Are communication skills important for engineers? A relevant research question for engineering students and curriculum designers

dr. Jeroen Lievens
Docent Communicatie & Engels
Faculty of Engineering Technology KU Leuven
Campus Diepenbeek, Belgium
E-mail: jeroen.lievens@kuleuven.be
jeroen.lievens@khlim.be

Conference Key Areas: Language issues in engineering education, Curriculum development, Engineering education research, Integration of research into engineering education

Keywords: Communication, Academic writing, Language, Action research

INTRODUCTION

For most of the 20th century, language and communication courses were not a constituent part of the engineering curriculum[1]. But over the course of the last decades, many have argued for their inclusion into engineering education. Beder, an engineering education researcher, makes the point that in post-Fordist economies, the engineering profile has gained a strong social dimension:

> 'The image of the engineer as technically-inclined and socially introvert is increasingly outdated. Engineering is an intensely social activity and engineers today are well aware of the social dimensions of their work. [...] The new engineer doesn't shrink from the social aspects of engineering work but embraces them and gives them full consideration.' [1]

It has repeatedly been argued that, due to the fundamental changes in the structure of economies and the operational structures of companies (horizontalisation, collaboration, interdisciplinary teamwork, globalisation,...) communication, language and literacy skills are a much more vital part of the engineer's competence profile than they used to be [2-11].

To date, however, communication courses do not stake the same, self-evident claims on engineering curricula as technical or scientific subjects do. The sense of urgency with which institutions make room for communication in their engineering curricula is variable. With technology ever specialising and budgets decreasing, communication courses sometimes meet with resistance from curriculum designers. Students, too,

[1] Parts of this paper and some research findings were already published in Jeroen Lievens, Debunking the "Nerd" Myth: Doing Action Research with First-Year Engineering Students in the Academic Writing Class, *Journal of Academic Writing*, Vol. 2, No. 1, Autumn 2012, pages 74-84

sometimes question the urgency of communication courses, which are often felt to go beyond what many engineering students identify as their core competencies (science, technology, research, problem-solving...).

This ambivalent situation gives rise to the following questions: Is it possible to collect hard and local evidence of the importance of communication skills for a career in engineering? And if so, can this evidence be used to help shape engineering curricula and to help convince students of the importance of communication skills?

1 APPROACH

The approach that was opted for, is an action research approach. Action research is also known as participatory research, collaborative enquiry or action learning [12-13].

> 'Primary is its focus on turning the people involved into researchers, too - people learn best, and more willingly apply what they have learned, when they do it themselves. It also has a social dimension - the research takes place in real-world situations, and aims to solve real problems.' [14]

In this case, engineering students were turned into researchers of a real-world situation: they were asked to investigate whether professionally active engineers, living in Flanders, consider communication skills important for their careers, and if so, which communication skills in particular. Their research findings aim to solve a real problem, i.e. to research the debated position of communication courses in the engineering curriculum.

The first term module of the 1ABA course "Research & Communication" at Faculteit Industrieel Ingenieur (Diepenbeek, Belgium), as elaborated in *Fig. 1* alongside the second and third term modules, provided the opportunity for implementing the action research approach.

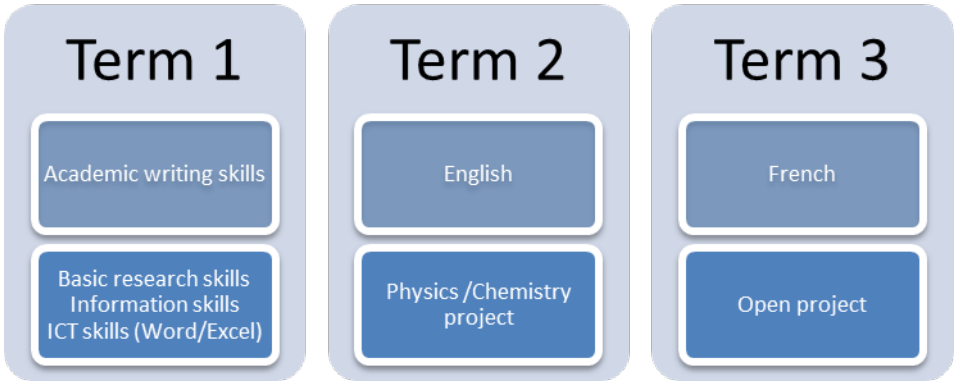


Fig. 1. Program for the course "Research and communication" (2 ECTS per term) in 1ABA, FI[2]

In the first term module, teams of 3 to 4 students were asked to write a brief research paper on the importance of communication skills for engineers on the basis of a literature review and an online questionnaire. The online questionnaire, developed by the teaching staff[2] and made available through Zoho Creator, consists of 10 multiple choice questions polling the importance of several communication skills in the workplace (foreign languages, writing, public speaking, negotiation skills...)[3]. All

[2] The teaching staff consists of Mieke Buntinx (Basic research skills), Dirk Willem (ICT skills), Lize Jaspers (Information skills), Hannelore Dierickx and Jeroen Lievens (Academic writing skills).

[3] The questionnaire can be found here: https://creator.zoho.com/jlievens/enqu-te-ingenieurs-en-communicatie-/form-perma/Ingenieurs_en_communicatie/

students were asked to distribute this questionnaire among engineers in their personal or their parents' networks via e-mail. The questionnaire yields an Excel sheet, aggregating the respondents' answers and personal data (age, engineering profile, sector, company size, gender and engineering diploma). All student teams were asked to define a more focused research question, (e.g. "Are foreign languages important for a career in construction engineering, and if so, which?"), to cull the relevant data from the Excel sheet and to write out their findings in a brief, academically formatted research paper supported with graphs.

All steps in the process were supported by the teaching staff. In 12 contact hours of "academic writing", students were taught the basics of academic writing (structure, register, phrasing, spelling, grammar, referencing, lay-out and formatting guidelines) and helped with their paper. In 2 contact hours of "basic research skills", students made themselves acquainted with elementary concepts in research methodology (drawing up a research questions, defining targets, selecting an appropriate method...). In 2 contact hours of "information skills" students learned how and where to find trustworthy research findings and relevant literature. In 2 contact hours of "Excel skills", students acquired such useful techniques as using formulas, macros and filters, and generating graphs. In 1 contact hour of "Word skills", students were offered support on relevant digital word processing topics (setting margins, automatic generation of table of contents, lists of graphs and tables and a reference list).

The academic writing staff provided feedback on the paper through an evaluation form with the following rubrics: use of source materials, content, topic focus, structure, argumentation, academic register, lay-out and correctness. The Word/Excel teaching staff evaluated and commented on the efficiency with which the Excel calculations and graphs were executed and on the techniques used to generate the Word file.

The goals were to improve the research and academic writing skills of students, and simultaneously to convince them of the relevance of communication skills for a career in engineering. From a larger perspective, the goal was to build an extensive set of local and hard data to help solidify and shape the place of communication courses in the engineering curriculum.

2 RESULTS AND DISCUSSION

2.1 Notable questionnaire results

Over the course of three first term modules (2010, 2011 and 2012), a total of 577 professionally active engineers have completed the questionnaire (which amounts to approximately 1 respondent per student)[4]. Some of the more significant results are discussed below.

A first interesting finding (see *Fig. 2*) is that engineers spend a very significant amount of their working time actively communicating (writing e-mails and reports, making phonecalls, having meetings...).

[4] Ethical clearance to make use of the questionnaire responses was sought and procured through a passage on the questionnaire stating that by submitting the form, the respondent agrees to surrender the submitted data for purposes of research and publication.

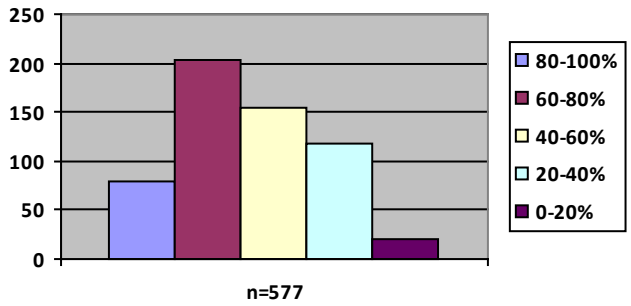


Fig. 2. The amount of working time spent actively communicating

On average, respondents spend 57% of their working time on active communication. This figure is higher than expected. Beer and McMurray, for instance, estimated that engineers spend 20-40% of their working time on communication [15].

A second finding is that engineers perceive their communication skills to impact their careers strongly. If “factor 1” amounts to “irrelevant” and “factor 5” to “all-defining”, then the majority of respondents, irrespective of engineering profile, selected a factor 4 to describe the impact of communication skills on their career (see *Fig. 3*) .

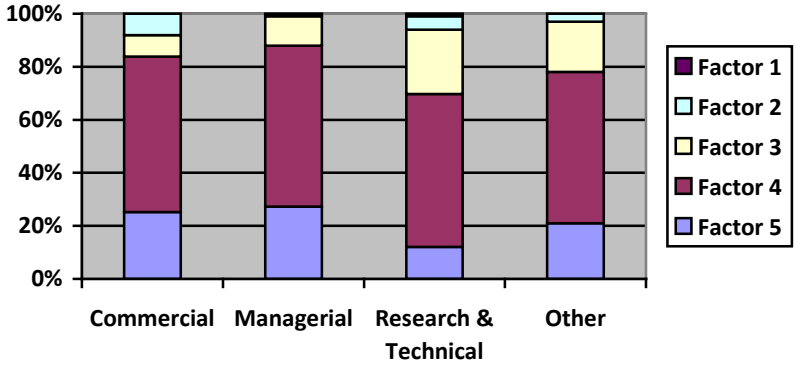


Fig. 3. The perceived impact of communication skills on the career of the engineer, from factor 1 (irrelevant) to factor 5 (all-defining) versus engineering profile.

A third interesting finding is that the mastery of English is considered crucial for a career in engineering in Flanders (see *Fig. 4*).

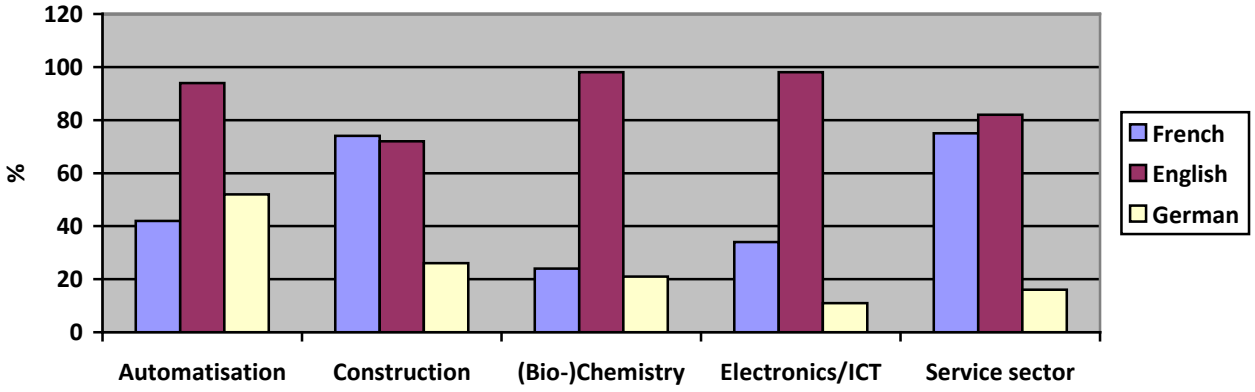
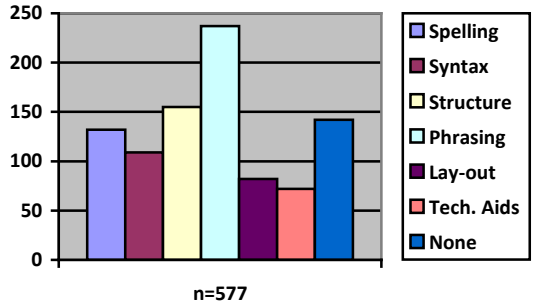


Fig. 4. The perceived necessity of foreign language skills versus engineering sector

Only in the construction sector, mastery of French is considered requisite more often than the mastery of English. It is also noteworthy that the mastery of German is considered crucial by more than 50% of the engineers in the sector of automatisation. From the questionnaire, it also appeared that 26% of respondents had followed a foreign language course following their graduation to be able to meet workplace requirements.

A final notable finding is that only one fourth of the engineers (resp. 25% and 23%) claims to experience no problems with the various dimensions of written and oral communication (see *Fig. 5 & 6*).



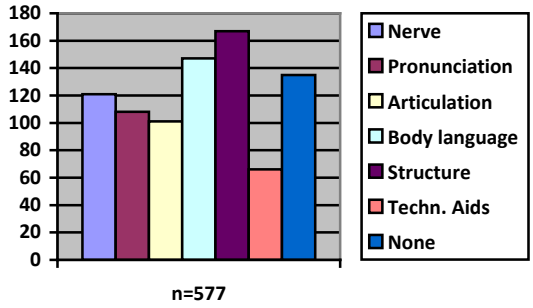


Fig. 5 & 6 Aspects of resp. written and oral communication that engineers struggle with.

In all, respondents indicate that communication and language skills are very important for their careers. At the same time, three fourths struggle with at least one aspect of written or oral communication. Many engineers have followed additional communication or foreign language courses following their graduation: 32% have followed a course on their own initiative, 28% have followed a course on the employer's request and another 8% is considering following an additional communication or language course.

2.2 Student papers

In their papers, students analyzed the relationship between the engineering profession and communication and language skills from a great variety of perspectives[5]. The fundamental recommendation, however, was uniformly to maintain or even augment the position of communication courses in the curriculum.

Comparisons of the current FI² curriculum and the questionnaire results led students to make the following, more specific recommendations:

- with respect to oral communication, the curriculum should make more room for meeting and negotiation skills (the current curriculum focuses on presentation skills, while meeting and negotiation skills are considered a crucial aspect of their profession by 48% of respondents, compared to 52% for presentations);
- with respect to written communication, the curriculum should make more room for writing for non-specialists (the current curriculum focuses on genres written

[5] Students were informed in writing that the research results could be used for research and publication purposes, and that they could withdraw the results should they wish to do so.

for the professional in-crowd, while writing for a non-specialist audience is considered a crucial aspect of their profession by 53% of respondents, compared to 57% for specialist audiences);

- with respect to foreign languages, the curriculum should diversify its foreign language offer in function of the different engineering branches (see *Fig. 4*) .

3 EVALUATION

3.1 Student questionnaire

Following the course module, students were asked to complete a brief, psychometric questionnaire. The questionnaire uses a 5 point Likert scale and helps build an understanding of the effectiveness of the above-described approach.

Was the action research approach successful in convincing first-year engineering students of the importance of communication skills for engineers? (see *Fig. 7*)

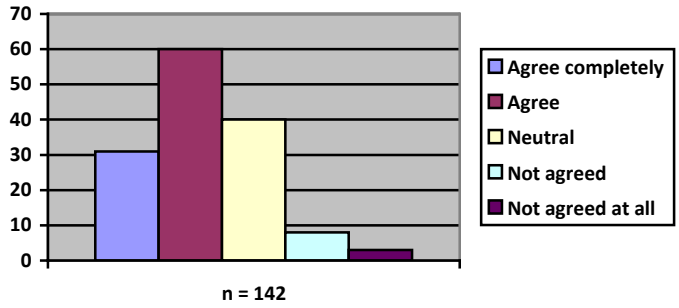


Fig. 7. "Working with authentic questionnaire results has convinced me of the importance of communication skills for engineers".

64% of students either agreed or agreed completely with the claim that the results of the questionnaires have positively influenced their ideas on the importance of communication skills for engineers. Of the 11 students in the categories "Not agreed" and "Not agreed at all", 5 added the comment that they were convinced already. It is impossible to state with reasonable accuracy how many the 30% of students in the "neutral" category were already convinced as well.

Was the course module successful in improving students' academic writing skills? (see *Fig. 8*)

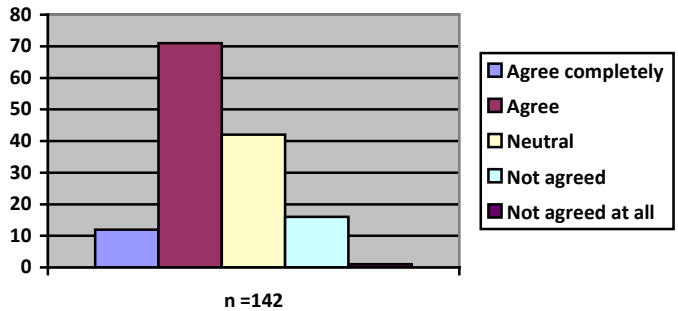


Fig. 8. "My academic writing skills have improved by writing out the research results in a paper"

58% of students either agreed or agreed completely with the claim that their academic writing skills have improved, while 12% disagreed or disagreed completely. It was attempted to validate student perceptions by comparing their paper with a formal text students had written preceding the course module. Mainly, students handed in essays, book reports, integrated project reports ("GIP") they had written in the final year of secondary education. The validation procedure was judged defective, however, because the pre- and post-text could not be compared reliably. The genres were too different to allow for a comparison of such parameters as structure, register, use of source materials and lay-out. Moreover, it was unclear to what extent the pre-texts had been proofread by third parties.

Was the approach successful in improving students' research skills? (see *Fig. 9*)

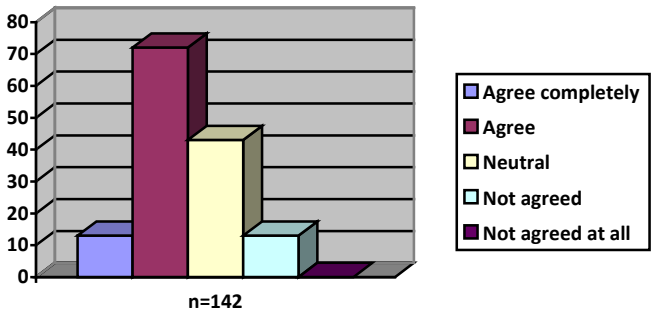


Fig. 9. "My research skills have improved over the course of the module"

60% of students agreed or agreed completely that their research skills had improved, while 6% did not.

In all, around 60% of the students consider the approach to be successful in achieving its targets. Around 30% takes a neutral stance. It has been observed too that, since the implementation of "Research & Communication", students are better equipped to write their bachelor papers. A similar finding is expected for the master's theses, though the first students to follow the course module in 2010 are still to start their master year (Autumn 2013).

3.2 Curricular impact

The set of local, recent and empirical data that was accumulated has turned out to be useful in the many curricular debates that have been conducted in the 4-year process of integrating the KHLim and XIOS curricula into the FI² curriculum and in arguing for the position of communication courses in the curriculum of the newly established Faculty for Engineering Technology of KU Leuven. The data set helps to give the workplace a systematic voice in curricular debates while traditional platforms for consulting the workplace often struggle to obtain a significant number of representatives.

4 CONCLUSION

The action research approach studied – and, simultaneously, improved – the fundamental interactions between students, teachers, the school and the workplace. A majority of students feels that they have gained a better insight into the reality of

21st century engineering and that they have improved their academic writing and research skills. The approach allowed teachers to create a functional task that integrated several course topics and that allowed students to make use of their perceived core competencies (problem solving, data analysis,...) in the process of acquiring a competency that is, for many, at some remove from their innate talents [16]. Moreover, "soft topic" teachers developed a "hard" way of speaking out in curricular debates. Finally, the school benefited from the systematic input of the workplace through the questionnaire, while the workplace, in turn, will benefit from graduated engineers with adequate communication skills.

REFERENCES

[1] Beder, S. (1998), A bit of the Rain Man in every engineer?, *Engineers Australia*, April 1998, pp. 57

[2] Craig, L., Lerner N. and Poe, M. (2008), Innovation across the Curriculum: Three case studies in Teaching Science and Engineering Communication, *IEEE Transactions on Professional Communication,* Vol. 51, No. 3, pp. 280–299

[3] Ford, D.F. and Riley, L.A. (2003), Integrating Communication and Engineering Education: A Look at Curricula, Courses and Support Systems, *Journal of Engineering Education,* Vol. 92, No. 4, pp. 325–328

[4] Heilmeier, G. (1995), Educating Tomorrow's Engineers, *ASEE Prism*, Vol. 12, May/June,

[5] Koen, P.A. and Pankaj, K. (1999), ABET 2000: What are the Most Important Criteria to the Supervisors of New Engineering Undergraduates, Proceedings of the *1999 ASEE Annual Conference*, USA: North Carolina.

[6] Lang, J.D., Cruse, S., McVey, F.D. and McMasters, J. (1999), Industry Expectations of New Engineers: A Survey to Assist Curriculum Designers, *Journal of Engineering Education,* Vol. 88, No. 1, pp. 43–51

[7] Lynn, L. and Salzman, H. (2007), The real global technology challenge, *Change: The Magazine of Higher Learning,* Vol. 39, No. 4, pp. 8–13

[8] Melin Emilsson, U. and Lilje,B. (2008), Training social competence in engineering education: necessary, possible or not even desirable? An explorative study from a surveying education programme. *European Journal of Engineering Education,* Vol. 33, No. 3, pp. 259–269.

[9] National Academy of Engineering (2004), *The Engineer of 2020: Visions of Engineering in the New Century*, Washington, DC: National Academy Press

[10] Riley, L.A., Furth, P. and Zelmer, J. (2000), Assessing Our Engineering Alumni: Determinants of Success in the Workplace, Proceedings of the *2000 ASEE/Gulf-Southwest Section Annual Conference*

[11] Williams, R. (2003), Education for the profession formerly known as engineering, *Chronicle of Higher Education* [online], available from <http://chronicle.com/weekly/v49/i20/20b01201.htm>

[12] Koshy, V. (2005), *Action Research for Improving Educational Practice*, London: Sage Publications

[13] Norton, L. (2009), *Action Research in Teaching and Learning: A Practical Guide to Conducting Pedagogical Research in Universities*, London: Routledge

[14] O'Brien, R. (2001), Um exame da abordagem metodológica da pesquisa ação [An Overview of the Methodological Approach of Action Research] in *Teoria e Prática da Pesquisa Ação* [*Theory and Practice of Action Research*]. ed. by Roberto Richardson. João Pessoa, Brazil: Universidade Federal da Paraíba. English version available from http://www.web.ca/~robrien/papers/arfinal.html>

[15] Beer, D. and McMurrey, D. (1997), *A Guide to Writing as an Engineer*, New York: Wiley and Sons

[16] Van den Branden, K. (2006), *Task-Based Language Education. From theory to practice*, Cambridge: Cambridge University Press