Diagnostic testing - What? When? Why? & How?

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Background

- Cardiff MPharm graduate
- Pharmacist
- Academic in CU since 2006
- Research in Microneedles and DPIs
- Improve calculations skills of MPharm graduates

Pharm Calcs Teaching pre-2005

Pre-University: GCSE Mathematics/Chemistry A-level (or equivalents)

	TEACHING	ASSESSMENT
Year 1	Basic Calculations (catch-up class) Dedicated pharmaceutical calculations CAL session (x2) -Calculators permitted	Dedicated pharmaceutical calculations assessment -Calculator permitted -MCQs -20 Q's in 90minutes
Year 2	Sterile and non-sterile dosage forms laboratory classes Practice of Pharmacy (POP) practical classes	Timetests -Calculations part of a practical examination -Calculator permitted
Year 3	Formulation Science II laboratory classes	Timetests - Calculations section in a practical examination - Calculator permitted
Year 4	None	None

Pre-registration experience and examination

Pharm Calcs Teaching 2014-15

Pre-University: GCSE Mathematics/Chemistry A-level (or equivalents)

	TEACHING	Sum ASSESSMENT
Year 1	Diagnostic Test Pharmaceutical Calculations 'Lecture' Dedicated pharmaceutical calculations workshops (x2) PBL and formative assessment) No Calculators permitted	Dedicated pharm calcs assessment -Calculator permitted -20 Qs in 90minutes
Year 2	Pharmaceutical calculations teaching session (PBL and formative assessment) -Calculators permitted	Dedicated pharm calcs assessment -Calculators permitted -10Q in 60 minutes
Year 3	Pharmaceutical calculations teaching session (PBL and formative assessment) -Calculators permitted	Dedicated pharm calcs assessment -Calculators permitted -10Q in 60minutes
Year 4	Pharmaceutical calculations/numeracy lecture Dedicated pharmaceutical calculations workshops (x2) (PBL and formative assessment) -No calculators permitted	Dedicated pharm calcs assessment -GPhC style questions -No calculator -MCQs -10 Q's in 45minutes

Maths Support Service

Pre-registration experience and examination

Outline of talk

1. Introduction – What's the problem?
2. Diagnostic Design and Development
3. Results of the Diagnostic
   a. Pharmacy
   b. Medicine - Not today ☺

What stimulated numeracy interest?

- Failure rate
  1/116 in 2008
  17/123 in 2009

- Mean
  18.6 in 2008
  17.0 in 2009

- Range
  13.5-20 in 2008
  4.5-20 in 2009

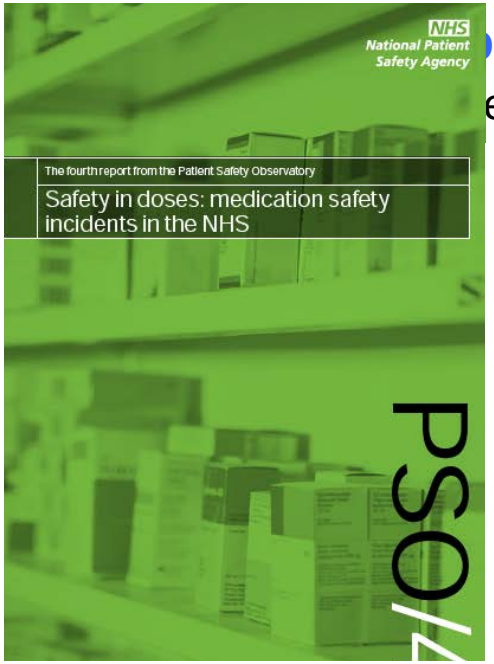
Numeracy is "*a proficiency which involves* ***confidence and competence*** *with numbers and measures*" (DfEE, 1999)

Dept. for Education and Employment (1999). *The National Numeracy Strategy.*

Why do students need to be numerate?

- Universities should develop student competency. Numeracy is a skill that is "*key to the future of graduates whatever they intend to do in later life*" (NCIHE, 1997).

National Committee of Inquiry into Higher Education (NCIHE). 1997. *National Committee of Inquiry into Higher Education. 'The Dearing Report'.*

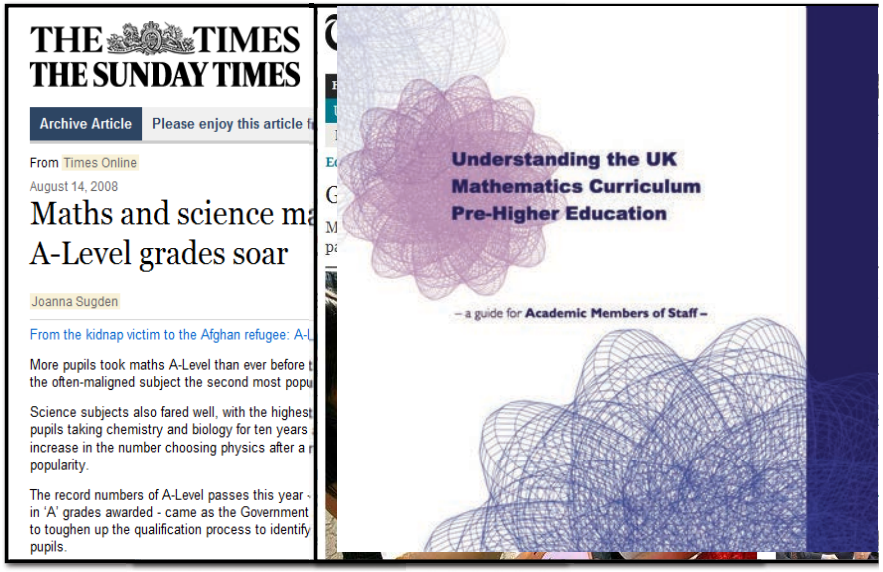


IC students need erate?

Seven key actions to improve medication safety

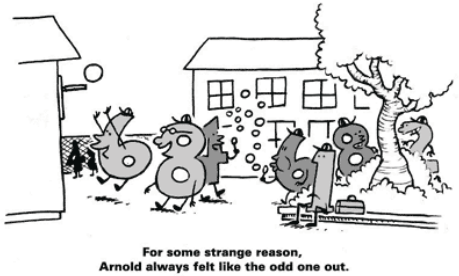
1. **Increase reporting and learning from medication incidents**
   Increase reporting and learning from medication incidents and identify actions against local risks in an annual medication report.
2. **Implement NPSA safer medication practice recommendations**
   Implement and audit the NPSA safer medication practice recommendations, including the alerts on anticoagulants, injectable medicines and wrong route errors published in March 2007.
3. **Improve staff skills and competences**
   Healthcare workers should ensure they have the required work competences and support to use medicines safely. Work competences for anticoagulant therapy, use of injectable medicines and paediatric infusions are set out in the NPSA safe medication practice work programme for 2007-08.
4. **Minimise dosing errors**
   Provide information, training and tools for staff to make calculations of doses easier, and target efforts towards high-risk areas (such as children) and high-risk drugs (such as insulin).

It doesn't add up?



Who are our entry students?

- High academic achievers
- Maths anxiety
- Increasing diversity in educational backgrounds and experiences:-
  - entry criteria
  - mature students
  - international student

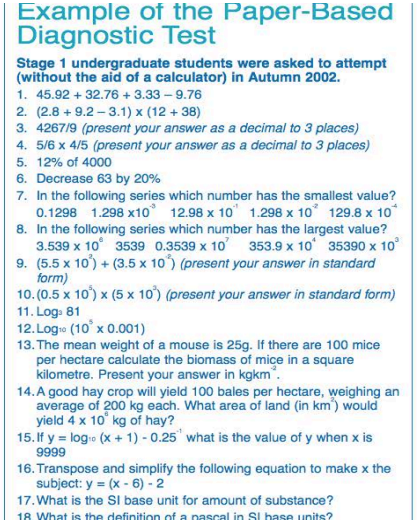


How do we differentiate and target support?

Diagnostic maths/numeracy tests

- Intrinsic/inherent ability
- Diversity of tests in HEIs a
- Focused in maths/engine
- Nursing
- Pharmacy
- Biosciences

Tariq 2003



Aims

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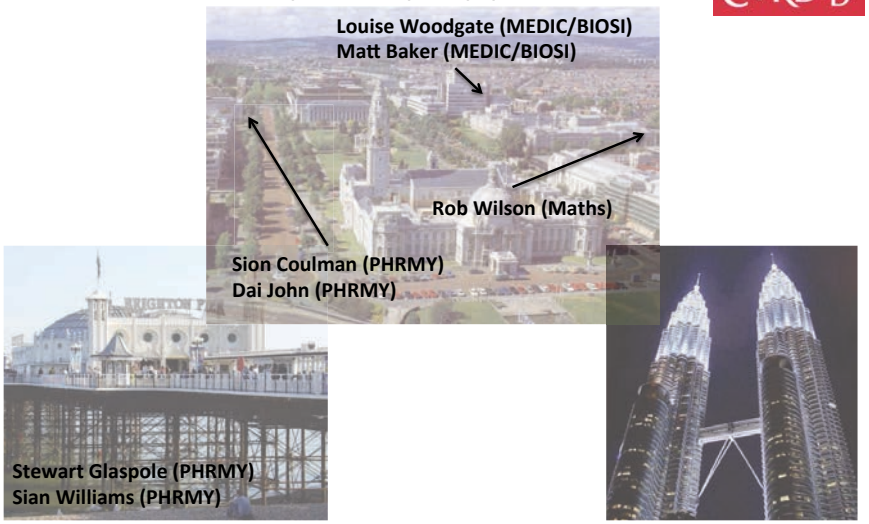
1. **To develop a robust, contextualised medicines-based numeracy diagnostic tool for students entering a Pharmacy/Medicine degree**
2. To evaluate the inherent skills of students entering the Pharmacy/Medicine degree for
   i. Self-diagnosis and awareness
   ii. Targeted teaching strategies and activities

Pilot development: 'International' multi-disciplinary Approach



Methodology – **Stage A**

Review of diagnostic tools in the literature in terms of content and structure

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Ethical Approval – School of Pharmacy Ethics Committees

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Semi-structured interviews with academic "experts"

Results – Stage A - Interviews

- **The need:**
  i. Numeracy skills are an issue with undergraduates at more than one school of pharmacy
  ii. A tailored numeracy diagnostic would be useful
- **Suggested Numeracy Domains:**
  - Multiplication
  - Division
  - Percentage
  - Ratio
  - Fractions
  - Decimals
  - Estimation
  - Unit Conversions

Results - Stage A - Interviews

"loading difficulty up in terms of progression is quite useful to do it within a skill"

"if the items are contextualised then that is a major benefit to giving the students some more meaningful information"

- **Computer-based** tool with **no multiple choice** and **no calculators.**
- A **time limit of 30 minutes** was also suggested.
- Two interviewees suggested incorporating **confidence assessments.**

Methodology – Stage A

Develop a question pool based on the results of the literature review, interviews and mathematic and numeracy learning resources

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Conduct focus group with pharmacist teacher practitioners to assess **content validity** of the questions

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Construct a pilot diagnostic tool, **reconvene focus groups and review**

Results - Stage A – Focus Groups

- Only 2 questions shown to them were rated 'difficult'
  "Questions are too easy"
- The reconvened focus group felt there was a **progression of difficulty** but that -
  " [It's] ***not necessarily hard maths but just harder questions because of the concepts being brought into it"***

Drafting the Tool

- **Validity:** The content was considered valid for a medicines-based course.
- **Balance:** Suggestions included more questions on units and division and less on fractions and decimals.
- **Level:** The medicine-based contexts were considered suitable for students entering a medicines-based degree, with no prior knowledge of medicines – Too easy?
- **Time:** 30 minute time limit was considered appropriate.

Methodology – Stage A

Conduct a pilot with first year pharmacy students to assess the **face validity** (n = 10)

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Review the diagnostic tool based on the results of the pilot

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Completion of pilot diagnostic tool

Acknowledgement: Sarah Jarman

Results – Stage A –Piloting Draft Tool

- Students found **some wording and contexts confusing**
  "new words like you say the glucose monitor, things like that I think threw me a bit"
- Students found the **confidence section** was quick to complete and had positive comments.
  "instead of going straight through the paper until the end you think about whether you understood it or not"
- **Face Validity -** Eight students piloted the Draft Diagnostic Tool
  - 6/8 completed within 30 minutes
  - 1/8 achieved 100%
  - Students gave more incorrect answers to the questions identified by the focus groups as being more difficult
  - Most students were confident when they gave correct answers but some were confident when giving incorrect answers
- A **time limit increase to 45 minutes** was suggested during discussions.

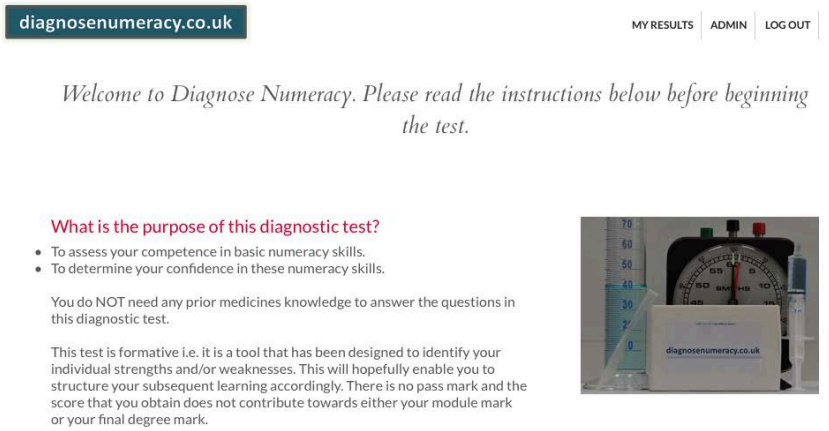
Finalised Pilot Diagnostic Tool

- 25 questions in 45 minutes
- No Calculator
- Six Domains with increasing difficulty within a domain:-

1. **Multiplication**
2. **Division**
3. **Ratio**
4. **Fractions**
5. **Percentages**
6. **Unit Conversion**

- Evaluation of **confidence**

Transferring online (2012)



Acknowledgement: Rob Wilson & David Mills

Stage B: Using the tool

- Cardiff PHRMY 2010 –
  - Cardiff and KL
- Cardiff MEDIC 2010 -
- Brighton PHRMY 2010 -
- LJMU 2013 -

Stage B: Contextualised, validated (face and content) and reliable

- 547/562 first years at Cardiff School of Pharmacy taken the test since 2010

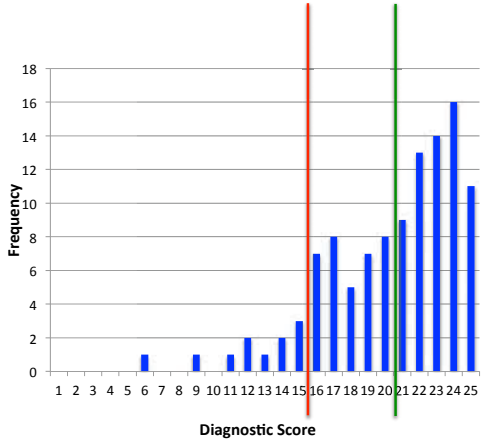
- **Quantitative analysis** of items:
  - P Value (0.0 = too easy; 1.0 = too hard)
  - Discrimination Index (27%; <0.19 = “unsatisfactory”; 6 items)
  - Point biserial coefficient (>0.15 = ok; >0.25 good; 3 items)
  - Cronbach’s alpha (>0.7 consistent; 0.77)
  - Test:Re-test analysis

- **Qualitative Student evaluation** (increase face validity):
  - Clarity
  - Timing

Stage B: How is it used?

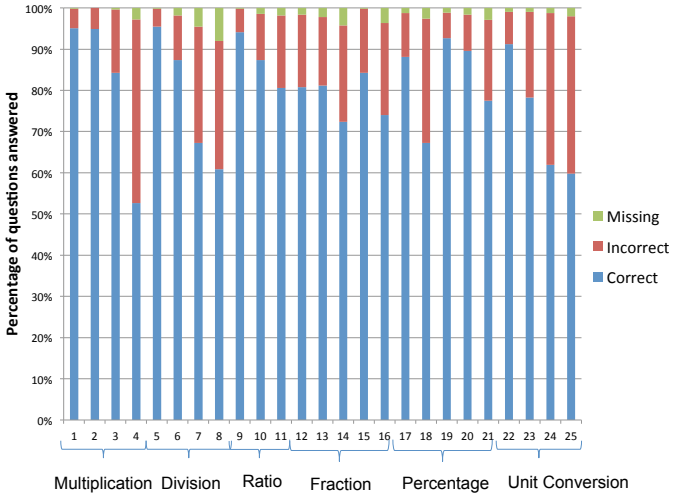
- Students sit the diagnostic in Week 2 of the first semester
- No prior notice
- Instant marks and feedback provided to students
- Results enable students to self-diagnose and lecturers to modify and target teaching activities
- Slightly different approaches between Schools

How is it used in Cardiff?



- Traffic light system
- Green - ☺
- Amber – Online and MSS
- Red – Online, MSS and tutorial

How is it used in Cardiff?



Post-test questionnaire

Diagnostic Numeracy Tool Questionnaire 2014

Now that you have completed the numeracy diagnostic test, please answer the following questions. Your responses will be coded so that they are read anonymously, independent of your test. Importantly, the responses that you give will be used to improve the test for future years.

1. Sex: ☐Male ☐Female **2. Year of birth:**

3a. Please indicate the country in which you were educated at the following age ranges:-

5-11 years old:

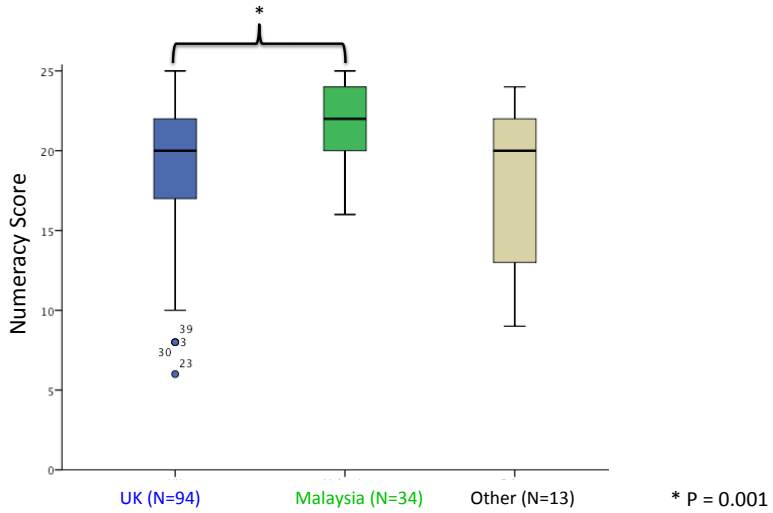
11-16 years old:

16-18 years old:

3b. Please complete the table, indicating ALL mathematics qualifications you have obtained before enrolling on the degree programme including (i) the *type of qualification*, (ii) *the country* in which you obtained that qualification and (iii) the *grade* of the qualifications you obtained.

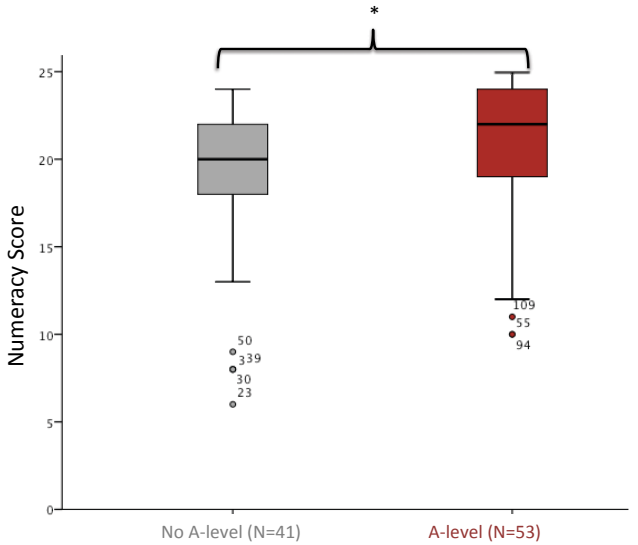
i. Type	✓ or ✖	ii. Country of Study	iii. Grade
GCSE / O-level / or equivalent			
AS-Level / or equivalent			
A-Level / or equivalent			
Degree level or equivalent			
Other			

Principal country of education



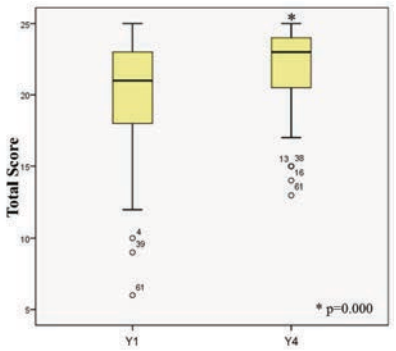
* P = 0.001

Highest mathematics qualification

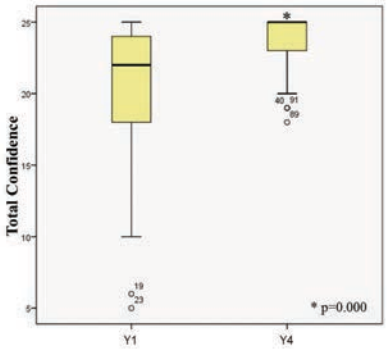


* P = 0.026

Do students improve during the MPharm?



Competence



Confidence

Conclusions

- Developed a robust contextualised numeracy diagnostic tool.
- Inherent numeracy skills of those students entering the MPharm programme in Cardiff (and other institutions) is highly variable.
- The numeracy diagnostic tool is being (or could be) used to:-
  - Target support in this subject at an early stage
  - Facilitate self-evaluation of inherent numeracy skills
  - Provide information to Depts about a student cohort
  - Entry Test

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