Assessing mathematical connections in high stakes assessment

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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”

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

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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.
Some examples

OCR practice papers

4. John is going to drive from Cambridge to Newcastle.

Scale: 1cm represents 50 miles

(a) John needs to be in Newcastle at 11am.
He drives at an average speed of 60 miles per hour.
What time does he need to leave Cambridge?

4. An interior angle of a regular polygon is eleven times its exterior angle.
Work out the number of sides of the polygon.

4

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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 180/n = 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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