Assessing mathematical connections in high stakes assessment

Professor Andrew Noyes

University of Nottingham

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‘connectivity’

The first of 3 important principles guiding the Cambridge Mathematics Framework:

“connectivity: making important connections explicit in a consistent way will help these connections to be referenced more easily, including those which may span multiple areas or otherwise tend to escape attention in existing curricula”

Beliefs	Problem	Perspective	Design approach
Connected understanding	Adherence to canonical examples of particular mathematical ideas or structures may close down more appropriate options	Linking disparate content which has common mathematical structure can provide more options for decision-making in curriculum and resource design	Identify and link fundamental mathematical ideas, structure, practices, and ways of thinking across the Framework

Connectionist teaching

Askew et al (1997, 3)

Highly effective teachers believed that being numerate requires:

- having **a rich network of connections** between different mathematical ideas
- Etc.

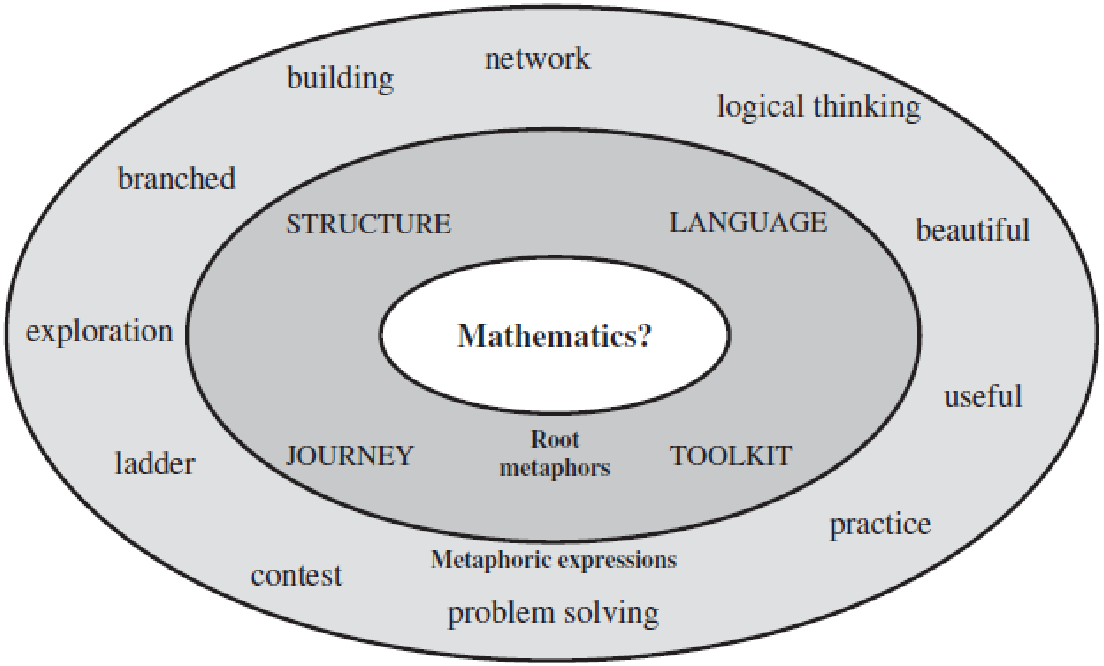
They used corresponding teaching approaches that:

- **connected** *different areas of mathematics* and *different ideas in the same area of mathematics* using a variety of words, symbols and diagrams
- Etc.

…it was clear that those teachers with a strongly connectionist orientation were more likely to have classes that made greater gains over the two terms than those classes of teachers with strongly discovery or transmission orientations. (p28)

Frameworks and networks

- Waypoints, edges, research nodes



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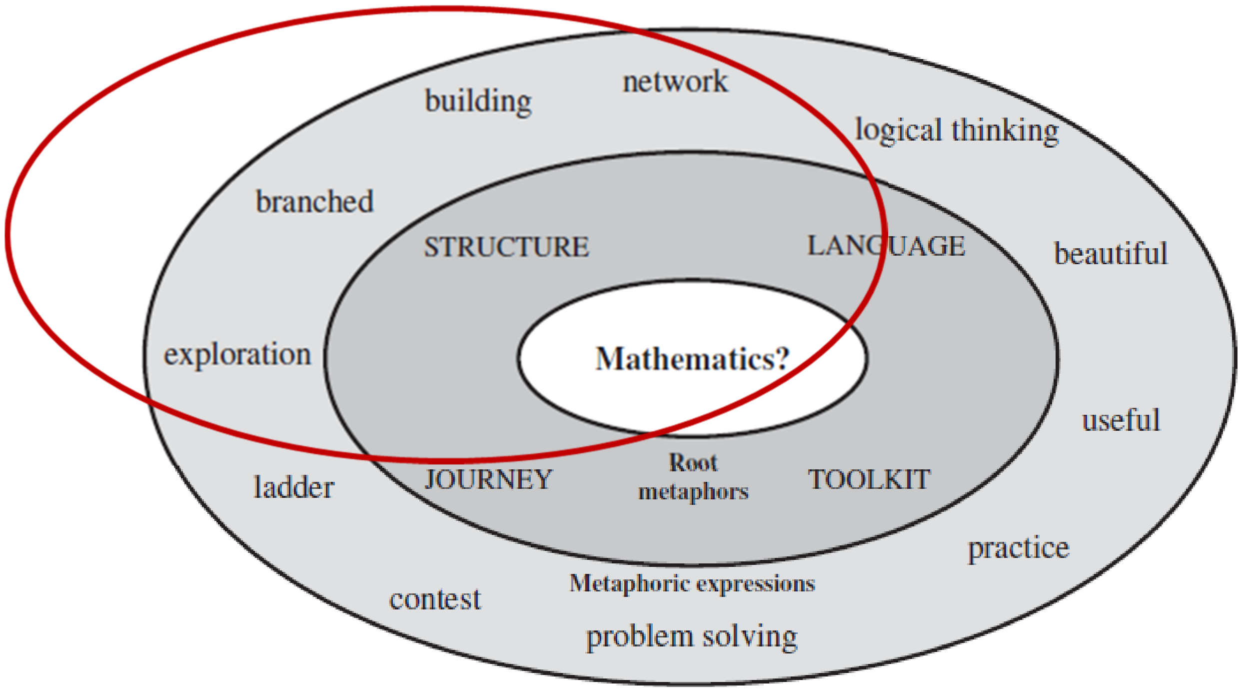


High stakes assessment (e.g. GCSE)

- Reductive & unidimensional; very little to say about competence
- Marketised and regulated
- Atomised and compensatory
- Little space for experimentation or evolutionary development

- Reformed GCSE has an increased focus on problem solving and reasoning (30% at Higher, 25% at Foundation)
- 1/2 vs 4/5 mark questions

AO3	**Solve problems within mathematics and in other contexts** Students should be able to: • translate problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes • make and use connections between different parts of mathematics • interpret results in the context of the given problem • evaluate methods used and results obtained • evaluate solutions to identify how they may have been affected by assumptions made Where problems require candidates to 'use and apply standard techniques' or to 'reason, interpret and communicate mathematically' a proportion of those marks should be attributed to the corresponding Assessment Objective.	30%	25%

Some examples

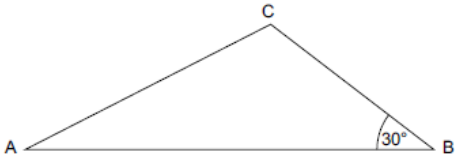
OCR practice papers

(c) Gary's alarm and Ian's alarm both bleep at 7:50 am.
Then Gary's alarm bleeps every 6 minutes and Ian's alarm bleeps every 4 minutes.

What is the next time both alarms bleep together?

16 Triangle ABC has area 40 cm^2.
AB = 2BC.

Not to scale



Work out the length of BC.
Give your answer as a surd in its simplest form.

4 An interior angle of a regular polygon is eleven times its exterior angle.

Work out the number of sides of the polygon.

4 John is going to drive from Cambridge to Newcastle.

Scale: 1cm represents 50miles

(a) John needs to be in Newcastle at 11 am.
He drives at an average speed of 60 miles per hour.

What time does he need to leave Cambridge?

4			24	**4** **1AO1.3b** **1AO3.1b** **1AO3.2** **1AO3.3**	**M2** for 11x + x = 180 or 15 Or **M1** for 11x and x AND **M1** for 360 ÷ *their* 15	Accept alternative methods e.g. **M2** for 180 – 360/n = 11(360/n) **M1** for 180n = 4320

Some final thoughts…

1. Is there a problem with AO3.2?

   “make and use connections between different parts of mathematics”

   - **Combine** different parts of mathematics…

   OR

   - Make use of the **connections** within mathematics…

2. High stakes tests don’t do much to assess mathematical connections

   - What would such items look like?

3. Professional development for examiners

   “A national strategy for the **professional development of mathematics assessment writers** should be considered. This is a problem that should be tackled by QCDA/ Ofqual rather than at Awarding Body Level, and is of particular importance in ensuring that qualifications can evolve to support desired curriculum and pedagogic change in addition to supporting innovation in new qualifications” (EMP final report)

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