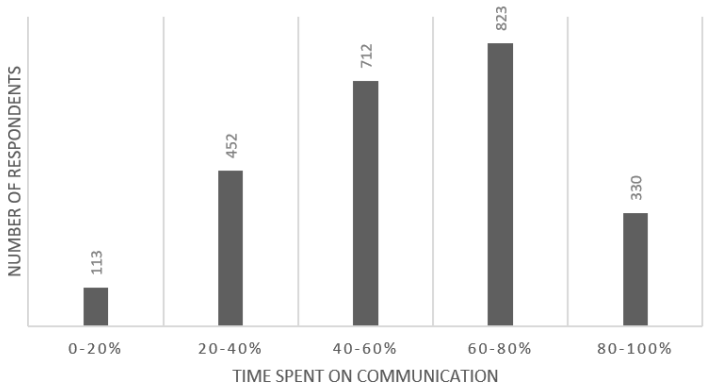

Figure 1. Time spent on communication in an average work day (questionnaire results).

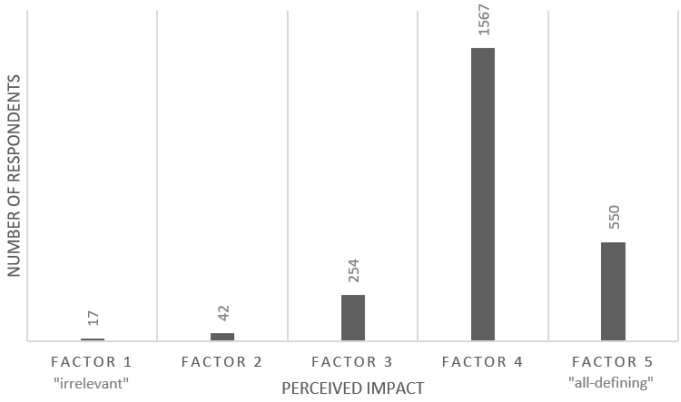

Figure 2. Perceived impact of communication skills on career path (questionnaire results).

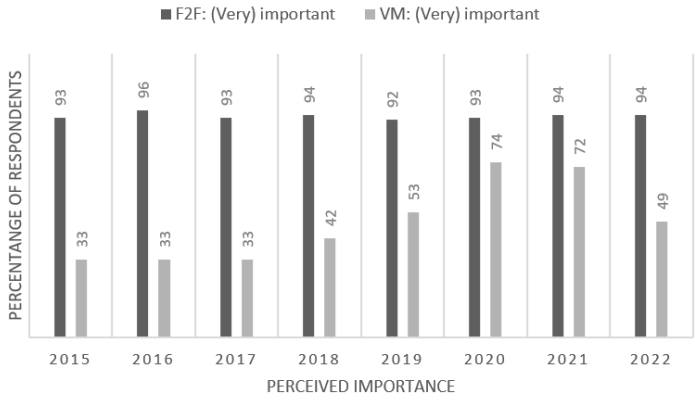

Figure 3. Perceived importance of face-to-face communication and virtual meetings.

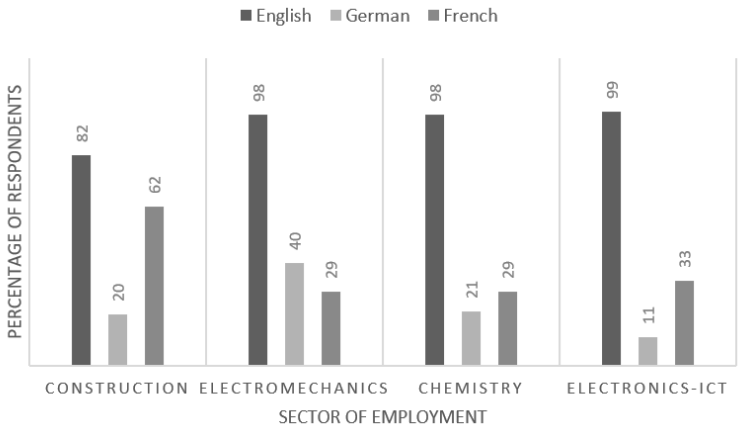

Figure 4. Perceived necessity of foreign languages for engineers in different sectors of employment.

In January 2023, upon completion of the course, the students were invited to complete a questionnaire that aimed to evaluate the effectiveness of the described didactic approach. The response rate was 50%, with 36 responding students out of 72. Figures 5, 6, 7 and 8 show some of the results of the questionnaire, which used a five-point Likert scale for agreement.

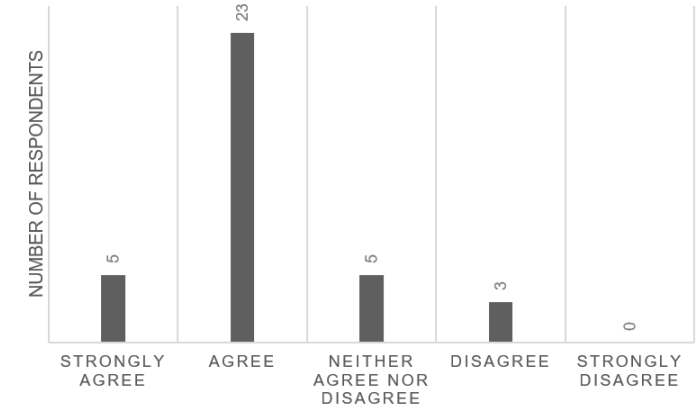

Figure 5. "By doing this research, I have been able to establish 'with my own eyes' that communication skills are important for engineers".

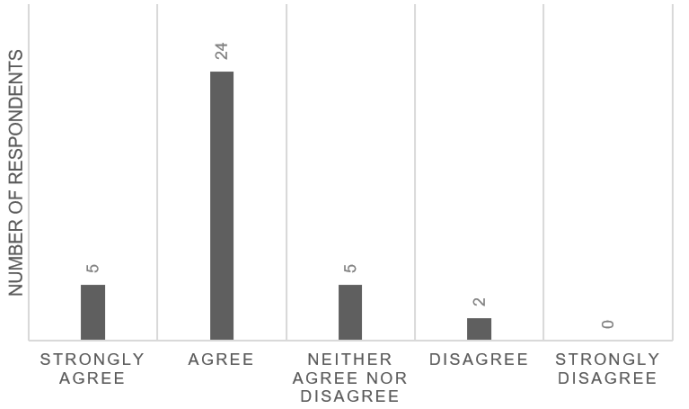

Figure 6. "During this course, I have improved my research skills".

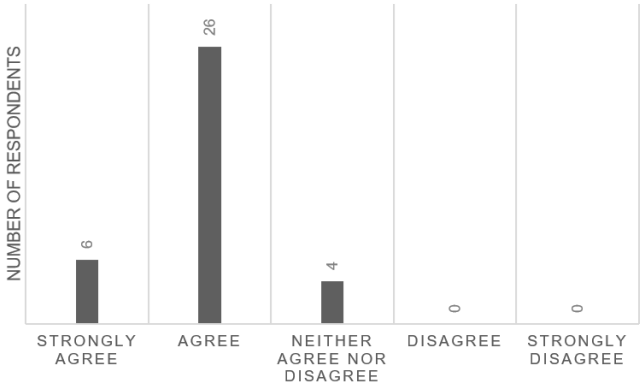

Figure 7. "During this course, I have developed my writing skills".

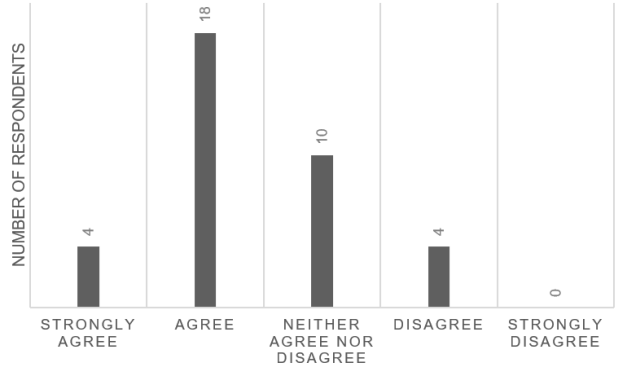

Figure 8. "During this course, I have improved my understanding of the engineering professional identity".

From these figures, it seems fair to conclude that the approach was largely successful in achieving its didactic targets.

4. Conclusion

To develop a strong sense of engineering identity, students need to have a sound understanding of the lived realities of the workplace. Interventions based on observation are certainly preferable to stereotypes and hearsay, but arguably, an even more potent way to bust misleading and exclusionary myths about "the engineer" is to have students themselves research the workplace and workplace expectations. Moreover, this approach allows for an integration of this process of identity formation in the core curriculum as students can simultaneously be taught vital engineering and employability skills such as research skills, writing skills and even – in this particular case – statistics.

The approach described in this paper can be easily modified to fit the needs, concerns and curricular goals of other fields of higher education, just as easily as it can be modified to include other employability skills besides communication skills, such as teamwork skills, leadership, life-long learning, creativity, problem-solving skills... A teacher design team interested in this approach could ponder the following questions as a starting point: Which misconceptions may exist among students about their future professional selves? Which course in the curriculum could accommodate a student-driven research project in this aspect of professional identity? Which didactic approach can maximize the interplay between research project activities and other curricular goals? How can the approach allow the personal interests of the students to co-define their research trajectory? Developing such a course certainly requires significant effort, but it may well end up benefiting the students, the teaching staff and the workplace all at once.

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