Enhancing student communication skills via debating Engineering Ethics

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ABSTRACT

In Engineering, the construction of informed, persuasive and convincing arguments is at the very core of everyday practice. However, in taught postgraduate education there is often an excessive focus on assessment of these skills through written arguments or oral presentations that are usually in the form of long uninterrupted monologues, where the construction of the arguments themselves is almost never challenged. To change this status quo, we have successfully pioneered the use of oral debate as a dynamic and engaging mechanism to develop and assess this skill in our Chemical Engineering MSc students.

Debate is an ideal mechanism to assess our students' ability to construct arguments as it actively encourages them to (1) think about both sides of an argument, (2) consider how they can persuade others and (3) express their viewpoint

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professionally but with conviction. For this reason, the debates undertaken were linked to important engineering ethical dilemmas, by discussing topics such as "should developing countries prioritise the shift to clean energy over economic growth".

The development of this debate-based training and assessment has had numerous positive outcomes on the students' learning experience and vital skills development. Importantly students found the debates to be both an interesting and enjoyable method of assessment and noted that the skills learned would be useful in their future careers. In this concept paper we present our experiences in delivering debate assessments to engineering students along with recommendations for practitioners wishing to implement similar styles of performative assessments in their own pedagogy.

1 INTRODUCTION

1.1 Problem

A core part of everyday practice as an engineer, whether in the classroom or in industry, is the ability to construct persuasive and convincing arguments [1]. Despite this, we very rarely see the skills being actively developed in taught undergraduate and postgraduate engineering courses. It is rarer still that they are directly assessed, and if they are there is commonly a major focus on written arguments within larger reports. Whilst oral presentations do appear to allow the assessment of spoken arguments, they are usually in the form of pre-prepared, long and uninterrupted monologues, in many cases read from text or bullet points, followed by technical questions. Although these methods do allow technical expertise to be demonstrated, the quality of the argument structure and its impact, i.e. its construction, is almost never appraised. Possibly more importantly, arguments are also rarely challenged, particularly in the spoken form, despite this being a common feature of an engineer's everyday professional experience.

It is clear that in engineering education we must develop teaching and assessment methods that promote team working and effective communication, actively engage the students and allow them to improve their ability to develop, present and adapt arguments. To achieve this we would ideally pair any new pedagogical practice with subjects that allow for nuanced, complex and two-sided thought and discussion, as this will help to meet the requirements of classroom assessment as presented by the National Research Council [2]: to "give students the opportunity to think critically as they apply their understanding under novel conditions to solve new problems or to explain novel phenomena."

1.2 Ethics in Engineering

Ethics is an area, unlike most others in engineering, where there is no 'right' or 'wrong' answer to a question, rather we must use ethical frameworks to form views on which is the optimal path to follow. Nonetheless, it is a topic that it vital that engineers both engage with and understand; It is mandatory that ethics is taught for IChemE [3] accreditation. When discussing ethics in practice we must persuade and

convince others, within our team and more widely, that our choice is appropriate, potentially adapting and reframing our arguments based on their unique perspective. Although written essays may be utilised to assess these skills to some degree, they primarily assess slow cognitive argument formation and presentation. Yet, in a non-educational context (e.g., employment) making fast-paced decisions that must instantaneously be justified, and are frequently challenged, is a common, if not every day, occurrence. Performative assessment methods, like debate, are better placed to develop and assess these skills.

1.3 Debate as a form of assessment for engineering ethics

The term debate finds itself applied to describe a broad and diverse spectrum of activities, ranging all the way from formalised parliamentary proceedings to chaotic online forum threads. In the context of utilising debating as a pedagogical tool, leading practitioners have defined a debate as referring to, broadly, “an equitably structured communication event about some topic of interest, with opposing advocates alternating before a decision-making body” [4].

There are several published examples from higher education where in-class debates have been used successfully, both as formative and summative assessments, yet the majority of the cases have been within humanities subjects with only a few examples from STEM subjects [5]. Debates encourage students to focus less on the facts, but more on how they use them to construct robust arguments, by conducting thorough independent research to develop a deeper understanding of the technical knowledge in order to be able to present that information robustly [6]. The development of such argument construction skills, alongside having to consider alternative viewpoints, is particularly useful for students’ to be able to discuss ethical dilemmas [7]. Debate has been clearly shown to be a successful tool for building student’s confidence in handling ethical dilemmas, particularly in relation to the health care sector where debate has been shown to improve nurses moral judgement [7]. However it has yet to be shown that this will work in an engineering context.

For many students, a debate may be the first time that their ideas have been critically challenged and so students are encouraged to think critically about the material in order to actively engage with the other side and present dynamic and robust arguments. In the few examples of debate being used within STEM subjects [5], the studies that have been discussed have clearly shown that debate-based assessments are beneficial to the student experience. Hence in the 2019/2020 academic year we piloted the use of oral debate as a mechanism to assess our Chemical Engineering MSc students’ understanding of ethical issues – a vital part of Chemical Engineering education [3]. As per the definition earlier stated given by [4], in our assessments we made use of a style of formalised debating which is standard at many competitive debating tournaments in the UK, making a few minor adaptations to simplify the rules for our students’ benefit. Borrowing from competitive standards ensured that as a means of assessment our debates were suitably

structured, equitably-balanced and involved direct communication towards the assessors as the adjudicating decision-making body.

1.4 Objectives

Given the clear benefits of debating as a form of assessment that have previously been discussed, in the 2019/2020 academic year we piloted the use of oral debate as a mechanism to assess our Chemical Engineering MSc students' understanding of ethical issues – a vital part of Chemical Engineering education [3].

The aims of this pilot were to: a) determine if debating would provide valuable skills to engineering students, b) determine the best way of assessing debating skills and c) provide a framework for debating in engineering education that can be implemented by other teaching practitioners

In this concept paper we will discuss how effective the pilot year was and what impact it had on our students. We will also discuss how we have since developed the debating assessment, with a view to providing recommendations and encouragement for other teaching practitioners who wish to implement similar assessment techniques in their own courses.

2 METHODOLOGY

2.1 Student Background

This study was undertaken in a Department of Chemical Engineering at University College London, as part of the development of a new MSc level module on 'Research Skills' with an annual enrolment of 22-40 students. The students taking this course all have an undergraduate degree in Chemical Engineering, Chemistry or similar, however come from institutions across the globe. This lecture course was designed to ensure that they all have the same training to successfully undertake their final research projects. Alongside more traditional skills topics including literature searching and academic writing, research ethics is taught. Ethics was a subject that had not been explicitly taught as part of either undergraduate or postgraduate courses prior to 'Research Skills', instead different aspects had been covered in various modules. 'Research Skills' is fully assessed via coursework (both written and oral), with no examination component. Prior to the conception of this course, any preparation for the MSc research project was presented via traditional didactic lectures or in written texts.

The debate assessments were piloted in the first term of the 2019/2020 academic year. After their success this was continued, despite the pandemic, through the subsequent two academic years. These debates have had remarkable success in both in person, and remote teaching environments.

2.2 Debate Assessments

As previously discussed, debate is an ideal mechanism to assess our students' ability to create strong arguments, a valuable skill for the workplace, and especially for discussing the numerous ethical issues we face as engineers. However, for the

majority of students debating is a novel form of communication which they are unlikely to have any significant prior experience of. Hence, we recognised that we would first need to provide the students with debating skills training before we utilised debate in any assessment.

In the pilot year, 2019/2020, bespoke hands-on training workshops were developed, in collaboration with the leading UK debating charity Debate Mate [8], to teach debating skills to the students, as well as providing opportunities for cohort building and increasing student confidence in public speaking. This training included sessions of information transfer from Debate Mate mentors to students (direct teaching), student-led activities, and scenario based applied learning via mini-debates. They therefore developed the students' critical and creative thinking skills for problem solving and encouraged the students to think on their feet and build dynamic arguments. This debate training was vital in improving the communication skills of the students and enhancing their ability to influence others and create impact with their arguments.

The students were then split into small teams for the final assessment, participating in a structured debate on an ethical issue related to science and engineering. The students were given their motion and whether they would be for or against the motion, one week to prior to the assessment for them to adequately prepare background research. An example debate motion is:

"*This house would punish workers who do not blow the whistle on malpractice, corruption or negligence as if they had carried out those acts themselves*."

In the debate, students presented their arguments (and rebutted arguments from the opposing team) using techniques learned in the training sessions. Teams could interrupt each other through requests for 'points of information' (POIs) and questions could be asked by the audience, responses to these had to be integrated into the final speaker's summary. This meant students could not prepare a static speech, but instead needed to reactively adapt their argument as the debate progressed, in order to be more persuasive.

In the assessed debates our students were evaluated on three key areas. Firstly, Style, the extent to which they were communicating clearly, confidently and utilising the persuasive techniques covered in the training sessions. Secondly, Content, the strength of their argumentation and rebuttal in terms of logical construction and analytical sophistication. And thirdly, Strategy, which covered a broad range of criteria including role fulfilment, time management, teamwork and engagement with POI's and questions from the audience where relevant. A representative from Debate Mate with a background in adjudicating competitive debating tournaments moderated the debates and functioned as a second marker.

2.3 Remote Learning

The pilot year was a great success and so the teaching team were highly motivated to continue to develop and optimise debating as an important training and assessment tool for the 2020/2021 academic year. However, in the 2020/21

academic year debates and training were moved online due to the Covid-19 pandemic. All teaching and assessments were undertaken via an online platform (Zoom). Online debate training sessions had very similar content to that of the previous year, ensuring that the vital aspects of communication for leadership were still practiced. For the debates, functionalities of the platform helped to maintain the dynamic and high energy feeling for this highly engaging form of assessment. The whole class was present on the Zoom call, and they were encouraged to use the 'reactions' emojis (e.g. applause) to praise or support well-made arguments (in place of in-room applause). Participants could make POIs via the 'raise hand' function and the moderator ensured the speaker was aware.

3 RESULTS

3.1 Student Feedback

When implementing a new form of assessment, it is important to evaluate how the students perceived the task and whether they found it useful. Over the past years we have actively gathered feedback from students on how they found the debate assessment. We conducted a non-compulsory anonymous survey asking the students if they believe that the debating had a "positive impact on their learning experience". The results of this survey for the past three years are shown in figure 1, with all students indicating that they agreed with the statement.

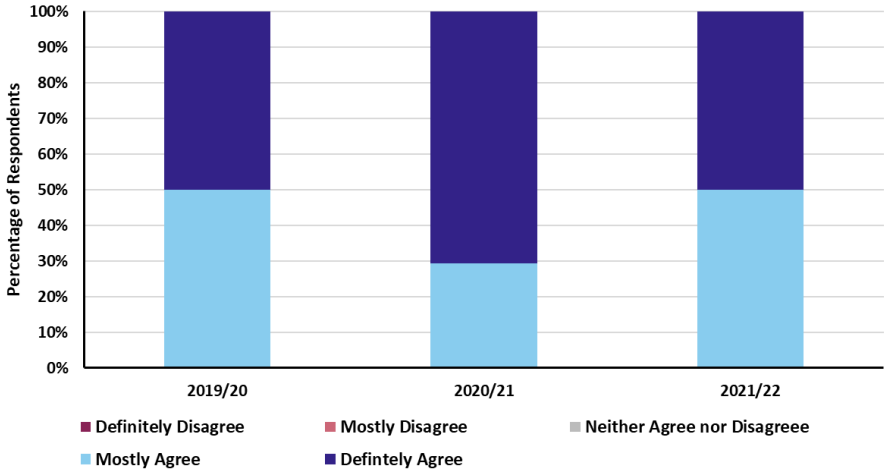

Fig. 1. Number of students surveyed as to whether debating had a "positive impact on their learning experience"

In addition to the survey, we also contacted students from the pilot year, 6 months after they graduated, to gain an insight into how the debating has helped them in their career. They were asked "Do you believe the debate skills you learned at UCL have been helpful for you in your career since your MSc finished? If so please briefly detail how?" All responses received were positive with key comments including:

- "I have now noticed that I am a lot more comfortable presenting to groups in my current graduate scheme"
- "During the interview, some interviewers gave a topic for interviewees to debate and then made a judgment from their performance in debating"

- “It has enhanced my ability to make a point sound convincing”
- “The debate class has improved my communication and presentation skills, in particular it inspired me the method to appropriately respond the challenging questions raised from the investors”

The final way we have received feedback from the students regarding the debates is through the national Postgraduate Taught Experience Survey (PTES). This is a general survey asking about their experience on their MSc, and as such none of the questions specifically focussed on the debates. One of the questions on this survey is “what was the most enjoyable part of the course” and multiple students highlighted the debates here with comments such as “it has improved my oral English and teamwork ability”. This clearly shows that the students found the debate activity to be a highlight of their course.

3.2 Staff reflections

Whilst the pilot year was a resounding success, especially in terms of student feedback, the teaching staff discussed their reflections of how the assessment had gone from a pedagogical perspective and made some minor modifications to the way it was run to improve the experience.

The first observation was that whilst the requirement to form a rebuttal of the previous speaker’s point and use of POIs meant that there was some element of students creating responsive arguments, it was still felt that this was done superficially, and students had overprepared speeches. In order to discourage this level of detailed preparation in the 2020/21 academic year, the students were given their motion one week before the assessment but were only told which side they were arguing for on the day of the assessment. They were then given 10 minutes to discuss their strategy as a group before the debate started. We saw that the quality of responsive engagement in these debates were much higher than those of the previous year.

The second key observation that we made was that the students were quite tentative about undertaking an assessment that involved such a high level of group work at the beginning of the academic year, when they were not quite comfortable working with each other. To address this we moved the debates from the first academic term to the second. This allowed the students to become more familiar with each other before being presented with a completely new style of assessment. We saw that this was effective as there was a greater interaction from all the students in the debates, with more POIs and more questions from the audience.

4 SUMMARY AND INSIGHTS

The development of this debate-based training and assessment has had several positive outcomes on the students’ learning experience and vital skills development. Importantly students found the debates to be both an interesting and enjoyable method of assessment and noted that the skills learned would be useful as they look for jobs (e.g., at assessment centres). This can be attributed to the fact that,

compared to typical technical presentations, the students are required to do more thorough research in order to consider both sides of the argument and work convincingly as a cohesive team, rather than a group of individuals, in order to strengthen their overall argument.

Not only were the debates high quality, but the practice of having to fully engage with what others are saying and being able to respond dynamically has enabled the students to improve their communication skills in other aspects of their learning. For example, in a subsequent presentation assessment the quality of the responses to questions was much higher than expected, with students providing well-reasoned responses rather than just rephrasing what has already been said. Students were also much more willing to ask their peers sensible questions, rather than it only being academics asking them.

The success of the pilot and onward implementation of debate training and assessment for MSc students has led the Chemical Engineering Department to begin work to expand this training across the other students across the postgraduate taught and undergraduate cohorts, as it has been seen that the communication skills that the students develop are invaluable for them in their future careers.

4.1 Recommendations

Due to the success of implementing this debate assessment we strongly encourage other engineering education practitioners to implement similar styles of assessment in their own teaching. Having run this assessment for the past three years we provide here a series of recommendations:

1. It is vital that there should be adequate training on how to construct arguments and particularly the structure of a debate as this will likely be completely unfamiliar to the majority of students.
2. How the assessments will be graded should be clearly communicated to the students from the beginning. It is important to be clear that their grades will not be directly related to whether or not their team win the debate, and also that the assigned debate topics are fair and balanced, to ensure that the students on both sides can reasonably be expected to offer strong arguments.
3. Having one student on the team in a non-speaking role helps students with lower confidence, especially those with a different native language. This student will still assist their group with their pre-debate preparation and will still have the opportunity to take an active role in the debate if they wish to offer points of information to the other side.
4. The quality of the arguments being presented is higher if students are only told the side which they are arguing 10 minutes before the debates occur, as this further limits the chances of students presenting pre-prepared speeches.

4.2 Acknowledgements

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REFERENCES

[1] Sageev, P., & Romanowski, C. J. (2001). A message from recent engineering graduates in the workplace: Results of a survey on technical communication skills. *Journal of Engineering Education*, Vol. 90, No. 4, pp. 685-693.

[2] National Research Council (2001), Classroom assessment and the national Science Education Standards, National Academies Press, Washington, DC

[3] IChemE (2019). Accreditation of chemical engineering programmes: A guide for higher education providers and assessors

[4] Snider, A., & Schnurer, M. (2002). Many sides: Debate across the curriculum. IDEA.

[5] Healey, R. L. (2012). The power of debate: Reflections on the potential of debates for engaging students in critical thinking about controversial geographical topics. *Journal of Geography in Higher Education*, Vol. 36, No. 2, pp. 239-257

[6] Kennedy, R. (2007). In-class debates: Fertile ground for active learning and the cultivation of critical thinking and oral communication skills. International Journal of Teaching & Learning in Higher Education, Vol. 19, No.2, pp. 183-190.

[7] Kim, W. J., & Park, J. H. (2019). The effects of debate-based ethics education on the moral sensitivity and judgment of nursing students: A quasi-experimental study. Nurse Education Today, 83, 104200.

[8] https://debatemate.org/wp-content/uploads/2021/07/Annual-Report-19-20-FINAL_Low_Quality.pdf (Accessed March 2022)