Into the Heat of the Debate: Simulating a Program Committee Within Computer Science Education

Sam Maesschalck
Computing and Communications
Lancaster University
United Kingdom
s.maesschalck@lancaster.ac.uk

Matthew Bradbury
Computing and Communications
Lancaster University
United Kingdom
m.s.bradbury@lancaster.ac.uk

Vasileios Giotsas
Computing and Communications
Lancaster University
United Kingdom
v.giotsas@lancaster.ac.uk

***Abstract*—There are many teaching strategies in higher education; one of these is discussion-based teaching which aims to stimulate conversation and peer learning. Although this teaching strategy has many benefits for students, such as learning how to argue, it has not gained much traction in STEM subjects like Computer Science. However, soft skills have become increasingly important within these fields. A focus when recruiting for roles is not only on hard skills such as programming but also on the ability to communicate well with stakeholders. This paper explores and evaluates an approach to incorporate discussion-based teaching within computer science education, focusing on teaching hard and soft skills. To achieve this, we organised an *emulated* program committee type of activity for MSc students at our university. We evaluated the activity by asking the students to complete a survey and followed this up by interviewing several students to gather more in-depth reactions from the cohort. The results show that students feel they learnt about the topics tackled within the papers we have chosen, gained more confidence to tackle paper writing, understood the requirements of academic work, and improved their soft skills such as academic writing. The interviews show that students thoroughly enjoyed the activity and are keen to have more interactive discussion sessions like this.**

***Index Terms*—Discussion-Based Teaching, Computer Science Education, Employability, Student Engagement**

I. Introduction

Leaning is not solely about what knowledge the teacher transfers to the students but also includes what a student transfers to another student (Boud et al., 2014). Whereas within social science subjects, the idea of stimulating discussions between students is common practice (Ferreira and Serpa, 2017), we yet have to see this breakthrough in the computer science sphere, especially within more technical modules. However, these discussions could stimulate more peer learning, build upon current teaching practices, and stimulate critical thinking, which is essential to achieve effective teaching (Pilkington and Walker, 2003). Academia itself is based upon research and discussion, which raises the question of why this is not more ingrained in our teaching.

There are situations where a discussion-based seminar would not work within Computer Science. For example, students might not have enough knowledge to effectively argue their viewpoint within the early years of an undergraduate degree (Bovill et al., 2009). Unlike within social sciences, where students tend to have strong opinions throughout their degree and can express these within computer science, we do not always engage with these views as a teacher. Looking into third-year undergraduate modules, students should have obtained enough knowledge and opinions to discuss concepts and approaches within the field. When starting a job after graduation, they will have discussions with fellow developers, or during job interviews, they might have to explain in more detail why they have approached a problem in a certain way (Yorke, 2006). Including more seminar-style, discussion-based sessions could teach students professional soft skills that are needed for the 21st century (Andrews and Higson, 2008; Teo, 2019) with guidance and steering to prepare them for these occasions. We believe that there is a significant opportunity to stimulate building soft skills better within computer science. Because there are so many ways of implementing the same functionality in software, there are many possibilities to discuss and debate why one approach is slightly more efficient or elegant than another. These discussions, such as which programming language is best, are already prevalent on the Internet, and involving students in these can be beneficial.

Within this paper, we present the results of a teaching activity performed within one of our MSc Cyber Security modules to stimulate discussions and debates whilst still conveying technical knowledge to the students. We did this learning activity within a master's level module because we have a wide variety of knowledge and backgrounds within our cohort, from students with extensive professional experience to students who have recently graduated with a BSc degree. We have chosen a cyber security module because the subject allows for more discussion, as many concepts do not solely rely on technical aspects when debating them. For example, the discussion of safety vs security in Operational technology environments, security through obfuscation, and the concept of zero-trust security can all be approached from multiple perspectives. We have implemented a program committee-style exercise to achieve an environment that encourages these debates. We test if this would allow for an intersection between the academic research and technical aspects within the discussion.

The main contributions of this paper are:

- to present an approach to incorporate a simulated pro-

gramme committee within computer science education, and
- an initial evaluation of a small learning activity that aims to improve peer learning, student engagement and professional skills.

We have structured this paper as follows: Section II investigates the current literature regarding learning through debate and discussion. Section III presents the methodology used within and the setup of the learning activity done within the paper. Section IV evaluates the activity and presents the data and feedback we have obtained from the students after the exercise, we also interviewed the students (Section V), which we discuss in Section VI. Finally, Section VII concludes the paper and presents areas of future work within this area.

II. Background

Open discussion types of teaching have been very prevalent within social sciences subjects such as politics, law and sociology. In law, students can debate legal cases, in politics, diplomatic situations and in sociology aspects, such as why people commit a crime. Within computer science, there are many situations to do this as well. For example, students can debate which security mechanism to deploy when on a limited budget or which design pattern to use.

Current discussion-based learning and teaching research stems mainly from these social sciences subjects. However, teaching is often viewed as a creative art (Sawyer, 2004). These approaches from social science can also apply to science subjects, and group learning is already used within it. Working in groups to stimulate discussions and tackle case studies has already been proven to be effective for students (Flynn and Klein, 2001; Springer et al., 1999) and teachers (Gillies, 2006; Anderson and Schiano, 2014). Furthermore, learning from experience and real-world situations is beneficial and stimulates learning (Boud et al., 1993; Andresen et al., 2020). Having students learn from each other's experiences brings the theory into real life and encourages collaboration. It has also been proven that working in smaller groups instead of large lecture theatres improves students' academic performance (Ferreri and O'Connor, 2013).

Adopting discussions in problem-based learning environments has also enhanced students' understanding, retention and application of knowledge after a study involving medical students (Visschers-Pleijers et al., 2006; Moust et al., 2021). Further, previous studies show that structured activities involving discussions and debate result in a higher level of knowledge construction and critical thinking amongst students (Aviv et al., 2003; Kanuka et al., 2007; Carpenter, 2006). The importance of facilitation has been proven by Meyer (Meyer, 2003), who also notes the face-to-face aspect has some important values, such as immediacy and energy. However, leading discussions productively can be difficult (Grossman, 2021). This also raises the widespread concern about not having enough time to cover the required content when engaging in discussion with students (Brookfield and Preskill, 1999). But engaging students and encouraging them to think critically is what university education is about. Even smaller exercises that encourage discussion can have a significant impact. (Brookfield and Preskill, 1999) list and comment on many more concerns teachers might have regarding discussion as a way of teaching that must be taken into account. However, they are steadfast in believing it is a worthwhile activity. Many of the concerns related to time constraints are also a question for university leadership to structure teaching activities to be effective and schedule the time needed to achieve this. Research has shown that students rate group discussion activities higher and achieve better results because of them (Costa et al., 2007); therefore, they should be further explored.

III. Methodology

During this study, the cohort consisted of 36 students, all with a background in Computer Science (minimum 2:1 or equivalent). This module runs over two weeks in block mode, which means all the module's teaching was done in two weeks full-time. We presented the students with six papers, each including both practical and theoretical concepts, and split them into six groups of 6 students each. Each group had to pick one paper they had to read, discuss amongst themselves, and prepare a 10-minute presentation about its content and quality. We asked them to pay attention to the rigorousness and the evaluation of the paper. All students also had to pick another paper to read and briefly summarise. The papers identified for this exercise were carefully researched and picked for their technical aspect and the subject that had to align with our research expertise and the module's content. This is done to encourage students to understand a technical concept and provide an introduction to academic research.

Each group had one week to prepare for the program committee meeting, where they had to present their paper. The program committee ran over 2.5 hours. At the beginning of the session, each group presented their paper (± 10 minutes). After each presentation, there was a brief discussion in the room (5 minutes) to allow other students to ask questions about the paper. When all groups presented their work, there was a short break before going into the debate and discussion section of the activity. At the start of this part of the exercise, we notified the students there were three open slots for them to fill with a paper. They could reject all papers and accept none, only accept one or two papers, but they could only accept up to three papers. We had each group give a moment to argue for or against their own paper and encouraged this to be discussed amongst the committee. Afterwards, we scheduled a slot for the students to debate which papers they accepted.

A graphical overview of the preparation and program committee meeting can be found in Figure 1.

IV. Evaluation

We utilised a first-come, first-get approach and clarified this during the first lecture. After introducing the activity to the students, we discussed it on the day of the program committee, aside from a reminder to submit their presentations by the evening before the meeting. Students could submit either a

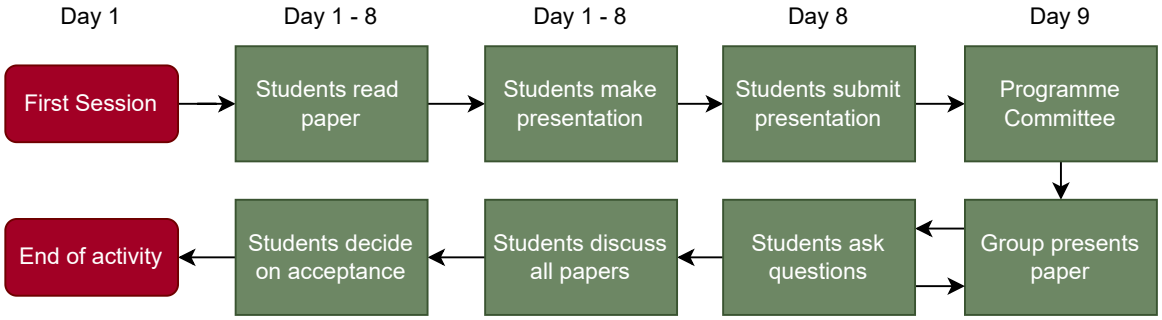

Fig. 1. Program Committee Activity Flow

slide-show presentation and present it in person or submit a video which we then showed during the session. Two groups submitted a video, and four groups submitted a slide show.

During the session, we reconfigured the room from a standard lecture setup into a setup with six tables where each group shared a table amongst themselves. This setup worked well for us as each group could discuss amongst themselves if needed, creating a more informal atmosphere, unlike the traditional row setup. During the presentations, most groups focused a bit too much on the presentation of the paper topic rather than the content and how it was presented, which should be taken into account in the future. All presentations were in-depth and showed that the students had thought about the technical aspect of the paper. Most of the students could respond well to more in-depth questions their peers, and we asked during the session, indicating they obtained technical knowledge on their paper topic. This is further corroborated by the responses on the post-activity survey, where on average, students indicated their knowledge on the paper topic increased by 47%. The minimum knowledge students reported having on their paper topic also increased from 1 to 4 on a scale of 0 to 10. Students further indicated an increase in knowledge on the other paper topics by 46%, indicating they have also learned from their peers. Both these numbers are also supported by verbal feedback obtained from the students.

In addition to the paper topics, we have also asked the students to indicate how much they learned about the module's general subject (penetration testing) and academic writing. Both saw a slight increase as well. Students indicated their general subject knowledge increased with an average of 27%. Their knowledge of academic writing increased, on average, by 33%. Compared to their previous module, the average grade on the research essay increased from 60 to 68%, showing a positive trend in their grades. This indicates that the activity has benefits across the board for students. We also have to consider the group aspect and how students indicated they enjoyed working in groups and that their relationships with fellow students increased. The students also indicated they enjoyed this exercise and would enjoy more open discussions/debates when talked to after the session. This also became clear at the end of the session, where students and staff spent around 10 minutes discussing general penetration testing and cyber

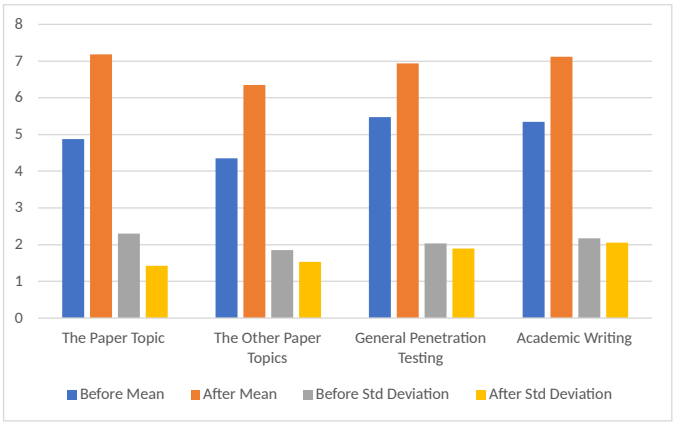

Fig. 2. Survey results after activity asking students to estimate their level of knowledge across four domains

security concepts. We saw good engagement from the cohort during the session and the post-session discussion. When asking students for open feedback, they replied that the activity was engaging and felt it helped them understand to analyse a paper. They further indicated they like to see realistic and practical papers that are varied from each other. This is in line with how we selected our papers, and we are delighted to get confirmation this is also what the students want.

An overview of the survey results can be found in Figure 2.

V. Student Interviews

To provide a stronger evaluation from the student's perspective and allow them to share their thoughts, we conducted four short interviews with students who participated in the activity. These four students were selected randomly from all students willing to participate in these interviews and were part of four different groups. The students were given all necessary ethics forms and participant information sheets before the interviews were conducted and approved by our Ethics Committee. Interviews were semi-structured as students were asked three questions, but probing was done to obtain additional details.

A. Student 1

What was your favourite part of the Program Committee activity?: The discussion part. I liked another paper and enjoyed asking questions to the group who had to present it. It was really nice to have a proper discussion session as this is not often done within computer science.

What did you learn most during the activity?: Because we had 6 people in a group, which I felt was a bit too much for the activity we needed to delegate the different parts of the activity. So I feel I learned a lot about organisation skills.

If you could change anything about the activity, what would it be?: I would like to have a bigger activity where we could have expanded more on the assignment. Having access to a large flip chart to share the main points of the papers and collaborate more with the group members during the discussion session.

B. Student 2

What was your favourite part of the Program Committee activity?: The presentation. I liked that everyone had different papers and presented different opinions. During the question part, the questions made it easier to understand the paper, and I understood the paper better because we needed to make a presentation about it.

What did you learn most during the activity?: Because I was working with different people, I learned a lot about working with people I did not know beforehand. Especially because it we got allocated a short time to prepare the presentation. I needed to be patient a lot. This activity helped me develop my professional skills, which are not often touched upon during a computer science education.

If you could change anything about the activity, what would it be?: A better-suited room could have improved the discussion. The current room did not feel completely supportive of the activity.

C. Student 3

What was your favourite part of the Program Committee activity?: I enjoyed being able to critique the paper we read as I felt it was badly written. Knowing that most of my coursemates agreed that scientific papers can be hard to read made me feel less stressed. All the papers were on different interesting topics, allowing me to learn more about them. I really liked the real-world focus of the papers.

What did you learn most?: Knowing the standard of academic writing and how complicated they can be. I also learned how to tackle a problem as a group and divide the sections and objectives of the assignment between each other.

If you could change anything about the activity, what would it be?: The room was not optimal for the discussion section. A larger room that stimulated the discussions better would be beneficial.

D. Student 4

What was your favourite part of the Program Committee activity?: I enjoyed reading the paper and understanding how the different sections of the paper linked together. By doing this, I learned something on a topic that was not necessarily covered in depth during the module and more about what an academic paper is.

What did you learn most?: I learned a lot about how to work in a group with people I did not previously work with. This is a good skill to have when starting a job.

If you could change anything about the activity, what would it be?: I do not really enjoy presenting for a group of people, so I would remove this. However, because we worked in a group, we could distribute the tasks so I did not have to present and could focus on my strengths.

VI. Discussion

With this study, we set out to investigate/reflect on an educational activity that aims to stimulate peer learning and discussions amongst a cohort of students. This encourages students to think beyond what we teach and lean upon their previous knowledge to critically evaluate what they believe is the right approach. Additionally, we want to get students accustomed to discussing in a professional setting and become aware of academic writing, as this is an important part of the programme.

Looking back at the session we organised, we can say we are extremely happy with the results. Both the written and verbal feedback we received from the cohort were positive and indicated the students feel they achieved the goals we have set out. They indicated they learned more about both the topic of their paper and the papers covered by the other groups, and they have improved their knowledge of the general subject of the module because they have engaged with the activity and the technical depth of the papers selected. Finally, the students also, based on the survey, feel they have obtained more skills regarding academic writing and analysing papers, which is something we put emphasis on throughout the programme. The engagement we saw throughout the 2.5-hour session was positive and encouraged us to organise more of these activities throughout the programme. On top of this, we saw good engagement when students started discussing the general topics of the papers and cyber security after the official session ended. We believe this level of engagement and participation is highly encouraging.

However, as with all activities, there are several improvements we have identified. Because students are not used to reviewing papers, it might be worthwhile to emphasise what is expected from the presentation to avoid too much focus on the topic that students are familiar with. We can also ask students to prepare some questions in advance on one or two other papers to encourage them to engage more and interact with the papers their group is not presenting. Looking more at actual program committees, we could ask students in each group to rank their papers and schedule another session where each group can discuss their paper more in-depth, and we can better guide students to the goals we have set out.

VII. Conclusion

Overall, we can report very positive outcomes from this initial activity and believe there is a lot of value in incorporating these activities throughout higher education. Our students clearly enjoyed participating in this activity and have indicated they welcomed the change from how teaching in computer science generally happens. In addition, we saw the average marks for their research essay increase as well compared to their previous module. We would also encourage colleagues to engage with colleagues in other faculties and subjects to share best practices with each other.

Further work in this area should focus on incorporating other discussion-based learning methods within computer science. Ideas can be drawn from strategies used within MBA programmes, such as discussing real-world situations that happened and how students would have reacted to those if they were in charge. This could be by putting students in leadership roles like CIO/CISO or IT manager. Even within non-leadership positions such as network engineers or software developers situations can arise where decisions have to be made. Discussing these within an educational environment could better prepare students for these situations when they go into a professional role. Aside from this, it could also prepare students for a more research role by teaching them to argue by leaning upon precedents and past research.

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References

D. Boud, R. Cohen *et al.*, *Peer learning in higher education: Learning from and with each other*. Routledge, 2014.

C. M. Ferreira and S. Serpa, "Challenges in the teaching of sociology in higher education. contributions to a discussion," *Societies*, vol. 7, no. 4, p. 30, 2017.

R. M. Pilkington and S. A. Walker, "Facilitating debate in networked learning: Reflecting on online synchronous discussion in higher education," *Instructional science*, vol. 31, no. 1, pp. 41–63, 2003.

C. Bovill, K. Morss, and C. Bulley, "Should students participate in curriculum design? discussion arising from a first year curriculum design project and a literature review," *Pedagogical Research in Maximising Education*, 2009.

M. Yorke, *Employability in higher education: what it is-what it is not*. Higher Education Academy York, 2006, vol. 1.

J. Andrews and H. Higson, "Graduate employability,'soft skills' versus 'hard'business knowledge: A european study," *Higher education in Europe*, vol. 33, no. 4, pp. 411–422, 2008.

P. Teo, "Teaching for the 21st century: A case for dialogic pedagogy," *Learning, Culture and Social Interaction*, vol. 21, pp. 170–178, 2019.

R. K. Sawyer, "Creative teaching: Collaborative discussion as disciplined improvisation," *Educational researcher*, vol. 33, no. 2, pp. 12–20, 2004.

A. E. Flynn and J. D. Klein, "The influence of discussion groups in a case-based learning environment," *Educational Technology Research and Development*, vol. 49, no. 3, pp. 71–86, 2001.

L. Springer, M. E. Stanne, and S. S. Donovan, "Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis," *Review of educational research*, vol. 69, no. 1, pp. 21–51, 1999.

R. M. Gillies, "Teachers' and students' verbal behaviours during cooperative and small-group learning," *British Journal of Educational Psychology*, vol. 76, no. 2, pp. 271–287, 2006.

E. Anderson and W. T. Schiano, *Teaching with cases: A practical guide*. Harvard Business Press, 2014.

D. Boud, R. Cohen, and D. Walker, *Using experience for learning*. McGraw-Hill Education (UK), 1993.

L. Andresen, D. Boud, and R. Cohen, "Experience-based learning," in *Understanding adult education and training*. Routledge, 2020, pp. 225–239.

S. P. Ferreri and S. K. O'Connor, "Redesign of a large lecture course into a small-group learning course," *American journal of pharmaceutical education*, vol. 77, no. 1, 2013.

A. J. Visschers-Pleijers, D. H. Dolmans, W. S. De Grave, I. H. Wolfhagen, J. A. Jacobs, and C. P. Van Der Vleuten, "Student perceptions about the characteristics of an effective discussion during the reporting phase in problem-based learning," *Medical Education*, vol. 40, no. 9, pp. 924–931, 2006.

J. Moust, P. Bouhuijs, and H. Schmidt, *Introduction to problem-based learning: A guide for students*. Routledge, 2021.

R. Aviv, Z. Erlich, G. Ravid, and A. Geva, "Network analysis of knowledge construction in asynchronous learning networks," *Journal of Asynchronous Learning Networks*, vol. 7, no. 3, pp. 1–23, 2003.

H. Kanuka, L. Rourke, and E. Laflamme, "The influence of instructional methods on the quality of online discussion," *British Journal of Educational Technology*, vol. 38, no. 2, pp. 260–271, 2007.

J. M. Carpenter, "Effective teaching methods for large classes," *Journal of Family & Consumer Sciences Education*, vol. 24, no. 2, 2006.

K. A. Meyer, "Face-to-face versus threaded discussions: The role of time and higher-order thinking," *Journal of Asynchronous Learning Networks*, vol. 7, no. 3, pp. 55–65, 2003.

P. Grossman, *Teaching core practices in teacher education*. Harvard Education Press, 2021.

S. Brookfield and S. Preskill, *Discussion as a way of teaching: Tools and techniques for university teachers*. McGraw-Hill Education (UK), 1999.

M. L. Costa, L. Van Rensburg, and N. Rushton, "Does teaching style matter? a randomised trial of group discussion versus lectures in orthopaedic undergraduate teaching," *Medical education*, vol. 41, no. 2, pp. 214–217, 2007.