

Interactive Lectures

A Game Show Format for First Year Problem Classes in Mathematical Modelling

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Abstract

Problem classes are traditionally used in the teaching of mathematics. For a first year Chemical Engineering course in mathematical modelling, a quiz based on the TV programme “Who Wants to Be a Millionaire?” has been introduced, in a problem class supporting lectures. Following group work, with one set problem per group, students present their solutions to the rest of the class. The quiz follows the presentations. Each group is represented by a volunteer, who attempts to win chocolate prizes. The questions are both general, and specific to the particular problem done by the group. Besides reinforcing earlier learning, the quiz is fun. Certainly it appears to have been appreciated by two successive student cohorts. The lecturer and postgraduate demonstrator have also enjoyed the problem classes more than traditional formats.

Level of Material: First Year

The Execution

This modelling sub-module consists of 13 lectures, and 2 x 2h problem classes. A highly structured approach to modelling is taught in the lectures, with a strong emphasis on the key issue: how does one begin? Students usually struggle to turn a problem expressed in words into mathematical equations, and the method given to them is almost formulaic. Many examples of modelling are presented. These are taken from chemical and biochemical engineering practice and there are some of broader interest e.g. mathematical ecology. The engineering context is never allowed to overwhelm the modelling, and is often simplified and always explained. Detailed notes are provided in the lectures, and from next year it is intended to post these on the intranet. A-level mathematics is assumed, as is attendance at a prerequisite Engineering mathematics course in which calculus is revised. Mathematical modelling leads naturally to the derivation of differential equations. The methods of solving first order and some second order ordinary differential equations (ODEs) are taught.

The problem classes are intended to provide practice at modelling and in solving the resulting equations. The problem classes occur on (separate) afternoons in the second term. Both involve 25 to 30 students, and each is repeated, as the whole cohort is 55 to 60 students. The first problem class emphasises the development of models, beginning with the students criticising an attempt at “modelling” from a Tom and Jerry cartoon (a short video clip from which is used as light relief in an earlier lecture). The second problem class begins with more difficult model building involving second order ODEs and the quiz finishes this problem class.

In order to break up cliques and promote better interpersonal skills (i.e. team work), the students are allocated at random to one of 4 groups as they arrive. There are 7 to 8 students per group. The first 50 min of the second problem class is group work on one of 4 set problems, resulting in the preparation of a few overhead transparencies explaining the group’s problem and its solution. The author and a postgraduate demonstrator circulate around the groups giving advice. Strong students are asked to help weaker students, so that all group members understand the group solution (and more interpersonal skills are practised). After a short break, one student volunteer from each group presents to the whole class (4 x 5 min). Originally it was conceived that any student might be asked to present, but compulsion was replaced by the offer of a reward; the volunteer receives a large chocolate bar as a reward. It is certainly the case that presenting complex mathematical derivations on a few overheads and in a few minutes makes a student have some sympathy with the lecturer!

After the presentations, the “Who Wants to be a Modell...er?” quiz begins. A second volunteer from each group faces 6 questions related to his or her group’s problem. Four answers are given with every question. These are shown on an overhead projector to the student (who comes to the front of the room) and the rest of the class. Typically one answer will be correct, one will be obviously wrong, and the other two contain typical student errors. The student must choose one. As in the TV show the student has “lifelines”. “Phone a friend” becomes ask a specific group member, “Ask the audience” means ask the class, and “50:50” works by the author removing two answers (not necessarily at random; a struggling student might be left with the correct answer and an obviously wrong one, whilst a stronger student might be left to choose between the correct answer and a common trap). The rewards for correct responses are chocolate bars, of the small party pack variety, for later distribution to the group. Unlike the TV show, one cannot lose everything: 1 correct answer overall is rewarded with 1 bar; 2 answers correct, 2 bars; 3 correct, 4 bars; up to 6 correct answers, 32 bars! The first question is always a joke (e.g. “Which of the following is a great model? Prof. Thomas, Kate Moss, a Skoda, La-La”; cheesy but gets things going in a non-threatening way!).

The questions are such that it is hard not to get at least 5 correct. When appropriate, discussion of the incorrect choices and the traps follows a question, using a whiteboard for notes when necessary. The 4 quizzes take about 40 min, completing a 2 hour class.

Pre-requisite Knowledge

The participants are first year Chemical Engineering students, all with Mathematics A-level or equivalent, generally at grade C or higher. Some students have grade A and/or A-level Further Mathematics. All have taken the first term of an Engineering mathematics course, which both revises and extends A-level knowledge. The modelling course runs simultaneously with the second term of this mathematics course.

How Are Students With Different Mathematical Backgrounds Supported?

The students are supported within their groups, with limited further support from the author and a demonstrator.

What Support Was Needed?

Both author and demonstrator have attended courses on small group teaching.

The Barriers

Volunteers are usually difficult to find, but chocolate seems to be sufficiently attractive. The volunteers are usually the better/more confident students, but the quiz is sufficiently stimulating to keep everyone's attention. If the groups were smaller, and there was a facilitator added to each group, no student could "hide". However, this would require much more demonstrating effort. If every group presented a solution, the problem class would become too long. The chocolate costs about £10 –15.



The Enablers

The problem classes mix several elements; this and of course the quiz itself keep student interest high. Chocolate is an acceptable reward and is key to the exercise! All the proceedings are very informal and essentially non-threatening, which helps improve participation.

Evidence of Success

Attendance at the problem classes is nearly 100%, and rarely does anyone leave before the end. Students have sometimes asked if they can attend the repeat of a problem class they have attended! The interactions between students, and between them and staff, are at a high level throughout. Student feedback is positive (leaving aside the obvious "What was best about the course?", "The chocolate."). The quality of answers to the assessed coursework (which follows the problem classes) has improved significantly. The author and demonstrator have both enjoyed the problem classes, more than for previous traditional approaches.

How Can Other Academics Reproduce This?

The methods are simple and should be easily reproduced by anyone who has seen the TV show. The game show (quiz) format could be applied in other mathematical problem classes, or problem classes in many subject areas.

Quality Assurance

Peer observation and monitoring of student feedback. Further issues can be raised at Staff/Student Committee.

Other Recommendations

The author intends to spend yet more time watching TV in the hope of finding other game formats that might be used in learning and teaching.