MATHS WITH MANIPULATIVES: DOMINOES

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Sometimes in our attempts to 'cover the curriculum', we jump from one topic or idea to another. In so doing, we create stress for ourselves and miss opportunities to link the Content and Proficiency Strands of the Mathematics Curriculum. In this article, I will use one manipulative, dominoes, and show how a few basic ideas may be extended.

DOMINOES

Twenty-one of the standard double-six dominoes can be linked to the rolling of two six-sided dice, e.g. 6-4. The remaining seven dominoes in a standard double-six set are made up of 6-0, 5-0, 4-0, 3-0, 2-0, 1-0, and 0-0.

SORT IT OUT

When students first work with a set of dominoes, I asked them to check whether they have a full set; however, I avoid telling them how. They will need to apply some sorting procedure to determine if they have a complete set or if there are any missing or double-ups. Dominoes often get mixed up in classrooms as they are often the black and white variety. Multiple colours will make them easier to look after and maintain.

Consider the mathematics behind such a simple sorting task. Students have to identify an attribute and use this as a sorting system. Some systems include:

- Odd and even dot sums
- Doubles and others
- Dot Totals, 0, 1 , 2, 3 etc. This system produces a bell curve-like graph that shows symmetry (see Figure 1)
- All the dominoes with a six in them, followed by all the remaining dominoes with a five etc. (see Figure 2)

When students sort the dominoes and explain how they have done this, they are using their mathematical vocabulary and reasoning. Eventually, students will work out that there are 28 dominoes in a standard set. This can lead to a variety of further investigations.

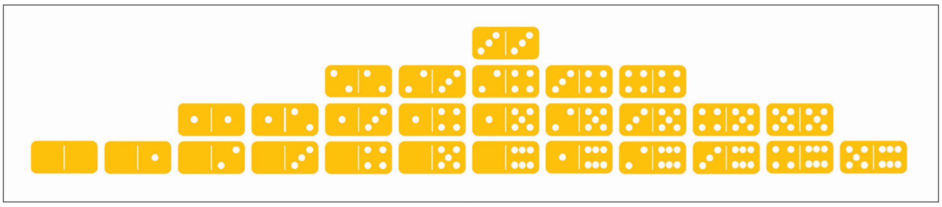

Figure 1. Sorting dominos system 1.

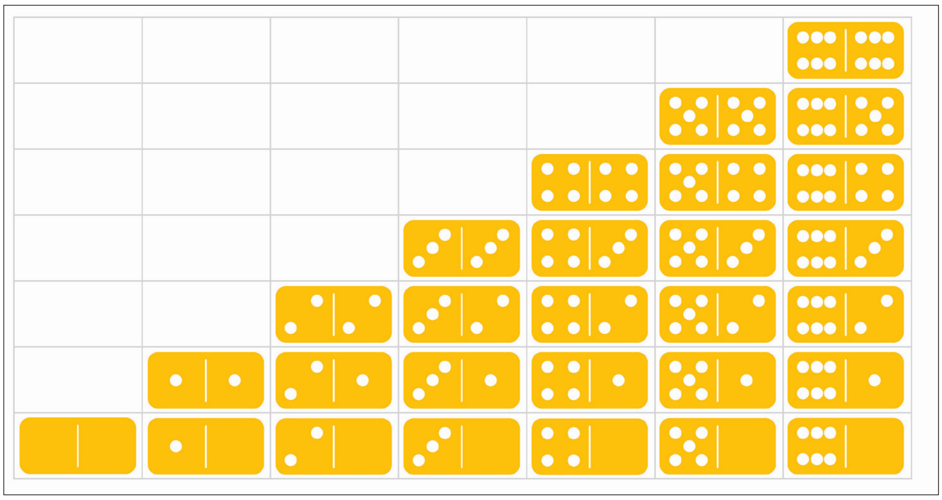

Figure 2. Sorting dominos system 2.

HOW MANY DOMINOES?

How many dominoes in a:

- Double-nine set
- Double-twelve set
- Double-fifteen set?

HOW MANY SPOTS?

A more challenging question is to determine the total number of spots on the various different sets of dominoes. A task like this requires using all four proficiencies (Understanding, Fluency Problem Solving and Reasoning) together. This makes it simpler to differentiate, as students can choose their own challenge or choose a simpler challenge and apply what they learn to solve a harder challenge.

A FOCUS ON REASONING

The following tasks all involve Understanding, Fluency and Problem Solving, but rely on Reasoning to determine when all of the possible solutions have been found.

REASONING TASK 1: DOMINO TRAINS

Students join dominoes to make 'Trains of Ten'.

- A domino may be joined to another domino if the number of spots match.
- Altogether there should be ten spots (see Figure 3).

Consider some reasoning associated with this task.

What is the shortest length train possible?

What is the longest train possible? What might it look like? Hint (or enabling prompt – it is five dominoes long.)

Armed with this knowledge, students can work systematically to determine all of the possible answers.

Extending the thinking

Set the challenge of making a train, using exactly five dominoes, where the total number of spots is twenty. Note, students still need to apply the joining rule (where the number of dots at a join must match).

This task may be altered further to use ten dominoes, having a total of 40 spots. Remember the joining rule still applies.

The mathematics inherent in these tasks may at first appear simple- matching and counting. However, after trying the task, I am sure that you will agree that the reasoning involved makes this an activity well worth introducing to your students.

REASONING TASK 2: THREE DOMINOES

The idea of asking 'open-ended' questions may be applied to dominoes. Consider the following task.

There are three dominoes that are joined. Remember to join, the dots on each end of the domino must match. The first domino is a double. Other dominoes also may be doubles. The total number of dots is 21 (see Figure 4).

Finding a solution is satisfying. Finding all of the possible solutions and explaining how you did it is where the real thinking or reasoning comes into play. Consider a few starting points. If you begin with a double six, the domino that joins on must have six dots on the matching side, so you have already used up 18 dots. So if you have used 6-6 and 6-?, ?-?, what dominoes might work? You will soon exhaust all of the possibilities — time to try double five and so on.

THE VALUE OF THE MANIPULATIVE

The nice part about these problems is that while manipulating the dominoes, it is as though the students' thinking was out there on the table. Teachers can observe, ask questions, or prompt a line of thinking while students try different options.

Students can record their thinking by literally photographing or drawing rectangles with dots inside. Eventually, the dots may be replaced with numbers

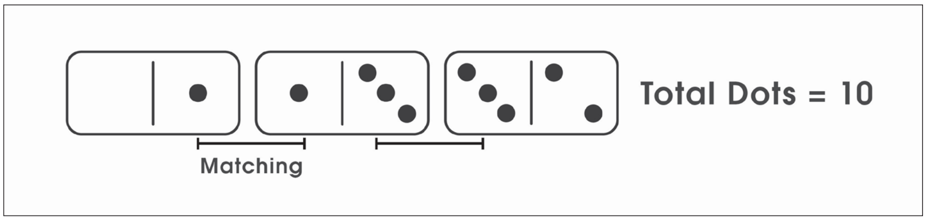

Figure 3. Total 10 train.

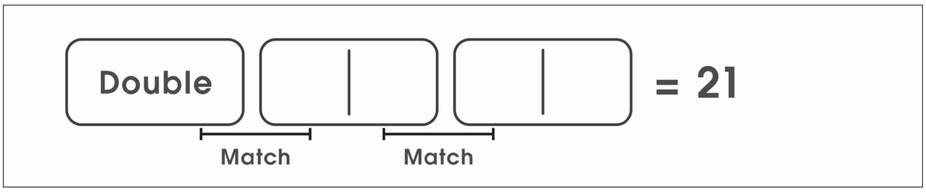

Figure 4. Total 21 train.

and then some code such as 6-5 might be applied to refer to the six-five domino. Students may use large magnetic dominoes or standard dominoes to show and explain their reasoning to others.

Remember the manipulative is just the catalyst for promoting the thinking. The language used will help develop the mathematical concept to be developed. The manipulative is just a means to an end.

CONCLUSION

A colleague once said to me:

'The telling teacher is not the telling teacher.'

They were implying that teachers who just tell students how to go about solving a problem will not have as much impact as those who support the learner through well thought out enabling prompts. The real art is working out which students require which level of support. In Australian Rules Football, we would call this 'reading the play'. To do this, the player needs to have achieved a level of fluency, understand the game but also understand the flow of the current game and think through a winning play. All of this happens in 'real-time'.

Likewise, for a teacher to help their students, certain decisions are made in real-time. This means that the teacher needs to be familiar with the problem and anticipate possible issues. The teacher also needs to know their students well enough to make split-second decisions as to what support they might offer.

Try some of these tasks yourself and then try with some students. Try it again and again, and you will develop your own variations as you become familiar with the problem. Any recording that the students make may be used as evidence to show how they have reasoned about the task.

AUTHOR

Paul Swan has worked at primary, secondary and tertiary levels and is keen to share good ideas for teaching (G.I.F.T.S), via his website (www.drpaulswan.com.au), videos, publications, games and presentations.