Dr Edward de Bono's

six thinking hats and numeracy

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applies the popular teaching approach of "thinking hats" to mathematics education.

In education, the term "metacognition" describes thinking about thinking. Within mathematics, the term "metacomputation" describes thinking about computational methods and tools (Shumway, 1994). This article shows how the Six Thinking Hats can be used to demonstrate metacognition and metacomputation in the primary classroom. Following are suggested teaching and learning sequences for developing these concepts, using Dr de Bono's hats as graphic organisers.

A Melbourne primary school recently adopted Edward de Bono's Six Thinking Hats across all grade levels as an adjunct to their meta-cognitive curriculum. First, each hat and its thinking style was introduced individually progressing to the introduction of hat sequences. Figure 1 illustrates all Six Thinking Hats by colour and type of thinking identified as relevant to the mathematics curriculum in no particular order.

While the Thinking Hats can be organised into different sequences of any number and in any order, certain sequences work better than others do. It is recommended that Yellow Hat be presented first in order to "set the stage for innovation", while presenting Red Hat after Green Hat is recommended for "prioritising key areas" and "discarding others" (McQuaig, 2005).

A source reference currently used by this primary school is *Teaching Thinking Skills in the Primary Years: A Whole School Approach,* by Michael Pohl. The evaluation sequence known as "the sequence for usable alternatives" can be used to consider problems such as the benefits and aspects that are more challenging found in "Would you rather…?"–situations. Pohl uses the example of, "Would you rather spend all of your pocket money or save some?". This sequence can also be used for choosing between whether to use a calculator, pencil and paper method or a mental computation strategy. A class brainstorm may uncover several reasons to choose particular methods that individual students may not have arrived at on their own. Once each option has been assessed for benefits and difficulties, Pohl's suggested sequence for making choices is Yellow Hat, Black Hat, and Red Hat. Pohl further suggests a design sequence of Blue Hat, Green Hat, and Red Hat for children exploring and inventing. This could be specifically used for computational strategies, for both written and mental methods. The primary school was also developing a "numeracy block" using whole/part/whole teaching. It was decided that spending more time applying Blue Hat and Green Hat thinking would cater for students needing extension, as this requires higher order thinking.

Figure 2 illustrates a traditional teaching learning sequence that seeks a definitive response to a number fact such as, 6 × 7. As this question has a single answer it can be regarded as factual or informative and therefore in the realm of White Hat. The emotional response that this question can evoke from students can be positive or not: confidence if the answer is known or anxiety if not

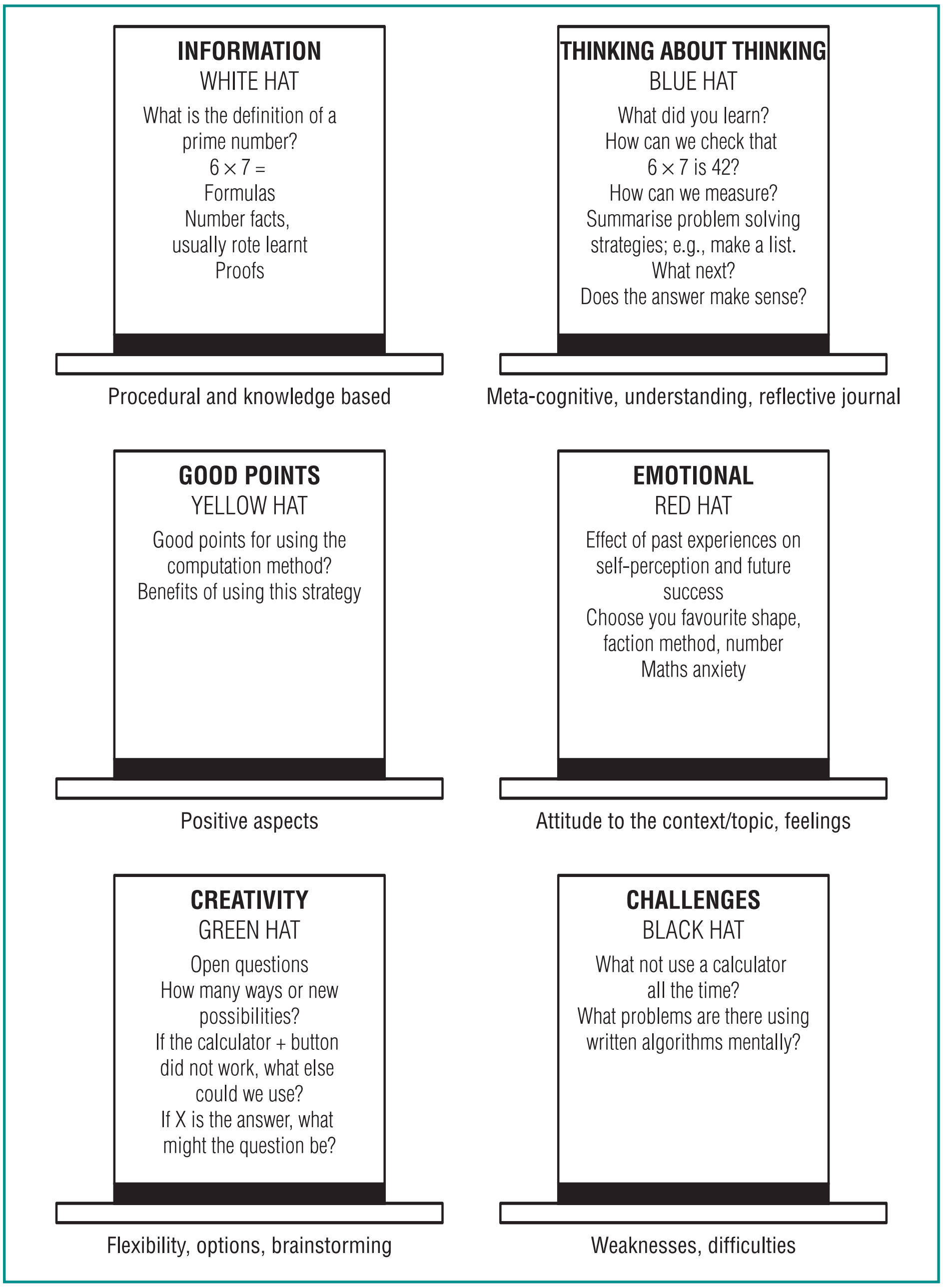

Figure 1. Dr Edward de Bono's six thinking hats as applied to numeracy.
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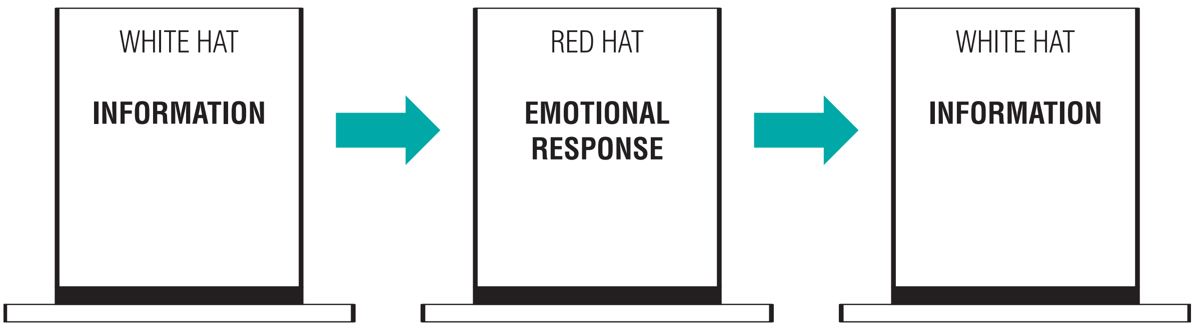


Figure 2. A traditional mathematics teaching and learning sequence using two of the six thinking hats.

and speed of response was required for success. The student would usually either refer to existing knowledge to solve such examples, either by reciting tables or an instrumental procedure such as removing zeros (McIntosh, De Nardi, Swan, 1994) in the example of 60 × 70. If the student already knows the answer, this is White Hat thinking as no learning has taken place. If however, students are asked to explain their mental computation methods as in a study by Paterson (2004), first they reflect on their answers using Blue Hat thinking. Students are also more likely to use Green Hat to check using a different method and then both Yellow and Black Hats to evaluate which is the best method if the two answers do not match. Increasing student opportunities for using their own invented methods and mental computation are more likely to develop conceptual rather than instrumental learning through the use of Green Hat thinking.

Figure 3 demonstrates a metacognitive teaching and learning sequence in an attempt to show how current mathematical teaching pedagogies being implemented in schools today can fit into a Six Thinking Hats teaching sequence. Presenting Green Hat after Black Hat can overcome weaknesses by generating new and different strategies.

Figure 3 starts and ends with metacomputation. Metacomputation

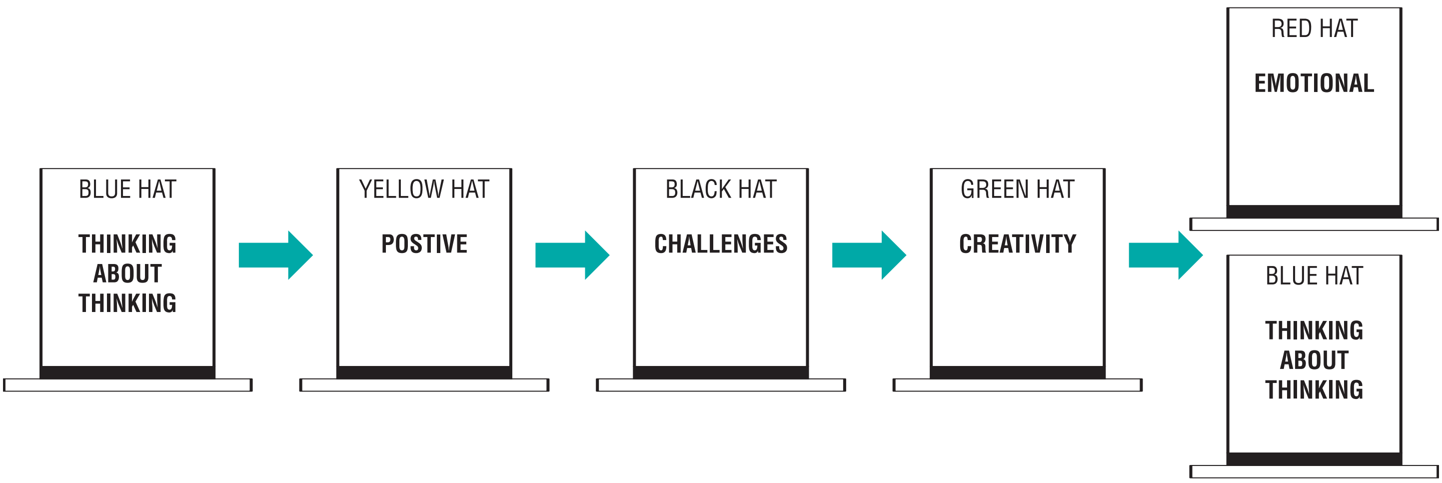


Figure 3. A metacognitive numeracy teaching and learning sequence.

is reflective, hence Blue Hat thinking. What did we set out to learn, and what did we learn? This reflects current numeracy pedagogy, which encourages students to pose their own problems and construct their own computation methods. This sequence can extend more able students by incorporating creativity and risk-taking, for example, with the use of open questioning. By asking students, "How many ways can you make 180?" or, "How many ways can you think of to check your answer?" to a contextualised problem, students are practising Green Hat thinking. This relating of operations and number facts and being flexible with numbers can also develop number sense. For example, in order to work out the change for the computation, "Six dollars take away four dollars fifty," a student response might be: "Six take four, then take half off," or "You could do 600 take 450 cents." At the fourth stage, (Yellow and Black Hat) thinking combines to analyse both the benefits and weaknesses of the Green Hat ideas. This should involve class discussions with the sharing of ideas so that students may adopt a more efficient computation method in future. As some students have been found to lack many mental strategies, it may be useful to provide written algorithms to be calculated mentally as an example of Black Hat thinking to illustrate the need for developing efficient mental strategies. For example, the calculation 199 + 65, could be solved as: "It's 199 add 1 from the 5 to make 200 and

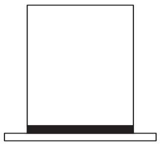
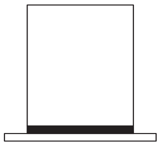
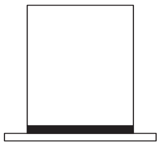
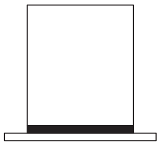
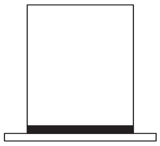
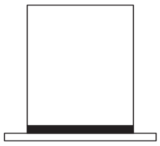
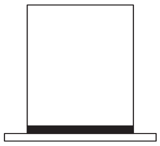
	Complete the statements below and match the colour hat to show what thinking was used. Which colour hat covers all of these aspects?
	My favourite shape is a …………………….. The thing I liked best about studying shapes was ………………………..
	The problem with curved shapes is ………………………… The problem with irregular shapes is………………………..
	The face of a 50-cent piece has 12 edges. It is called a ………….. Tell me three things you know about a cube shape 1. ……………………………………… 2. ……………………………………… 3. ………………………………………
	……………………… shapes are useful because they stack. What is good about your favourite shape?………………
	How could we group 3D shapes? According to ……………….. How could we group 2D shapes? ………………………………
	Can you invent a new shape? Draw and name it.

Figure 4. Student worksheet; may also substitute coin or number for shape.

you've got 64, so 264." Compare this to the time taken using the standard mental algorithm method and a calculator as well as the increased chance of error. Finally, students revisit Blue Hat thinking, which is reflective and reason whether the responses make sense. Finally, the class may refer to all six Thinking Hats when using reflective journals (Blue Hat) to summarise the topic studied. For example, what were their attitudes before and after (Red Hat), what new knowledge/skills (Green Hat) were uncovered?

In Western Australia, *working mathematically* is the newest strand of the mathematics key learning area (KLA) in *Curriculum Frameworks* (Curriculum Council, 1998). The Six Thinking Hats could be used within this strand. For example, in Ray Robicheaux's problem solving activity "How can we design paper money for the visually impaired?" one sequence might be Blue Hat (what thinking is needed), Green Hat (suggest several solutions, list all the strategies), followed by Yellow and Black Hats (evaluate), return to Green Hat (for new ideas), Red Hat (to prioritise these solutions) and finally returning to Blue Hat (summarise the most appropriate strategies in response to: does it make sense?). With good teaching practices, we could turn students' emotional responses to their mathematics experiences (Red Hat) into positive ones!

Although worksheets are included in the source reference, numbers 1 to 3 assesses the student's comprehension of the Thinking Hats rather than assessing specific curriculum outcomes. The real value in such worksheets would be to supply the colour of the hat and ask students for an example of that thinking or re-word the worksheet to suit the mathematical topic. The sample-adapted worksheet shown in Figure 4 is suitable for evaluating a Grade 1 unit on shapes.

References

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