Communication Activity Implementation over 3 Engineering Universities: Values and Challenges

Leandro Cruz, Mariana; Carthy, D; Craps, S.

Publication date
2019

Document Version
Accepted author manuscript

Published in
proceedings of the 47th SEFI Annual Conference in Budapest 16-19 September 2019

Citation (APA)
Leandro Cruz, M., Carthy, D., & Craps, S. (2019). Communication Activity Implementation over 3 Engineering Universities: Values and Challenges. In *proceedings of the 47th SEFI Annual Conference in Budapest 16-19 September 2019*

Communication Activity Implementation over 3 Engineering Universities: Values and Challenges

M. Leandro Cruz
TU Delft
Delft, The Netherlands

D. Carthy
TU Dublin
Dublin, Ireland

S. Craps
KU Leuven
Leuven, Belgium

Conference Key Areas: Engineering skills, Curriculum development

Keywords: Curriculum elements, engineering education, communication skills, values, challenges

ABSTRACT

The urgency to stimulate transversal competencies is evident and acknowledged by accreditation commissions and institutions. For this reason, higher engineering education has developed practices and implemented in the engineering curricula elements that stimulate these competencies. However, educators find difficulties in developing and implementing them due to lack of time or experience, space in the degrees, or lack of institution support. This study describes a communication activity created and implemented over three engineering education institutions as part of a European knowledge alliance project and presents the values and challenges experienced by the universities after its implementation. Students carried out a short questionnaire at the end of the activity and the data from the three institutions were compared. The findings of this study showed that students perceived that this communication activity helped them to understand the importance of communication skills, and because of its nature of *plug and play* it was easily transferable to the three universities. This study provides educators with a new educational practice easy to implement and effective to stimulate student reflection on their communication skills.

Keywords: Curriculum elements, engineering education, communication skills, values, challenges

1. INTRODUCTION

Transversal competencies have gained importance in the engineering curricula in the last decades. Accreditation bodies such as the ABET Engineering Criteria in the US and the European Network for Engineering Accreditation in Europe and higher education institutions emphasized the incorporation of transversal competencies into engineering education curricula to allow students a smoother transition from education to employment. Engineering students equipped with transversal competencies are deemed more capable to enter the labour market [1]. Both industry [2] and academics [3] agree that transversal competencies such as planning and time management, problem-solving, communication, teamwork, lifelong learning, taking initiative, and creative and critical thinking are important for engineers. This study will focus on communication skills.

Communication is an essential skill for engineers' professional life. Novices engineers reported that they spend 32% of their time using verbal communication with other people and 28% in writing [4]. Another study [5] showed that engineers spend on average 57% of their working time on active communication such as writing e-mails and reports, making phone calls and having meetings. Also, young engineers spend a great part of their time listening [4]. Moreover, Lappalainen [6] argues that, in technology sectors, engineers are constantly exchanging information between other engineering fields and society. They need to communicate effectively to show their vision, to put plans into practice, and to stimulate feedback mechanisms. This importance of communication for engineers rises the need to integrate communication skills in the engineering curricula.

The development of communication skills in engineering curricula is mostly in the form of oral presentations [7] and written reports [8] in project-based learning courses. However, communication extends to informal listening and speaking which are rarely addressed in engineering curricula. Therefore, this study investigates the implementation of a communication activity that was developed to create students' awareness and reflect on effective verbal and visual communication. This includes actively listening, describing information, effectively answering, asking questions, and drawing images.

This study will compare the results of the implementation of this communication activity in three engineering universities, partners in the European project PREFER. Additionally, values of this activity to students perceived by the implementers, and challenges of its implementation will be reported.

The following research questions are addressed in this study:

1. How do engineering student groups perform during the communication activity?
2. How do engineering students perceive the activity?
3. How do educators perceive the activity?

2. METHODOLOGY

This study took a mixed quantitative and qualitative approach utilising a case study methodology to answer the first two research questions.

The performance of the group was analysed based on the scores of the outcome drawings produced by each group during the communication activity. The rubric, present in [9], was used to score the drawings for example on the amount, position, and colour of the objects.

A paper and pencil questionnaire delivered at the end of the communication activity collected information on students' perception of their communication performance in the activity ("*How was your communication skills in this activity?*" and "*Explain briefly why.*"), on points of improvement ("*What do you feel you can improve?*") and importance of communication skills ("*Do you feel that this activity helped you to understand the importance of communication?*"). The themes that emerged from the analysis of the students' explanations are presented as quotes. They are in italic and are associated with the role and university of the correspondent students.

The third research question was explored qualitatively through feedback responses of the implementers of the activity in the three universities. The purpose of this approach was to find out the values and challenges of the activity in the implementers' perspectives.

Ethical approval was granted for this study and participants have consented to be part of this research.

3. COMMUNICATION ACTIVITY DESCRIPTION

3.1. Learning outcomes

At the end of this communication activity, students will be able to:

- Experience effective oral and visual communication by means of active listening, describing images, effectively answering, asking questions and drawing images
- Understand the importance of effective oral and visual communication for engineers

3.2. Design of the activity

The communication activity is based on the children's game, the Chinese whispers. Its objective is to pass around the message to draw an image similar to the original image provided (*Figure 1*). Due to this difference between the original game, it is named Chinese Whisper wi*th a Twist*.

This activity has a duration of one hour and allows students to practice their communication skills by actively listening, describing information, effectively answering and asking questions. It is performed in groups and each group is divided into three roles (A, B and C). The rules and dynamics of this activity are shown in *Figure 1*.

3.3. Implementation

Data were collected between March 2018 and April 2019 in three European engineering universities (*Table 1*), known as TU Delft (The Netherlands), KU Leuven (Belgium) and TU Dublin (Ireland). The same vector image (see Figure 1 in [9]) was used in the three universities. This image was chosen so that it could be used in all university contexts.

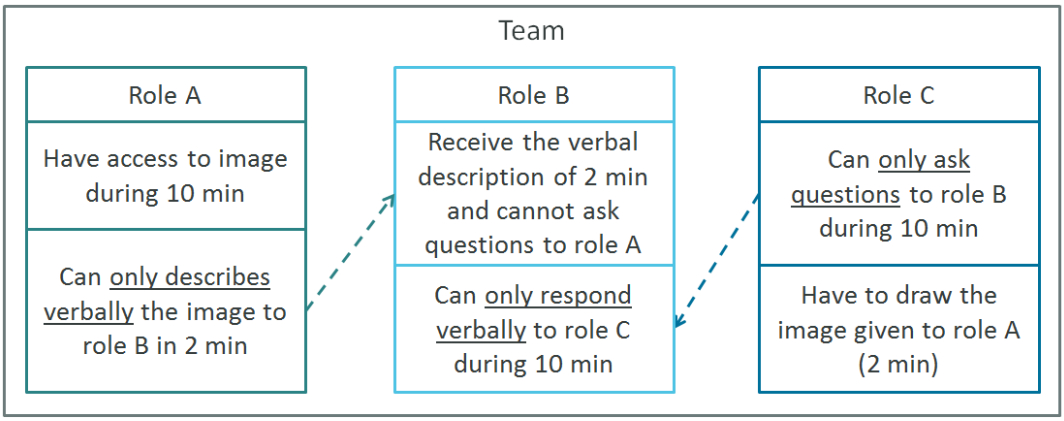

Figure 1 - Rules of the communication activity per role of each team.

Table 1 – Summary of information about the three participant universities.

	TU Delft	**KU Leuven**		**TU Dublin**
Implementation	March 2018	September 2018	April 2019	March 2019
Number of participants	20*	17	10	6
Roles per team (A-B-C)	4x (2-2-1)	2x (2-2-2) & (2-1-2)	2x (1-1-1) & (1-1-2)	(3-2-1)

*Of the 20 participants, one did not return the final questionnaire.

The communication activity at TU Delft was integrated into the Forensic Engineering course at the faculty of Aerospace Engineering and was delivered to international first-year Master students by the two-class lecturers in March 2018.

The activity at KU Leuven was implemented twice. First in September 2018 in a one-week summer school with international Master students of KU Leuven and FH Dortmund, and second in April 2019 with Master students of different KU Leuven campuses.

Finally, the activity at TU Dublin was carried out in March 2019 with a group of first-year Bachelor students in a project-based learning course.

The activity was conducted in English, except during the second implementation in KU Leuven that was in Dutch.

4. RESULTS

4.1. Group performances

Over the four implementations of the communication activity in the three universities, eleven drawings were produced as an outcome of each group. These drawings were measured with the rubric previously mentioned. The groups and the corresponding drawings' scores per category (objects, amount, colour, position and details) present on the rubric are present in *Table 2*. In this, we can observe which aspects the groups focused on and as a result how well they performed during the activity.

The results showed that the flow of communication between the participants within the roles worked very adequately in two groups (group 4 of TU Delft and group 1 of TU Dublin). They strategically and efficiently communicated by conveying information, attentively listening and carefully drawing the image.

“I tried to convey information as efficiently as possible by visual (charades) and descriptive (talking) means.” (Student in role A, TU Dublin)

“Listened for most details.” (Student in role B, TU Dublin)

“I didn't start drawing until I understood exactly what and where everything in the picture is.” (Student in role C, TU Dublin)

These groups met most of the aspects present in the picture. They identified all the objects, colours and positions, but also small aspects such as the *ears of wheat* (see Figure 1 in [9]).

On the other hand, some groups (e.g. groups 2 and 3 in KU Leuven 2018) struggled with their communication skills and consequently, their group scores were lower. They missed several aspects in the picture such as objects and their colours and amount, as well as most of the details.

"Didn't listen/take into account the suggestion of another team player "C". And paid attention to some details, but did not ask about the main feature - background colours/amount of trees in total." (Student in role C, group 3, KU Leuven)

The average groups met more than half of the aspects of the picture. They performed well on the identification of objects. While some groups focused on the colours of the objects (e.g. TU Delft group 1 and KU Leuven 2019 group 1), others neglected them (TU Delft group 3 and KU Leuven 2018 group 1). Only one group (KU Leuven 2018 group 1) was able to identify more than half of the details in the picture.

Table 2 - Drawing scores per team assessed through a rubric (see Figure 1 in [9]). The maximum score is 43 points.

University	**Groups**	**Rubric Scores**					
		Objects	**Amount**	**Colour**	**Position**	**Details**	**Total per group**
TU Delft	1	6	4	6	4	7	27
	2	5	4	4	4	5	22
	3	6	4	1	4	8	23
	4	7	4	7	7	11	36
KU Leuven 2018	1	6	4	2	4	9	25
	2	4	3	1	4	5	17
	3	3	3	3	3	5	17
KU Leuven 2019	1	6	3	6	4	7	25
	2	5	4	4	3	7	23
	3	6	4	3	3	8	24
TU Dublin	1	7	4	7	6	9	33
Total per rubric		**7**	**5**	**7**	**7**	**17**	**43**

4.2. Students' perceptions

Over the three universities, a total of 52 engineering students completed the questionnaire delivered at the end of the activity.

Students were asked to rate their communication skills and to provide an explanation for their responses. The findings show that 86.5% of students in the three universities perceived they were very good or good communicators (*Figure 2*). The majority of students in role A stated they described the image in a precise and structured way and conveyed information well. Students in role B indicated they attentively listened and clearly answered the questions with the information received. Finally, students in role C asked general and in-depth questions to draw the image.

> *"…We broke it* (the image) *down to elements (objects, shapes, colour, positioning) and we were able to provide all the information"* (Student in role A, TU Delft)
>
> *"I was clear and got lots of detail."* (Student in role B, KU Leuven)
>
> *"Based on the role, I felt that the communication skills shown by me were met, having answered all the questions satisfactorily."* (Student in role B, TU Delft)
>
> *"Asked both in-depth and broad, general questions."* (Student in role C, KU Leuven 2018)

A small percentage of students (13.5% who responded *neither good nor bad*) realised that their communication could have been better.

> *"I tended to rush and forget important details/clarification."* (Student in role A, TU Delft)
>
> *"My questions could have been more to the point (and same goes for drawing skills)"* (Student in role C, TU Delft)
>
> *"Forgot to ask a lot of detailed questions because I assumed a lot like a sunset: orange, cow drawn in this way…"* (Student in role C, KU Leuven 2019)

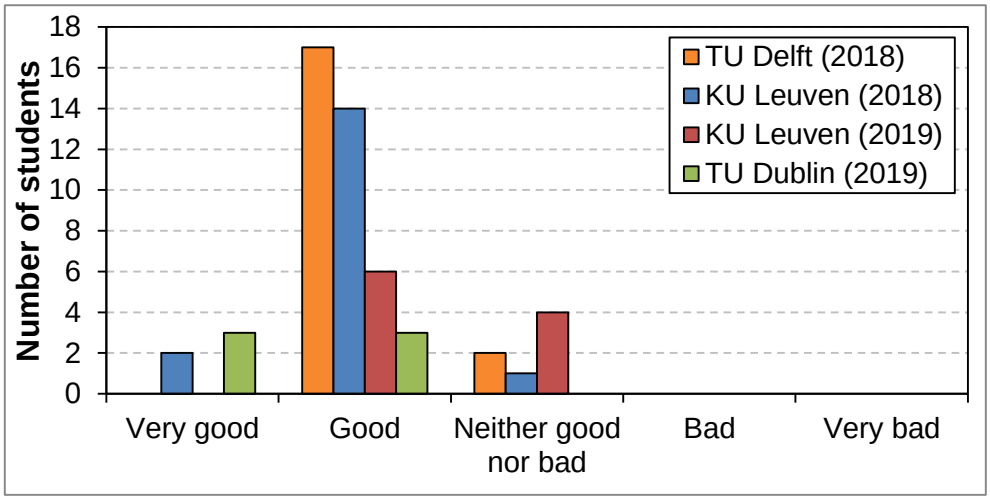

Figure 2 – Communication skills perceived by students (n = 52) on a 5-point Likert scale (very good, good, neither good nor bad, bad, and very bad).

Also, students, who considered that their communication performance was adequate, recognised they could still improve their communication skills, especially to pay attention to details.

> *"After seeing the original picture, we got pretty close. We missed some details and maybe, I personally didn't analyse why the trees were slack."* (Student in role C, TU Delft)

> *"Apart from some minor details, I think we explained it very well."* (Student in role A, KU Leuven 2018)

Overall, when students were asked points of improvement (*Figure 3*), students in role A indicated skills as *describe information* and *pay attention to details*, in role B *write down information*, and in role C *ask questions* and *pay attention to details*. Another result from the questionnaires shows that 86.5% of the students from all the three universities strongly agreed and agreed that the activity has helped them to understand the importance of communication (*Figure 4*).

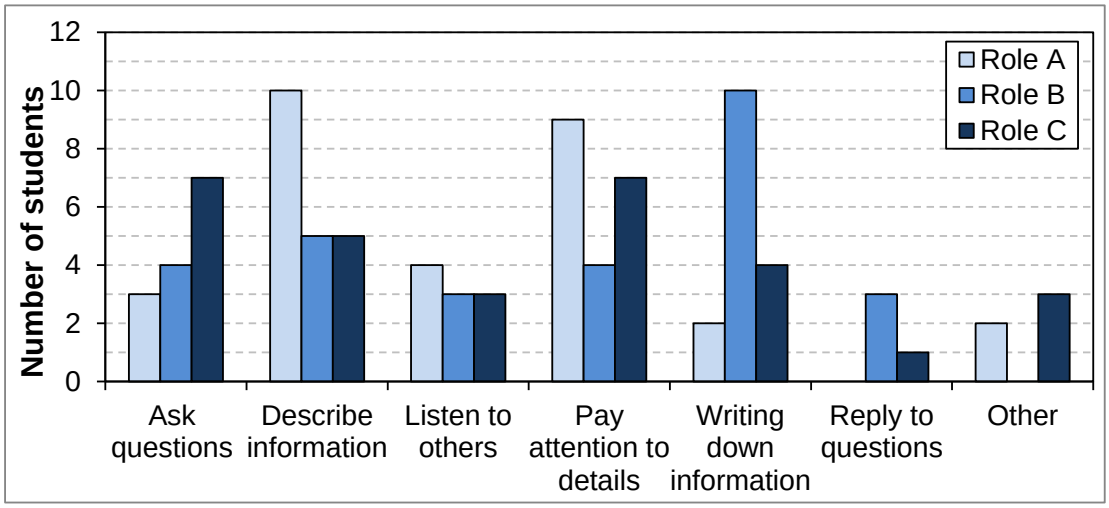

Figure 3 – Points of improvement perceived by students (n = 52) per role after the communication activity.

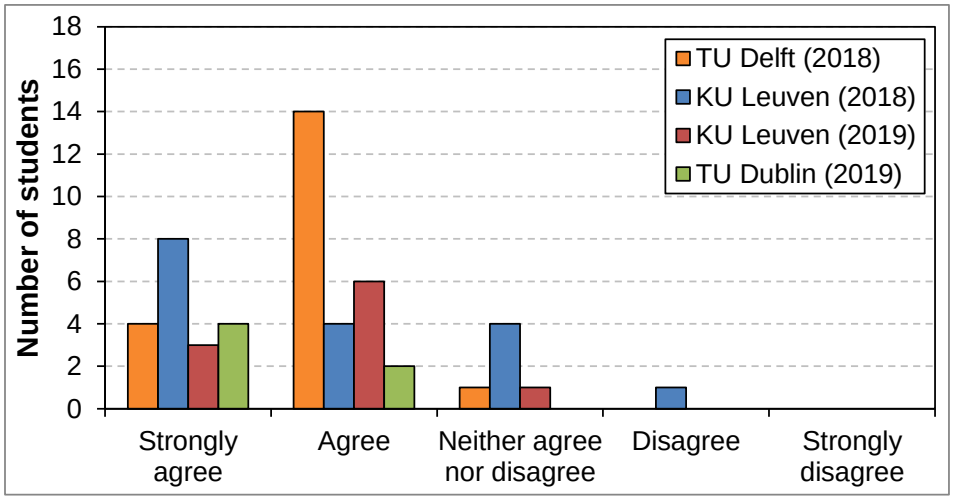

Figure 4 - Perception of students (n = 52) on whether this activity helped them to understand the importance of communication on 5-point Likert scale (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree).

4.3. Perspective of three universities

The implementers of the communication activity in the three universities provided with feedback on the activity. The feedback of the TU Delft lecturers was used to improve the implementation of the activity and it is described in a previous paper [9]. Overall, the implementers of the three universities considered the activity a fun and ice-breaker exercise, and easy to implement. Moreover, although implemented in different courses and contexts they indicated that the activity is adequate to experience and reflect on the importance of communication.

> *"In the context of a session on pitching, it was a fun exercise to let the students experience the importance of efficient communication."* (Implementer at KU Leuven)
>
> *"The value of the activity in this context is that it got students to think about the importance of communication, which is certainly of value when one is acting as a project manager on a design project."* (Implementer at TU Dublin)
>
> *"I think with the activity they learned a lot about the communication aspects, so I guess on that side I really like the activity. It was a really good activity."* (One of the lecturers at TU Delft)

A challenge in the implementation of the activity pointed out is when the class groups are large. This requires better organisation in the sense that larger or more rooms are needed as well as assistance to supervise the groups during the activity.

5. DISCUSSION & FUTURE WORK

This paper presents the findings from the implementation of a communication activity over three different European engineering universities.

The data from the three universities illustrated that most of the students perceived that their communication skills were good. The scores of the drawings showed, however, that some groups experienced some difficulties in communicating. A very interesting finding was that difficulties arose mainly with students who did not know each other (they just met in the one-week summer school), and were from different (e.g. Belgium and German) cultural backgrounds. On the other hand, the communication skills of the English native speakers (TU Dublin) worked really well. These results may indicate that the intercultural aspect played a role in the communication performance of the groups. Though, we believe that culture was not the only factor playing in the activity, but also the approach taken by the students when communicating their messages to draw the image. For example, students in group 4 of TU Delft were from different nationalities and not English native speakers, but they approached the exercise very strategically. They described the image by sections giving directions, sizes and colours, paid attention to most details, and asked first general questions and then more detailed questions to draw the image. A similar strategy was adopted by students in TU Dublin. Then the organisation of the group and how communication was transmitted was an important factor for effective communication. The factors (e.g. cultural and approach) that influenced students' communication may be investigated in a future research.

Overall, this activity seemed to stimulate students' reflection on their communication skills, including strengths and points for improvement, as well as to provide students

with awareness for the importance of communication. Moreover, the implementers of the activity in the three universities stated that they value this activity because it stimulates students' reflection on their communication skills. Therefore, we believe that this research provides engineering education with an activity that may help students to reflect on their communication strengths and aspects to develop and to gain awareness of the importance of effective communication necessary for the engineering labour market. An additional advantage of this activity is the ease of its implementation in different contexts.

Self-assessment tools are convenient instruments to measure students' competencies because they are easy to develop and implement. Nevertheless, they are subjective to people's bias. To overcome this research limitation, in future work, as complementary exploration, interviews will be conducted to evaluate students' experiences during the participation of the communication activity and how that may change the way students view or experience effective communication.

ACKNOWLEDGEMENTS

This work was supported by the Erasmus+ program of the European Union (grant agreement 575778-EPP-1-2016-1-BE-EPPKA2-KA) and is part of the PREFER project (http://www.preferproject.eu/). The authors would like to acknowledge their colleagues in the project as well as Michiel Schuurman and Calvin Rans for letting this communication activity to be implemented in TU Delft, and all the students for their enthusiastic participation and allowing us to use their data.

REFERENCES

[1] Mason, G., G. Williams, and S. Cranmer," Employability skills initiatives in higher education: what effects do they have on graduate labour market outcomes?", *Education Economics* Vol. 17, No. 1, 2009, pp. 1-30.

[2] Passow, H.J., and C.H. Passow," Which ABET competencies do engineering graduates find most important in their work?", *Journal of Engineering Education* Vol. 101, No. 1, 2012, pp. 95-118.

[3] Beagon, U., Bowe, B., "The Academic Perspective: A study of academic's perceptions of the importance of professional skills in engineering programmes in Ireland", *46th SEFI Annual Conference*, Copenhagen, Denmark, 2018.

[4] Trevelyan, J., "Mind the gaps: engineering education and practice", *Proceedings of the 21st Annual Conference for the Australasian Association for Engineering Education*, Sydney, Australia, 2010, pp. 383.

[5] Lievens, J., "Are communication skills important for engineers? A relevant research question for engineering students and curriculum designers", *41th SEFI Conference*, Leuven, Belgium, 2013, pp. 1-9.

[6] Lappalainen, P.," Communication as part of the engineering skills set", *European Journal of Engineering Education* Vol. 34, No. 2, 2009, pp. 123-129.

[7] Berjano, E., L. Sales-Nebot, and A. Lozano-Nieto," Improving professionalism in the engineering curriculum through a novel use of oral presentations", *European Journal of Engineering Education* Vol. 38, No. 2, 2013, pp. 121-130.

[8] Drury, H., T. Langrish, and P. O Carroll," Online approach to teaching report writing in chemical engineering: implementation and evaluation", *International Journal of Engineering Education* Vol. 22, No. 4, 2006, pp. 858.

[9] Leandro Cruz, M., and G.N. Saunders-Smits, "Design and Implementation of New Communication and Lifelong Learning elements in a Master Engineering Course", *46th SEFI Annual Conference*, 2018.