Understanding Students’ Minds: How to write more valid questions

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Local Examinations Syndicate
Validity

A question can only be valid if:

‘the students’ minds are doing the things we want them to show us they can do’
The four tools

1. Model of the Question Answering Process
2. Sources of Difficulty and Easiness (SODs & SOEs)
3. Outcome Space Generator
4. Scale of Cognitive Demands
Tool 1: The Question Answering Process
How students answer questions

• Learning

• Reading
  – activation of concepts
  – constructing a mental representation of the task

• Searching, Matching, Generating

• Writing
The Question Answering Process

Remember that Learning occurs over several years - but Reading, Searching, Matching, Generating and Writing happen in a few minutes under conditions of examination stress.
Operating under exam conditions

Stress and:

• capacity
• proceduralisation
• closure and checking
Tool 2: General SODs and SOEs

- Question Design
- Physical Features
- Language
- Process
- Mark Scheme
Example: Highlighting

Version A  8% correct
Using Fig. 1 describe the shape of the valley along this cross-section.
Use the following headings:
Valley floor ___________________
Valley sides ________________

Version B  38% correct
Using Fig. 1 describe the SHAPE of the valley along this cross-section.
(c) One method of neutralising the acid in paper is to use sodium carbonate.

When sodium carbonate reacts with sulphuric acid there are three products.

What are they?

1. Soap
2. Shampoo
3. Kitchen cleaner

The word ‘product’ has more than one meaning. For this student the everyday meaning dominated.
Outcome Space

• The range of answers, or of types of answers, to a question or task.

• Qualitative differences
  A  *Writer's expected range*
  B  *Observed range*

• The match between these two 'spaces' is a matter of test validity.

After Marton and Saljo, (1976)
Tool 3: The Outcome Space Generator

Read  Search  Match  Generate  Write

Outcome Space

X1  X3  X5  X6

X7  X4  X2
Joy uses a new toothpaste.

The toothpaste contains a chemical which stops bacteria growing in her mouth.

(a) (i) How do bacteria reproduce?
The Outcome Space Generator

Example

<table>
<thead>
<tr>
<th>Learn</th>
<th>Read</th>
<th>Search</th>
<th>Match/Generate</th>
<th>Write</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>57</td>
<td>52</td>
<td>44</td>
<td>28</td>
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</tr>
</tbody>
</table>

- Conditions for growth
- Germs or dirt
- Asexually or meiosis
- Multiply, split
- Food or mouth
- Chemicals or mouth
- Blank or irrelevant

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# Tool 4: Five-dimension Scale of Cognitive Demands

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Complexity</strong></td>
<td>Simple operations (i.e. ideas/steps)</td>
<td>No comprehension, except that required for natural language</td>
<td>Synthesis or evaluation of operations</td>
<td>Requires technical comprehension</td>
<td>Makes links between operations</td>
</tr>
<tr>
<td></td>
<td>No links between operations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Resources</strong></td>
<td>All and only the data/information needed is given</td>
<td></td>
<td></td>
<td>Student must generate the necessary data/information</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Deals with concrete objects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Abstractness</strong></td>
<td>Strategy is given</td>
<td>No need to monitor strategy</td>
<td>Students need to devise their own strategy</td>
<td>Students must monitor the application of their strategy</td>
<td>Must select content from a large, complex pool of information</td>
</tr>
<tr>
<td></td>
<td>No selection of information</td>
<td>required</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Task Strategy</strong></td>
<td>Organisation of response not required</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Response Strategy</strong></td>
<td></td>
<td></td>
<td></td>
<td>Must organise how to communicate response</td>
<td></td>
</tr>
</tbody>
</table>

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After Dall’Alba, G. and Edwards, J. (1981)
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