

Identifying mathematical “trouble-spots” –  
the challenge of collecting useful qualitative data on  
students' visits to a Maths Support Centre at a  
university in Ireland.

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UCD School of Mathematical  
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Scoil na nEolaiochtai  
Matamaitice UCD

# Outline of talk



1. UCD Maths Support Centre (MSC).
2. The research plan.
3. The problems and the challenges.
4. Finding solutions.
5. Further work.





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# The Maths Support Centre (MSC)



- University College Dublin (UCD) is largest university in Ireland 30,000 students on campus.
- UCD Maths Support Centre opened February 2004.
- Students from Access to PhD attend MSC.
- Programmes: students studying no mathematics module to those taking degree level mathematics.



# Electronic Records



- Electronic records: students log-in on entry to MSC and log-out after each session.
- Tutor enters summary of topic covered into database (topic entries).
- 20,000 database topic entry records maintained since 2009.
- These topic entries can be accessed by the lecturer in real time.



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# The Research Plan (September 2013)



- Approximately 4,500 topic entries annually.
- Valuable data for research?
- Identifying students' mathematical trouble-spots.
- However there was a major problem
  - the quality of topic entries.



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# The Problem



- Working in a Mathematics Support Centre is crazy, never have time to think.
- Believed we were doing a good job.
- But details of topic recording were insufficient for our purposes and
- There was no easy method available to extract a specific trouble-spot from the database.



# Examples from previous year



- “Trigonometry, Vectors.”
- “Changing units, Scientific Notation.”
- “Limits.”



# The Challenge



Record Suitable Qualitative Data?

We needed to find a way to record more meaningful data.



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# Stage 1: Categorisation of data



- Our first problem was to flag trouble-spots and retrieve these individually from the database.
- Picked ten topics I knew caused major problems for students.
- Then coded each problem enclosing them in curly brackets for easy retrieval from database.



# Examples of codes



Here are some examples of the proposed codes:

- Differentiation {d}
- Indices {i}
- Basic algebra {a}



## Stage 2: MSC involvement



MSC manager and tutors.

- Explained our proposed scheme to Dr Anthony Cronin (manager MSC).
- Spoke to tutors giving them examples of type of entry needed and a copy of the codes.
- Emphasized the importance of both
  - (i) identifying basic error and
  - (ii) entering category correctly.



# Examples of required entries given to tutors



One student did not know

$$x/2 = \frac{1}{2}x \quad \{a\}$$

Another student believed

$$x/2 = x^{-2} \quad \{a\}, \{i\}$$

Student asked why  $\sin x$ ,  $\cos x$ ,  $\tan x$   
changed sign as  $x$  goes from 0  
to  $2\pi$  {t}





# Stage 3: Pilot Study commenced 23<sup>rd</sup> October



Next two weeks spent:

- Training tutors:
  - helping them to correctly identify the basic errors and
  - enter the codes correctly.

Following three weeks:

- Checked database entries regularly and contacted tutors for further clarification if thought necessary.



# Some examples from Pilot Study



Data still insufficient for our research purposes.

Sketch a graph: Turning points, x  
and y co-ordinates.

{g}

Negative index: Question needed to  
know what to do with it.

{i}

Induction: Problem with algebra but  
not with induction.

{a}



## Stage 4: Focus Group held January 2014



Focus group with Anthony and MSC tutors.

- Needed to find a way to get more precise information and not overburden the tutors.
- Gave the tutors some examples of the type of topic entry required and asked for their suggestions.



# Examples given to tutors.



Where exactly was the problem here?

Example A: A Student had a problem with limits and continuity and a problem factoring out the "h" and expanding in a question on first principles.  $\{a\}, \{s\}, \{f\}$

This is type of entry we needed

Example B: A problem simplifying an expression (common denominator.)

$$P = 220 - n \left( \frac{200}{n+1} \right) \quad \{a\}, \{fr\}$$



# Consequential Improvements (Semester 2)



$\text{\LaTeX}$ entries: where tutors were familiar with  $\text{\LaTeX}$   
They entered equations/expressions using  
it.

Otherwise they used A4 pads with carbon copying paper.  
One copy for student and other copy for  
MSC.

Realised benefit of hard copy, all tutors use A4 pads  
Tutors still enter topic on database as  
previously.



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# Examples of second semester entries



1. Student was finding the critical points of  $\ln(\cos x)$ . But did not know that if  $\frac{a}{b} = 0$  then  $a$  must be zero and  $b$  not zero.  $\{a\}, \{fr\}, \{cp\}$
2. How to find a condition that ensures that a  $2 \times 2$  matrix has two equal eigen values. Student needed to know that  $b^2 - 4ac = 0$ .  $\{a\}, \{m\}$
3. Solving the indefinite integral  $\int e^{\sin(x)+c} \sin 2x dx$  using basic algebra to simplify  $e^{\sin(x)+c} = e^{\sin x} e^c$ .  $\{a\}, \{int\}$



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# Ongoing Research



**Tutor training:** If new tutors are to produce -the same quality of data we will need to develop a suitable training programme for them.

**Response of lecturers to enhanced data:** We would like to know if the relevant lecturer finds the enhanced data more useful.

**Analysis of data collected:** Our final objective is to analyse the data and develop some mathematical supports for our students.





Thank you.

Any questions?



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