BOSTES | BOARD OF STUDIES TEACHING & EDUCATIONAL STANDARDS NSW

Planning for success in secondary Mathematics

An online resource for high school teachers, students and parents

Information for teachers and schools

What's on the website?

This brochure tells you about a new resource produced by the Board of Studies, Teaching and Educational Standards NSW that demonstrates strategies that high school Mathematics teachers can use to support students. The strategies are based on careful research about Mathematics teaching in high school and have been developed in collaboration with many practising Mathematics teachers.

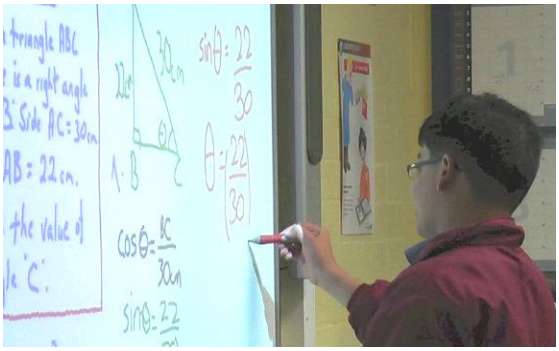
The resource[1] includes a demonstration lesson where the teacher is using specifically designed strategies to help students to undertake a mathematical process to solve a trigonometry problem.

Teaching mathematical processes

The strategies here focus on one part of Mathematics teaching practice: demonstrating mathematical processes.

Mathematical processes consist of a sequence of steps that teachers typically demonstrate with a worked example on the board. Students are then expected to practise the process demonstrated by completing a series of problems.

Of course, teachers don't demonstrate the worked example silently but explain each step carefully, often asking students to contribute by helping with parts of the calculations that they are familiar with. This helps to make the



demonstration interactive and build understanding.

Some students are able to follow each step of the teacher's explanation, understand the words used, recognise the relationship between what is being said and what is being written on the board, and remember the whole sequence.

These students are also most likely to respond to the teacher's questions and participate actively in the classroom discussion. When they come to practise the process, they get most of their problems correct and thus benefit from the practice.

However, other students may miss some elements of the explanation, or misunderstand some of the words the teacher uses. These students are less likely to participate actively in the classroom discussions, get more of their problems incorrect and so get less benefit from their classes. Some may disengage from learning Mathematics, claiming 'it is too hard'.

[1] http://www.boardofstudies.nsw.edu.au/7-10-literacy-numeracy

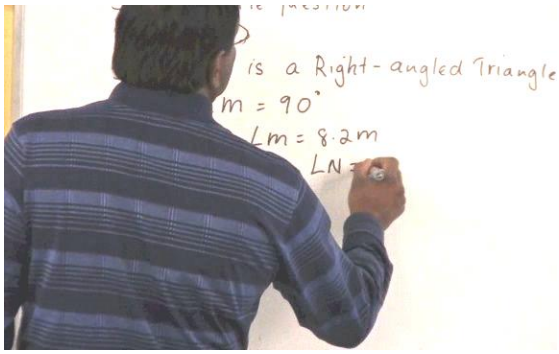
Modelling and guiding mathematical processes

The strategies here are designed to overcome these issues by building in more whole-class, literacy strategies to support the teaching of mathematical processes before students practise problems independently.

Rather than the teacher demonstrating once and then handing over to independent practice, the process in the demonstration is practised three times with different worked examples and increasing handover to students at each stage.

Stage 1: Teacher modelling

In the first stage, the teacher demonstrates the process in the standard fashion with a pre-worked example. However, a key difference is that the teacher has carefully planned how to explain each step in the process.

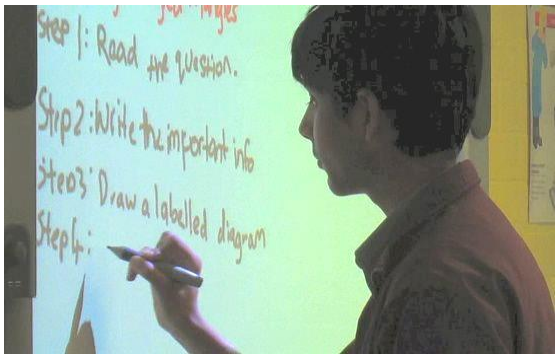


The first step is always to read the question/problem which has been written on the board. After reading, students are asked to identify key information in the question. The teacher then shows how to use this information to solve the problem.

The teacher explicitly names each step as it is explained and written on the board.

Stage 2: First guided practice

In the second stage the teacher starts asking the class what to do in each step so that students can repeat what was said in the first demonstration.



As the teacher has explicitly modelled each step, students' responses approximate what has already been modelled. In this way, students' understanding is affirmed.

Students take turns to come out and write the step on the board.

Stage 3: Second guided practice

In the third stage, another worked example is practised in the same way. This time, more students are able to confidently say and understand each step. In this way every student in the class gets an opportunity to participate actively, either saying the step or writing it on the board.

It is important to include as many students as possible in this stage, including those students who may be reluctant to respond. Because the steps in the process have now been modelled twice, most students are able to provide an appropriate answer and experience success in their engagement with the mathematical process.

It is this experience of success and praise from the teacher that engages students in learning.

Stage 4: Joint construction

Finally, the whole procedure is described on the board as a sequence of steps. Students take turns to describe each step as the class tells them what to write, with the teacher's guidance.

This activity is known as **joint construction** because the class is jointly constructing a text with the guidance of the teacher. The text in this case is a procedure for completing a mathematical process.

Students should keep a copy of the procedure so that they can refer to it if they wish, when they are solving problems.

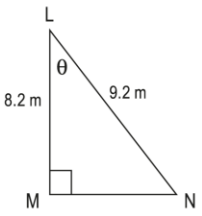
This process helps all students to achieve, as less able students are provided with an opportunity to understand and remember the steps needed to undertake a mathematical process, while more able students have the opportunity to better explain how they solve problems.

Programming and planning

It is recommended that these strategies are used for each new mathematical process that students need to learn. This is not an overly time-consuming process. In fact, the strategies in the four stages can be done in about 30 minutes and will enable students to successfully solve problems independently. This is a more efficient use of teaching time than trying to help individual students who are not yet independent.

The video included in this resource demonstrates the strategies in action across the four stages. The mathematical process demonstrated, is the process for using trigonometry to determine the missing angle of a right-angled triangle.

The planning by the teacher to model the mathematical process and the final procedure for the process that will be constructed by the students is included here.

Steps	Example
1 Read the question	In a triangle LMN, angle M = 90°. Side LN is 9.2m and side LM is 8.2m. Find the angle L to the nearest degree.
2 Make a note of the important information in the question.	The triangle is a right angle triangle Side LM is 8.2 Side LN is 9.2 Right angle at M
3 Draw a labelled diagram with this information. **4** Label the angle to be found as θ.	
5 Write down the three trigonometric ratios related to the right angled triangle.	$\text{Sin } \theta = \frac{\text{opposite side}}{\text{hypotenuse}} = \frac{MN}{9.2}$ $\text{Cos } \theta = \frac{\text{adjacent side}}{\text{hypotenuse}} = \frac{8.2}{9.2}$ $\text{Tan } \theta = \frac{\text{opposite side}}{\text{adjacent side}} = \frac{MN}{8.2}$
6 Find the right ratio to solve the question.	Cos θ
7 Use this ratio to solve the question.	$\frac{\text{Cos } \theta}{1} = \frac{8.2}{9.2}$ $9.2 \times \text{Cos } \theta = 8.2$ $\theta = \text{Cos}^{-1} \frac{8.2}{9.2}$
8 Use a calculator to calculate the angle.	$\theta = \text{Shift Cos } \theta \frac{8.2}{9.2}$ θ = 27°