



**UNSW**  
THE UNIVERSITY OF NEW SOUTH WALES

**EDUCATIONAL ASSESSMENT  
AUSTRALIA**

# TESTING WITH A TWIST

ASSESSMENT IDEAS FOR YEARS 7 TO 10  
MATHEMATICS

PAULA DONKIN

October 2005



Copyright in this paper is owned by Educational Assessment Australia, NewSouthGlobal Pty Limited unless otherwise indicated. Every effort has been made to trace and acknowledge copyright for materials used. Educational Assessment Australia apologises for any accidental infringement and welcomes information to redress the situation.

Any views expressed in this paper are those of the individual author, except where the author expressly, and with authority, states them to be the views of Educational Assessment Australia.

## Content

|   |          |
|---|----------|
| <b>Content.....</b>   | <b>2</b> |
| <b>Testing with a twist: Assessment ideas for Years 7 to 10 mathematics .....</b> | <b>3</b> |
| <b>Ideas for modifying traditional tests – Pretesting .....</b>                   | <b>3</b> |
| <b>“Double-barrel” testing.....</b>   | <b>3</b> |
| <b>Using non-traditional types of test questions – Non routine questions.....</b> | <b>4</b> |
| <b>Open questions .....</b>   | <b>4</b> |
| <b>Questions that require students to explain their answers in words .....</b>    | <b>4</b> |
| <b>Questions that can be answered at different levels of thinking .....</b>       | <b>5</b> |
| <b>Interviewing students about their test results .....</b>                       | <b>5</b> |
| <b>Open book testing .....</b>  | <b>6</b> |
| <b>Other types of assessment tasks – Practical tasks .....</b>                    | <b>6</b> |
| <b>Investigations.....</b>  | <b>7</b> |
| <b>Topic Summaries with Student Self Reflection.....</b>                          | <b>7</b> |
| <b>Research Projects.....</b>   | <b>8</b> |
| <b>Student Self Assessment .....</b>  | <b>8</b> |

## Testing with a twist: Assessment ideas for Years 7 to 10 mathematics

Paula Donkin: October 2005

I recently interviewed three mathematics teachers working in NSW government schools about their assessment practices for research towards a Doctorate of Education. This article outlines some of the assessment strategies they and I have used in our classrooms. These strategies are of two broad types. They include ideas for modifying traditional tests and other types of assessment tasks.

### Ideas for modifying traditional tests – Pretesting

One of the teachers that I interviewed gives her students a topic test at the **beginning** of each topic. The students are asked to attempt all of the questions they think they know how to do, showing all of their working, and indicate why they cannot do the rest of the questions. A question from one of her pretests is shown in figure 1.

|  |   |                        |                   |                 |  |  |  |
|--|---|------------------------|-------------------|-----------------|--|--|--|
| <p><b>Chance Assessment for Learning</b></p> <p>Name: _____</p>  | <p>If you can't answer a question, please indicate the reason by putting a tick in the appropriate box next to the question.</p> <table style="width: 100%; border: none;"> <tr> <td style="text-align: center; vertical-align: middle;">seen but forgotten how</td> <td style="text-align: center; vertical-align: middle;">never heard of it</td> <td style="text-align: center; vertical-align: middle;">ran out of time</td> </tr> <tr> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> </tr> </table> | seen but forgotten how | never heard of it | ran out of time |  |  |  |
| seen but forgotten how   | never heard of it   | ran out of time        |                   |                 |  |  |  |
|  |   |                        |                   |                 |  |  |  |
| <p>1. A coin is tossed five times and each time it comes up heads. Comment on the chance of the outcomes from the next toss.</p> |   |                        |                   |                 |  |  |  |

figure 1

The advantages of pretesting include that it assists in planning units of work. The teacher can use the results of the pretest to predict the amount of time that will need to be spent on each concept. The pretest can also uncover the misconceptions students have about concepts so the teacher can plan how to correct them. If the students are given a similar test at the end of the topic, the quality of their responses to comparable questions can be analysed to determine what they have learned.

### “Double-barrel” testing

Another teacher that I interviewed coined the phrase “double-barrel” testing to describe a modification that he made to his testing technique. He gave the students in one of his classes a test and marked each question as either right or wrong. He then asked the students to redo any question that they got wrong for homework. This was under “open book” conditions and the students understood that they could look at their textbooks, ask others for help, etc. He then collected and remarked the test.

Double barrel testing is useful for creating an expectation among students that they are expected to learn all of the knowledge and skills in a topic and that they are responsible for their own learning. This is assisted by not having the topic test at the very end of a topic. There should be enough time after the test to help the students discover what they still do not know.

## Using non-traditional types of test questions – Non routine questions

These are questions that are asked in a novel way so that they are not exactly like the questions in the textbook. The example in figure 2 of a non-routine test question is taken from the Year 7 Australasian Schools Mathematics Assessment for 2005.

31. Yuri has to shade one more cell in this grid so that it will have rotational symmetry. Which cell must Yuri shade?

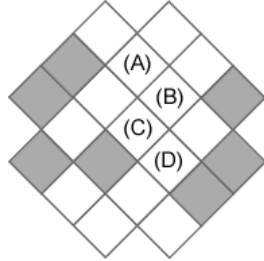


figure 2

It is likely that a student who can answer this question correctly has a good understanding of rotational symmetry.

## Open questions

These are questions that have more than one correct answer. An example of an open question is given in figure 3 below.

Write one fraction that is equivalent to  $\frac{2}{7}$ .

figure 3

Similarly, a student who can correctly answer this question is likely to understand equivalent fractions.

## Questions that require students to explain their answers in words

These types of questions are increasingly being used in the school certificate and the higher school certificate. A sample question is shown in figure 4 below.

Explain why the time 3:15 is the same as a quarter past 3.

figure 4

These questions can help students clarify their own understanding of concepts.

## Questions that can be answered at different levels of thinking

Figure 4 shows an example of a question of this type.

|     |   |   |   |    |
|-----|---|---|---|----|
| In  | 1 | 2 | 3 | 4  |
| Out | 2 | 5 | 8 | 11 |

1. What is the next In number?  
(Trivial. Counting by 1's).
2. What is the next Out number?  
(Easy. Recognising and extending a pattern formed by addition of a constant).
3. What is the Out number for an In number of 9?  
(Fairly easy. Extending both patterns by 4 terms).
4. What is the In number for an Out number of 122?  
(Fairly difficult. Substantially extending both patterns or finding a relationship between the In and Out numbers).
5. Explain in words how to find the Out number for a particular In number.  
(Difficult. Finding and explaining a relationship involving multiplication and subtraction by a constant).
6. Write a formula for finding an Out number given its In number.  
(Sophisticated. Expressing the relationship algebraically).

figure 4

## Interviewing students about their test results

This is potentially very time-consuming. My suggestion for making it manageable is to ask students to complete the interview template in figure 5 for homework after each test.

(Top of front page of interview template)

**Complete the table below for the questions for which you didn't get full marks. Use reasons from the list or write your own reason.**

### Reason List:

- A:** I had no idea how to do this question. I have never learnt how to do questions like this.  
**B:** I forgot how to do this question. I have done questions like it before but I forgot how.  
**C:** I knew how to do this question but I made a silly mistake and didn't get full marks.  
**D:** I thought I was doing this question the right way and I'm surprised I got it wrong.  
**E:** I ran out of time to do this question.

**Question Number**      **Reason Why You Didn't Get Full Marks for the Question**

(Top of back page of interview template)

**Complete the table below for the questions for which you did get full marks. Use reasons from the list or write your own reason.**

### Reason List:

- F:** I studied how to do questions like this.  
**G:** I didn't study questions like this but I remembered how to do it from when we did it in class.  
**H:** It was a lucky guess.

**Question Number**      **Reason Why You Did Get Full Marks for the Question**

figure 5

The teacher can then read the templates and note anything that he or she would like to discuss with each student. This can be done by walking around the class and talking to students about what they have written while they work on an independent activity.



## Investigations

One of the interviewees uses the investigation shown in figure 7 with his classes.

### *Number Chains*

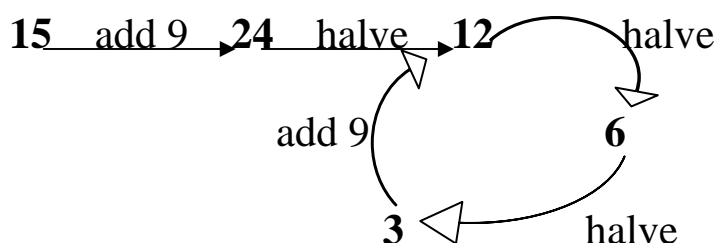
*Step 1: Think of a number.*

*Step 2: If it's even, halve it. If it's odd, add 9.*

*Step 3: Repeat step 2 until the numbers begin to repeat.*

#### **Instructions:**

Number chains can be obtained by following the above rule. For example if the number you thought of was 15, this would produce the number chain:



Investigate the number chains that result from different starting numbers.

figure 7

This investigation is great because it can be attempted by the weakest students while still challenging the most able students. A student who struggles with mathematics may still be able to list a few number chains with different starting numbers. Some students will notice that you always get the same few endings regardless of the starting number. They might even be able to state the only 3 possible endings. These are shown in figure 8.

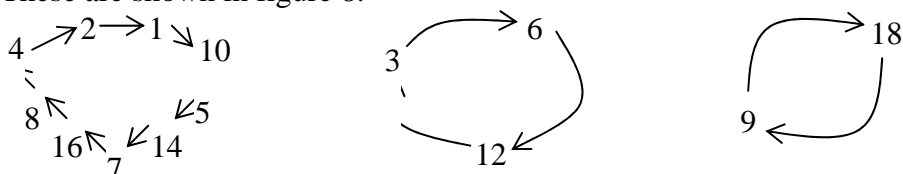


figure 8

The most able students should be encouraged to develop a rule for predicting what the ending will be for a given starting number. A few of these students may even be able to tell you why the rule works!

## Topic Summaries with Student Self Reflection

Another of the teachers that I interviewed asks her students to complete a summary and self reflection on each topic. She includes a space for this on each page of the program which is then photocopied and distributed to the students.

Asking the students to complete a topic summary on the relevant page from the program can encourage them to take responsibility for their own learning. The program tells them what they were meant to learn and the summary clarifies how much of this learning has taken place.

## Research Projects

The teacher who was mentioned in the previous section gave her Year 7 students the research project shown in figure 9.

### Number Theory Project

Group A: Prime (including prime factor trees) and composite numbers.

Group B: Factors, multiples, HCF, LCM, perfect and amicable numbers.

Group C: Figurative numbers – triangular, square etc, palindromic, Fibonacci, square and cube numbers.

#### PROCESS

1. Research your topic to find out the following:
  - i) What makes these numbers significant?
  - ii) What can we do with these numbers?
  - iii) Do they have a pattern? If so, can you find the general term or rule to describe the pattern?
  - iv) Any other important or unique facts?
2. Write up the information you will use to share with the other members of your group. Discuss its contents with your teacher.
3. Groups (i.e., all A's, etc.) will form to share and consolidate information, before preparing worksheets.
4. Original groups will reform so that all information can be shared and discussed.

figure 9

## Student Self Assessment

This teacher also helped her students to develop a self assessment rubric, part of which is shown in figure 10.

| <b>Self-Assessment Rubric</b>                       |   |  |   |   |
|---|---|--|---|---|
| Expected Quality                                    | <i>Platinum</i><br><input type="checkbox"/>   | <i>Gold</i><br><input type="checkbox"/>  | <i>Silver</i><br><input type="checkbox"/>   | <i>Bronze</i><br><input type="checkbox"/>   |
| Analysis, organisation and synthesis of information | I showed that I understand all of the properties of the numbers I investigated and my work was thoroughly researched. | I showed that I understand most of the properties of the numbers I investigated and my work was well researched. | I showed that I understand a few of the properties of the numbers I investigated and my work was reasonably researched. | I showed that I didn't understand the properties of the numbers I investigated and my work was poorly researched. |

figure 10

Happy assessing!