

# ENHANCING THE COMMUNICATION AND SPEAKING SKILLS OF MATHEMATICS UNDERGRADUATES

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ABSTRACT. In June 2011, the University of Lancaster delivered a substantially-enhanced course in Communication and Presentation Skills to 108 second-year undergraduate mathematicians. The course was delivered jointly by staff in the Department of Mathematics and Statistics and CETAD, the Centre for Training and Development at Lancaster. Funding for the course and its increased staffing requirement came from an MSOR HE Curriculum Innovation Fund grant of £5,000.

CETAD is a specialist unit which focuses on providing training programmes in the North West of England. This project was the first time that CETAD had worked with mathematics undergraduates.

Students were divided into 24 small groups. During the course, students prepared and delivered two group presentations, the first for formative assessment and the second for summative assessment. The final session focused on a codebreaking exercise. Feedback to students on their formative and summative assessments was given by a group of peers and by tutors. Participants were encouraged to reflect on their performances and their feedback, identifying development points for them to work on. The response from students was very encouraging.

## BACKGROUND

The importance of developing the communication and presentation skills of mathematics undergraduates has long been recognised by both universities and graduate employers. The 2002 Roberts Review, commissioned by HM Treasury [6], observed that graduate employers value candidates personal qualities and interpersonal skills; furthermore, “employers often regard SET graduates as being poor at applying and developing the knowledge and the skills that they have acquired.” In the same year, Challis, Gretton, Houston and Neill stressed that “professional mathematicians require good transferable skills, such as reading, writing, speaking and working with others, as well as subject-specific knowledge.” They made a case study of the Common Skills Workshop offered to Mathematical Studies students at the University of Ulster, which focused specifically on developing oral and written communication skills through teamwork and the submission of a group project [2]. Since 2002, considerable efforts have been made to enhance mathematics graduates’ skills by MSOR, the Mathematics, Statistics and OR Network, part of the UK Higher Education Academy. The relatively high cost of delivering skills development courses has, however, tended to limit their reach.

The Department of Mathematics and Statistics at the University of Lancaster offers a credit-bearing module in skills development, *MATH390 Project Skills*, which is compulsory for undergraduate students on its major degree schemes. The majority of teaching for *MATH390 Project Skills* takes place at the end of the students’ second year of study; the students then research, write and make a presentation on a group project during the first term of their third year of study.

The results of the 2010 National Student Survey [3] were very positive for Lancaster’s Mathematics and Statistics students, with the exception of the responses for communication and presentation skills. Only 55% of Mathematics and Statistics students agreed with Question 20, “My communication skills have improved,” which was the lowest ranked question. The overall Question 20 result within the University was 80%. For Question 19, “The course has helped me to present myself with confidence,” the result for the Mathematics and Statistics students was just 68%, which was significantly lower than the overall Lancaster result of 78%.

## THE PROJECT

With the support of an HE Curriculum Innovation Fund grant from MSOR of £5,000 it was resolved to devise and deliver an enhanced course in communication and voice skills as an embedded element of *MATH390 Project Skills*. The course sought to develop five key skills in particular:

- (1) The communication of ideas through speech;

- (2) The vocal skills needed to speak effectively;
- (3) The verbal description of quantitative data;
- (4) The oral interpretation of diagrams and graphs; and
- (5) Engagement with the audience.

The course was devised, written and delivered jointly by staff in the Department of Mathematics and Statistics and CETAD, the Centre for Training and Development at Lancaster. CETAD has experience of delivering courses on effective communication skills and presentation skills to a wide range of professional clients in the North West of England and is an Institute of Leadership and Management (ILM) Approved Centre for corporate training. This was the first time that CETAD had worked with mathematics undergraduates.

#### THE COURSE

The course, titled Communication and Presentation Skills, sought to teach students how to present numerate information, at an appropriate level, to various kinds of audiences. The sessions involved active participation by the students, with teamwork an essential element. Students were divided into four classes, with 27 in each class. Within each class, students formed themselves into six groups. Each class was taught by two tutors – one from the Department of Mathematics and Statistics and one from CETAD. Each student participated in a sequence of learning sessions, taking place over three successive Fridays in June 2011, covering:

- What makes a good communicator?
- Formative assessment: given a previously-unseen article from a magazine, your group has two and a half hours to prepare and deliver a 5-minute presentation on the article. You may not use visual aids.
- What makes a good oral presentation?
- Summative assessment: your group has one week to prepare and deliver a 10-minute presentation on a mathematical result of your choice. You may use visual aids.
- What is teamwork?
- The learning cycle.
- Team exercise: coding and codebreaking.

This sequence of topics was designed by CETAD staff to provide a synthesis of the elements of Kolb's Experiential Learning Cycle [4] to support higher level learning. This process included maximising opportunities for peer and tutor small group discussions, both inside and outside of the classroom setting, recreating a basic version of T-groups [5].

Students had nine hours' contact time with tutors over the duration of the course – three hours every Friday. The summative presentation marks contributed 10% of the students' overall marks for the *MATH390 Project Skills* module. Feedback to groups on both their formative and summative assessments was given by a group of their peers (immediately following the presentations) and by their tutors (within a week of their presentations). Participants were encouraged to reflect on their performances and their feedback, identifying development points for them to work on. Participants were able to use their recently-acquired skills in mathematical typesetting using  $\text{\LaTeX}$ , which they had been learning that month as another component of the *MATH390 Project Skills* module, to produce high quality slides for their summative presentations.

The team exercise on coding and codebreaking, devised by Department of Mathematics and Statistics staff, was created to highlight the benefits of collaborative work on mathematical problems. As the final part of the course it was designed to be an enjoyable – but mathematically rigorous – series of problems. In the task, each group used modular arithmetic and linear algebra to encode a short piece of poetry or prose. Each group had a different encoding key, represented by a three-by-three matrix with entries in the field of integers modulo 3. Encoded texts were passed to the group on the left, who were required to calculate the decoding key, represented by the inverse of the encoding key, and use this to decode the message.

Between June and November 2011 the students worked on their group projects. Each group made a 15-minute presentation on their project in November 2011, making use of the skills they had developed in the Communication and Presentation Skills course. The marks from the November presentations contributed a further 10% of the overall marks for *MATH390 Project Skills*.

## ASSESSMENT METHODOLOGY

CETAD staff devised detailed marking grids to assess both the formative and summative presentations. The marking process was designed to provide both group and individual rewards, and encourage group and individual responsibility, within the learning experience. This partly drove the need for group and individual practice, peer support, peer tutoring and peer feedback.

The table *Most people learn . . .*, attributed to William Glasser by Biggs, suggested that learning is more effective when you can apply it, and even more so when you apply what you have learnt in order to teach others [1].

## STUDENT FEEDBACK

Feedback from the participants on Communication and Presentation Skills was very encouraging. Of the 59 who completed a feedback form: 58 (98%) felt their presentation skills had improved; 43 (73%) rated the quality of the teaching “excellent”, with a further 13 (22%) rating it “good”; and 34 (58%) rated the course overall as “excellent”, with a further 21 (36%) rating it “good”. Here is a sample of responses to the two free response questions:

- *What were the most valuable aspects of the workshops?*
  - “Being forced to be confident”;
  - “Showing how to work as a group”;
  - “Preparing a presentation in a small amount of time”;
  - “Receiving prompt feedback from assessments”;
  - “Getting us to review what we had done”; and
  - “Having fun, light-hearted work”.
- *How could the workshops be improved?*
  - “More information on what it is actually about beforehand”;
  - “Be a bit more spread out over the year”; and
  - “More constructive feedback on presenting”.

One of the student representatives for the year group offered the following comments in February 2012:

“I found the presentation skills section of the module really helpful, but would have loved to have more than two weeks of my degree improving this skill, as I felt nerves and lack of support affected my final [group] project presentation. Maybe starting off in smaller groups, then moving to the larger groups for presentations, would have helped build confidence.”

## CONCLUSIONS

Throughout the development of this project, emphasis was placed on:

- The incremental development of communication skills;
- The importance of direct personal experience;
- Regular peer and tutor feedback; and
- Opportunities for reflection

as a basis for learning. The Communication and Presentation Skills course was felt to have been very successful and was repeated – using the same staff – in June 2012. The Department of Mathematics and Statistics is now considering how the other component courses of *MATH390 Project Skills* could be enhanced.

## ACKNOWLEDGEMENTS

The enhanced materials for the Communication and Presentation Skills course were devised, written and delivered by Eileen Cunningham, Lesley Harper, Shamim Khan and Hendryk Korzeniowski from CETAD and Gordon Blower and James Groves from the Department of Mathematics and Statistics, both at the University of Lancaster.

I would like to thank Lesley Harper for her help in preparing this final report, and providing some of the methodological references, and Jenna Sanderson, Third Year Student Representative, for allowing me to quote her personal feedback on the course.

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