

# To collect and analyse useful qualitative data on mathematical difficulties as experienced by students in a Mathematics Support Centre – A challenge?

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Scoil na nEolaíochtaí  
Matamaitice UCD

# Outline of talk



1. UCD Maths Support Centre
2. Our Research Project - Sept 2013
3. A Pilot Study - Feb 2014
4. Data collection - Sept 2014
5. Preliminary analysis of data - Jan 2015



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# The Maths Support Centre (MSC)



- UCD MSC opened February 2004
- Student level
- Student programmes
- Increasing numbers



# Electronic Records



- Database Recording
- 25,000 entries since 2009
- Accessed by the lecturer



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# Aim of our research



***Identifying university students' mathematical “trouble-spots” and developing effective supports: an analysis of Maths Support Centre Data.***



# Some examples from 25,000 entries



- *“Trigonometry, Vectors”*
- *“Changing units, scientific notation”*
- *“Limits”*





# Initial list of codes



V/Basic algebra	{a}
Factorising	{f}
Indices	{i}
Inequalities	{in}
Logs	{l}
Rules of signs	{s}
Trigonometry	{t}
Resultant of Sim eqns	{se}
Sets	{sets}
Unit vector	{uv}
Converting units	{cu}
Basic Statistics	{stat}
Basic Probability	{p}



# Outline of talk



3. A Pilot Study – Feb 2014

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# Informing Tutors



Meeting MSC tutors

mid January 2014



# Examples 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}



# To improve data



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

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

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



# Consequential Improvements



Extra category entries

$\text{\LaTeX}$ entries for mathematical expressions

Carbon copy A4 notebooks



# Pilot study data 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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# Final preparation



- Meeting with tutors
  - Collection dates
  - Change in coding



# Change to more explicit coding



	Orig Codes	New codes
V/Basic algebra	{a}	{alg}
Basic Statistics	{stat}	{stat}
Basic Probability	{p}	{prob}
Changing units	{cu}	{chunits}
Co-ordinate geometry (St line, Circle etc)	{cog}	{cogeom}
Critical points	{cp}	{crit}
Differentiation (application and rules)	{d}	{diff}
Factorising (also surds)	{f}	{fact}
Fractions (incl. ratio)	{fr}	{frac}
Functions (linear, quad and cubic, Solving $f(x) = 0$ )	{fun}	{fun}
Graphs (sketch'g and read'g data from graphs, tables)	{g}	{g}
Indices	{i}	{ind}
Inequalities	{in}	{ineq}
Integration	{int}	{int}
Logs	{l}	{log}



# Data Collection



- Daily tutor entry checks
- Additions to tutor entries



# Tutor entry in database



*Surveyors are looking at a clifftop. They look up at angle 24 deg and move 1500m closer and are at 29 deg to the top. Find height.*

*Used method of calling the unknown length  $x$  and dividing into two triangles and making two sim equations and solving for  $x$  (if needed) and height.*

*{trig}, {frac}, {fact}, {alg}*



# An example in tutor notebook



1045          6/11          KR

1500 {Model} add

cos  
sin  
tan

①  $\cos(27^\circ) = \frac{h}{x+1500}$   
 $h = \cos(27^\circ)(x+1500)$

①  $\tan(27^\circ) = \frac{h}{x}$   
 $h = \tan(27^\circ)(x)$

hate Can I say  
 Problem 2 - how to start  
 by taking a straight line  
 Problem 1 - I'd like a equation



# Query to tutor



**Were these the mathematical trouble-spots for the student?**

- 1: How to start by taking two right angled triangles
- 2: Finding 2 equations in  $x$  and  $h$  from triangles
- 3: Solving simultaneous equations



# Same page from notebook



$$\textcircled{1} \tan(27^\circ) = \frac{h}{x+1500}$$

$$h = \tan(27^\circ)(x+1500)$$

$$\textcircled{2} \tan(29^\circ) = \frac{h}{x}$$

$$h = x \tan 29^\circ$$

$$x \tan 29^\circ = (x+1500) \tan 27^\circ$$

$$x \tan 29^\circ = x \tan 27^\circ + 1500 \tan 27^\circ$$

$$x (\tan 29^\circ - \tan 27^\circ) = 1500 \tan 27^\circ$$

$$x = \frac{1500 \tan 27^\circ}{(\tan 29^\circ - \tan 27^\circ)}$$

$$h = x \tan 29^\circ$$

Problem 1 - how to start  
 by taking 2 straight Ds  
 Problem 2 - taking 2 equations  
 in x + h from Ds  
 Problem 3: Solving sim eqns  
 Yes.

kati Can I say  
 Problem 1 - how to start  
 by taking 2 straight Ds  
 Problem 2 - taking 2 equations  
 in x + h from Ds  
 Problem 3: Solving sim eqns  
 Yes.

10  
 12.5  
 10  
 17.5  
 20

$h = x \tan 29^\circ$   
 $h = (x+1500) \tan 27^\circ$

$x \tan 29^\circ = (x+1500) \tan 27^\circ$   
 $x \tan 29^\circ = x \tan 27^\circ + 1500 \tan 27^\circ$   
 $x \tan 29^\circ - x \tan 27^\circ = 1500 \tan 27^\circ$   
 $x (\tan 29^\circ - \tan 27^\circ) = 1500 \tan 27^\circ$   
 $x = \frac{1500 \tan 27^\circ}{(\tan 29^\circ - \tan 27^\circ)}$   
 $h = x \tan 29^\circ$



# Extending the data entry



*[NC:*

*Tutor said student did not know how to start by taking two rt. angled triangles.*

*Could not find two equations in  $h$  and had a problem solving the sim. equat'ns.*

*$\tan 27 = h/(x+1500)$  and  $\tan 29 = h/x$  .*



*Tutor wrote  $5x=10$ ;  $x=10/5$ . and  $20x =10$ ;  $x= 10/20$  in explanation while solving the sim. eqns. NC]*



# Outline of talk



1. UCD Maths Support Centre
2. Addressing the research question -  
a major problem
3. Initial data – a pilot study – Feb 2014
4. Data collection – Sept 2014
- 5. Preliminary analysis of data – Jan 2015**



# Preliminary analysis of data



Total number of student visits over eight weeks - 2012

Extracting information under the various codes.

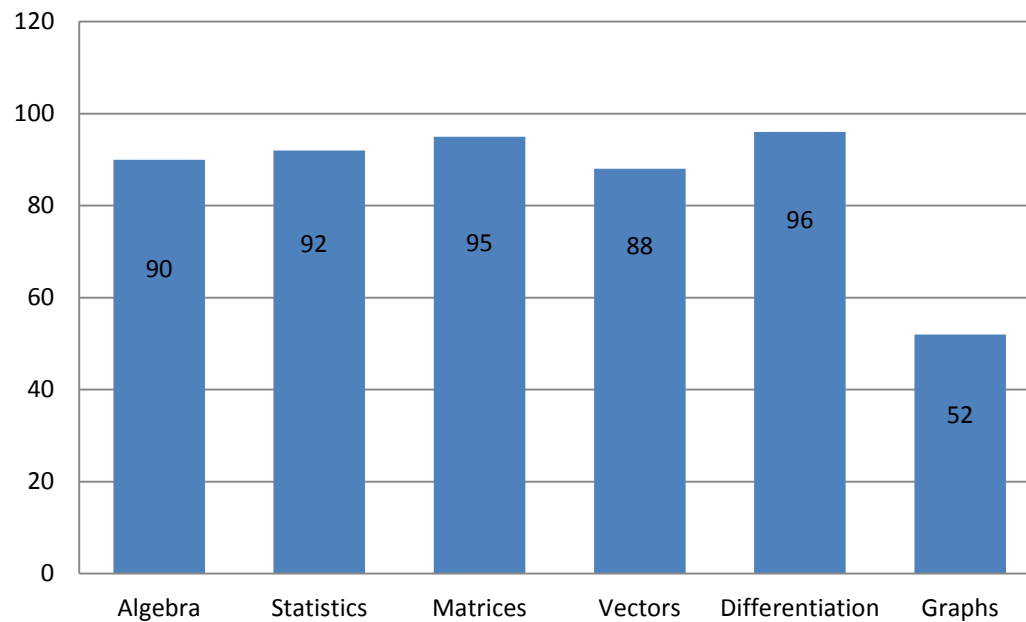
Third validation of the coding.



# Preliminary count of problem areas



**Preliminary count**





Thank you.  
Any questions?



For further information please contact  
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