Level 3 Mathematics - Problem Solving Toolbox

PEEL in Practice: 1300 ideas for quality teaching
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_Faye and Stephen have developed a new teaching procedure: they have described it so thoroughly that we felt it was not necessary to write a separate generic description for it. (Ed)_

Since 1985, teachers in the Project for Enhancing Effective Learning have been researching ways of stimulating and supporting learning that is more informed, purposeful, intellectually active and independent. _PEEL in Practice _is a database of articles written by these teachers. The teaching procedure referred to is one of more than two hundred detailed in _Teaching for Effective Learning: The complete book of PEEL teaching procedures._ Details of PEEL and its publications are available at [peelweb.org](http://peelweb.org).

This article comes from a presentation and workshop on Problem Solving and the Toolbox teaching procedure that we conducted at the 2003 PEEL conference. We commenced by asking participants to solve various types of mathematics problem solving tasks. The purpose was to highlight the definition of problem solving we wanted to use in the presentation and to have participants engage in a range of problem solving strategies. We define mathematical problem solving as working with mathematical problems that require the use of problem solving strategies and are not worded problems that can be rewritten as mathematical equations or solved using routine procedures. (See Figure 1 for examples).

**Sample 1**

A Worded Problem

There are three children in a group, each has two red balls and three green ribbons for their presentation. How many objects are there altogether?

We do not consider this mathematical Problem Solving

**Sample 2**

Problem Solving

Let each letter of the alphabet have a value associated with its position, e.g., a =1, b=2 and so on.

Can you make a word with the value of 100?
How many can you find?

**Figure 1. Samples that define Problem Solving**

As participants worked with the problems, we focused on the problem solving strategies that they used to solve the problems. It is our contention that few teachers were ever taught problem solving strategies explicitly at school. This has resulted in few teachers teaching problem solving strategies explicitly to their students. We asked the participants if they could remember being taught problem solving strategies and few could. Some of the teachers present taught problem solving strategies...
explicitly to their students but many, like us when we first started working with problem solving, did not have a pedagogical model or teaching procedure to use. Participants produced a long list of problem solving strategies that they had used in solving the problems we set.

We then set out to model the type of teaching Faye now uses with her class, with our group. When Faye began teaching problem solving with her Year 3/4 class a number of crucial issues arose. Her students were not using the problem solving strategies she expected them to know. Faye developed the Toolbox teaching procedure to be used for explicitly teaching problem solving strategies. The 'Toolbox' is based on the analogy of a tradesperson with her set of tools. ?You not only need the right tools in your toolbox, but you also need to know when to take out a tool and how to use it in that particular circumstance.? This is how Faye uses her Problem Solving Toolbox.

She has constructed a large A2 toolbox from blue card that has been laminated. On the front it says "Problem Solving Toolbox". Inside are individual laminated cards that demonstrate one of the problem strategies used in the class. The cards include:

- Finding a pattern
- Guess and check
- Draw a picture
- Working backwards.

Each laminated card has the strategy name and a picture on it. When a problem solving strategy is taught explicitly the card is attached to the front of the toolbox with a paper clip and left on display for the class. In teaching the strategy it is important for Faye to have specifically chosen activities that can be solved using this strategy to model the use of the strategy. She uses a range of activities to demonstrate the strategy and such strategies are taught like this once a week. In this way, Faye makes the strategy clear, children have used the strategy several ways and the cards contain a picture that works as a visual prompt to assist recall.

On other occasions, students are given investigations or problem solving tasks like Sample 2 in Figure 1 where students use a range of problem solving strategies. During these classes, when students get stuck they can refer to the Toolbox for strategies that assist them to move on. In this way the Toolbox offers a concrete model for the students to refer to when seeking a problem strategy to an unfamiliar problem. Given they have already been taught these problem strategies explicitly, the visual prompt of the card is often sufficient for them to be able to move on.

Faye now dedicates one lesson a week to developing a problem solving strategy, and one day a week is set aside for open-ended tasks that could require a range of strategies. She will often say to her students if they are struggling with a problem, "Go and have a look in the tool box and see which strategy you're working on". This is especially important on Thursdays, when she has the open-ended activities and problem solving activities as there might be a couple of older strategies that have not been covered for a few weeks. Faye usually has at least 5 different activities being conducted on Thursday with the children allocated to groups. She will say to the...
children, "Okay, if you are having problems, go to the front of the room and have a
look at the Toolbox and see which strategy might help you to work this out". Just by
pulling up one of those, the children will pull one out and say things like, "Yes, that
will help me" or "I never thought of using that - that's what I'll use". We think it is the
visual prompt as well as having the card in front of them that often assists students to
move on.

The Toolbox as a teaching procedure is not limited to mathematical problem solving.
As discussion at the end of the session brought out, it could be adapted as a teaching
procedures toolbox where the class adds the teaching procedures to the toolbox as
they are constructed during the year. In the same way we did at the conference and
Faye does her with her students, students can look inside the Toolbox for prompts
with their strategies.

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