ACER

PAT Teaching Resources Centre

Find out more
www.acer.org/pat-trc

PAT Maths

Concept builder: **Newman's error analysis**

Strands: Number and Algebra
Measurement and Geometry
Statistics and Probability

Newman's error analysis arose from research into language issues in maths in the 1970s. The theory posits that there are five stages that a student goes through to solve a word problem in mathematics.

BASIC STRUCTURE: FIVE STAGES OF SOLVING WORD PROBLEMS IN MATHEMATICS

Reading and decoding
The student reads the problem and decodes words and symbols.

Comprehending
The student makes sense of what they have read.

Transforming
The student 'mathematises' the problem; that is, works out what maths needs to be done.

Processing
The student does the maths.

Encoding
The student records their final result appropriately.

CONDUCTING THE ERROR ANALYSIS INTERVIEW

To conduct the error analysis, the teacher follows a series of interview cues to probe the student as they solve a word problem. Each cue relates directly to one of the five stages of the basic structure of solving word problems for mathematics. The interview can expose why a student has made an error in a word problem.

Interview cues

- Please read the question to me. If you don't know a word, leave it out.
- Tell me what the question is asking you to do.
- Tell me how you are going to find the answer.
- Show me what to do to get the answer. 'Talk aloud' as you do it, so that I can understand how you are thinking.
- Now, write down your answer to the question. (Newman, 1983)

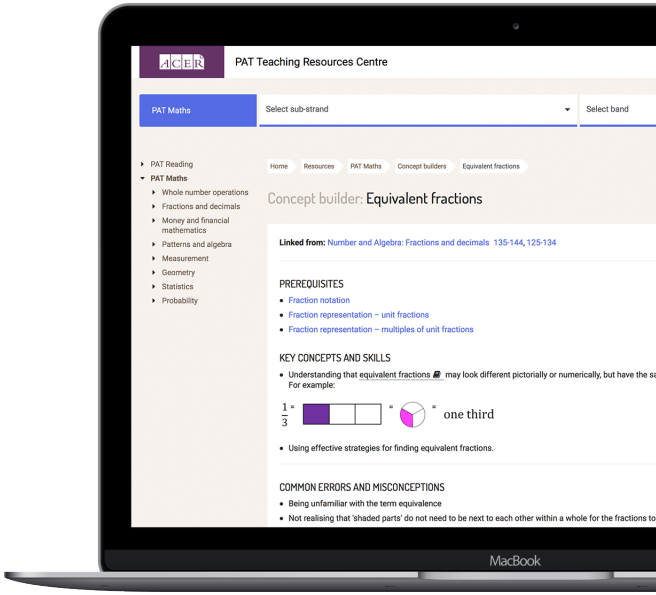
DIAGNOSING ERROR TYPES

Error type	Likely indicators	Suggested strategies for students
Reading/decoding	• Responses that show little or no engagement with the task • Responses that are consistent with an obvious misreading • Responses consistent with unfamiliarity with technical terms	• Refer to, or create, a glossary of new words and their meaning in maths

Comprehending	• Responses showing only a superficial engagement with the task • Responses consistent with a different (but related) question from the one being asked	• Ask yourself 'what do I have to find out or show?' • Draw a diagram • Restate the problem in your own words
Transforming	• Responses consistent with a different (but related) question from the one being asked • Responses consistent with the right numbers being used but with the wrong operations (or in the wrong order)	• Guess and check • Make a list or table • Look for a pattern • Make the numbers simpler • Experiment or act it out • Be patient: most problems are not solved quickly nor on the first attempt
Processing	• Arithmetic errors • Procedural errors • Incomplete solutions	• If one approach isn't working try a different one
Encoding	• Incomplete solutions • Responses that require some mathematical skill but which don't answer the question asked	• Does the answer make sense? • Have I answered the question fully?

FURTHER READING

New South Wales Department of Education and Communities. (2011). Newman's prompts: Finding out why students make mistakes. Retrieved from http://www.schools.nsw.edu.au/learning/7-12assessments/naplan/teachstrategies/yr2014/img/newman.pdf



Example Question (1): Calculate time in one region

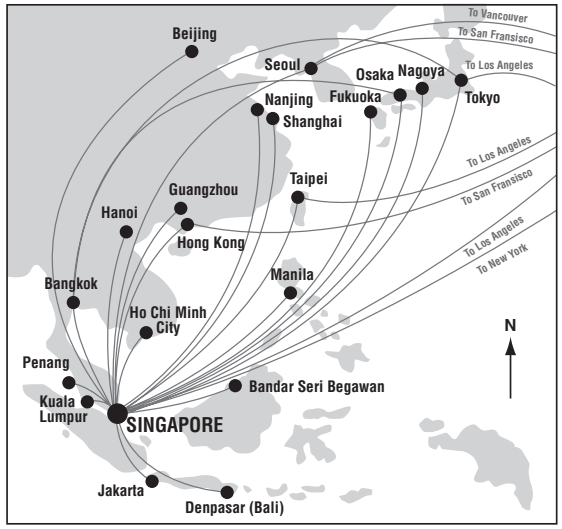
Content strand: Measurement and Geometry

PAT Maths description: Calculate time in one region, given current time in another region and time zone difference between the two regions.

QUESTION

Airline Routes

This map shows routes for an airline in Asia.



Question 3 of 3

M072007

3 Tokyo is one hour **ahead** of Singapore.

It is 11:30 pm Sunday in Tokyo.

What time is it in Singapore?

- ☐ 10:30 pm Sunday
- ☐ 12:30 am Sunday
- ☐ 10:30 pm Monday
- ☐ 12:30 am Monday

COMMON ERRORS AND MISCONCEPTIONS

Key	A: 10:30 pm Sunday
Item commentary	This item requires students to identify and link the relevant elements of the information provided to determine the corresponding time in a second location, where there is time difference of one hour between two locations; devise a strategy requiring targeted processing of the information provided; and select the correct time given in am and pm notation.

A	Key
B	12:30 am Sunday (may find one hour later but for the incorrect day OR may think one ahead must be for the same day) *Newman's comprehending or transforming error*
C	10:30 pm Monday (may find one hour behind for the next day OR may think one hour ahead must be for the next day) *Newman's comprehending or transforming error*
D	12:30 am Monday (may find one hour ahead of 11:30 pm Sunday) *Newman's comprehending or transforming error*

KEY CONCEPTS AND SKILLS

- Finding one hour later for a period across days

Example Question (2): Work out a fraction

Content strand: Number and Algebra

PAT Maths description: Work out the fraction that one length is of another length.

QUESTION

Alex at the Zoo

Alex went to the zoo.
He saw a baby giraffe next to its mother.

Question 1 of 2

L23201

1 **What fraction of the mother's height is the baby's height?**

- ☐ one half.
- ☐ one fifth.
- ☐ one quarter.
- ☐ three quarters.

COMMON ERRORS AND MISCONCEPTIONS

Key	A: one-half
Item commentary	This item requires students to estimate a fraction represented in an image of a real life context. Students need to compare two objects and draw an inference about the relative heights, and express this as a fraction. An understanding of simple fraction concepts is required.

A	Key
B	one-fifth (may think one-fifth represents 1212 in words) *Newman's reading and decoding error*
C	one-quarter (may select a familiar fraction, or associate the number of legs with the fraction) *Newman's comprehending error*
D	three-quarters (may think the mother's height is three-quarters more than the baby's height) *Newman's comprehending error*

KEY CONCEPTS AND SKILLS

- Comparing the heights of two objects and expressing one as a fraction of the other

Find out more
www.acer.org/pat-trc