Innovative Student Assessment in Engineering Mathematics

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Outline

Course background & history

Present course innovation & issues

Results, observations, proposals & conclusions

Course background: Mathematical methods

Who?

4th year chemical engineers (15 students per annum)
Mature & competent students (1st/2:1/2:2 Hons)

Why?

Develop physical intuition about maths problems arising in engineering systems

Apply maths methods to *unseen* problems

What?

3 classes of problem

H(yperbolic): waves, E(lliptic): steady fields, P(arabolic): diffusion

Course history: Prehistory

I lectured methods for H, E, P problems in class (chalk & talk)

I set exam (methods applied to unseen problems)

Students sat exam

Result

Students excellent at doing the problems I covered in class

Students poor at applying techniques to other problems

Learning the problems, not the underlying techniques

Course history: Recent past

3 student groups: H, E, P (5 students per group)

Groups specialized in methods for H, E or P problems

(with guidance from me)

Groups taught other students their specialism

Students assessed on how well their group taught

I set exam (methods applied to unseen problems)

Students sat exam

Result

Students expert in one problem class

Students reasonable at applying techniques to other problems

'We learn it, we teach it, why can't we set exam?'

Present course: Student assessment innovation

Group H sets question for E, P

Group E sets question for H, P

Group P sets question for H, E

3 issues:

Logistics

Quality

Robustness

Issue: Logistics

Groups must accelerate learning
to teach material *and* deliver exam question on time

Groups require guidance over compressed time frame

Resolution

Provide groups with trained postgraduate demonstrators
(CEEBL funding paid demonstrators)

Unexpected result: Deinhibition

Demonstrators claim students participate more
when I'm not present

Issue: Quality

Writing suitable exam questions is not easy!

(*Appropriateness*, *Accuracy*, *Clarity*)

Resolution

Exam question preparation 'training manual'

Start easy, get harder

Avoid dead ends

Remember Murphy's law

etc., etc.

External examiner saw all the questions

'Good paper'

Unexpected result: Exam technique

Student model answers don't always answer their own questions

Quality: Question preparation procedures

Ideas, suggestions

↓

1st draft

↓

Feedback (Appropriateness, Accuracy, Clarity)

↓

2nd draft

↓

Further editing by me (more drafts desirable, but time constraints)

↓

External examiner

Issue: Robustness

How to prevent cheating?

How to avoid ridiculously easy/difficult questions?

An issue of *trust*

Resolution:

Students assessed not only on how well they perform in exam

(up to 50 marks),

but also on how others perform in the question they set

i.e. on the *suitability* of their question

(up to 40 marks, plus 10 marks for delivery)

Results: Module marks

Marks entirely appropriate for a 4th year module

Innovative assessment scheme apparently a success

Overall module average:	65/100
Average exam performance:	27/50

(Students told to target exam for 30/50 average)
Lesser penalty for being below, than above, target

Group mark for question delivery and suitability:	38/50

Observations

One group devised a very creative and innovative question
(applied their specialist math method to a novel physical system;
selected and researched on their own initiative)

Considerable learning occurred merely in devising the question,
but currently no specific mechanism to reward this

Other students thought the unseen element was 'unfair'

Proposal

10 marks for question creativity/novelty/initiative
(not merely for question delivery)

Message to students: Expect the unexpected!

Rushing students to complete questions for external examiner
not necessarily wise: may compromise creativity

Unforseen consequences (post course delivery): Job interviews

Give an example of a time when you have been . . .

. . . placed in a position of trust?

. . . placed in a position of responsibility to others?

Every student mentioned this course in interview:

Every student now has a job!

Concluding remark

Comment from one student:

I didn't realize it was so tough to be an academic!