Finding the maths

Helping students connect their mathematical knowledge to other contexts

Students in a classroom focussed on engagement may have clear and well-defined expectations from the teacher. An important element of this type of teaching is helping students connect their work on a problem or task to the specific mathematical concepts or skills represented. Through these connections, students are more likely to recognise similar situations in the future where they might use the same or related processes. (Seeley, 2004, p. 3)

Chris Hurst urges us to enhance our students' numeracy skills by helping them recognise the mathematics that is embedded in everyday contexts.

The plethora of data that confronts us on a daily basis requires that we know more than simply being able to calculate. It demands that we understand the context in which the mathematical ideas are embedded and what those ideas are telling us in relation to that context. Also, it necessitates that we are prepared to question how data, and the associated claims, are presented. For primary teachers, the implication is that we must be prepared to help our students to develop these skills. *'Finding the Maths'* is one strategy that has been shown to be successful in helping students achieve this outcome.

This article, and the work samples contained in it, are based on an activity called 'Finding the Maths', the task sheet for which is shown in Figure 1.

Work samples were collected from Year Six and Seven students in six different classes. All names are pseudonyms in order to preserve the anonymity of students.

What is numeracy?

There are various interpretations of the term 'numeracy'. It is sometimes termed 'statistical literacy' (Watson, 1995, 2004), 'quantitative literacy' (Steen, 2001), and 'mathematical literacy' but it is apparent from research, that these terms may well mean one and the same thing. That is that numeracy entails a disposition to recognise, understand, and apply mathematical ideas in a wide range of contexts that may be quite different to those encountered in the mathematics classroom. This gives teachers a clear direction about the learning opportunities they need to provide in order to help their students become more numerate, as well as how they will evaluate the numeracy development of their students.

The problem

Many students who have an understanding of mathematical concepts often fail to recognise, understand or apply those mathematical ideas when they are embedded in a range of

contexts. According to Peter-Koop, "primary school children frequently engage in a rather arbitrary and random operational combination of numbers given in a text" (2004, p. 454). An example of this is shown in the 'Sun, Moon and Planets' sample (Figure 2). The student has shown some mathematical knowledge in being able to add and subtract but has applied these processes inappropriately. For example, adding the 'setting' times of the various bodies makes no sense at all.
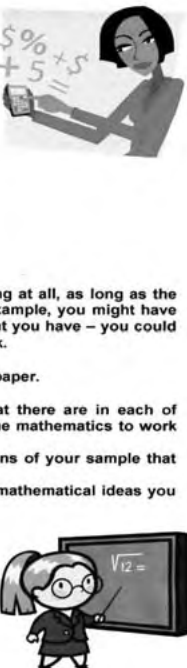

Figure 1: Task sheet for *Finding the Maths*

The inference is that teachers need to help their students bridge the gap between the mathematical ideas they know, and how to recognise and apply those ideas outside of the mathematics classroom

Figure 2: Sun, Moon and Planets task–student work sample

A numeracy framework

Willis and Hogan developed a numeracy framework, described in Hogan, (2000) and Morony, Hogan, and Thornton, (2004), to clarify how teachers could think about numeracy. It incorporated a blend of three types of thinking or knowledge:

- Mathematical–the skills, concepts and techniques for solving quantitative problems,
- Contextual–the awareness and knowledge of how the context affects the mathematics being used, and
- Strategic–the ability to recognise the appropriate mathematics needed to solve a problem, to apply and adapt it as necessary, and to question the use of mathematics in context.

Willis (1998) noted that a blend of the three types of thinking or knowledge was needed for a person to be considered truly numerate.

In addition, three roles were also identified as part of being numerate. These were:

- The fluent operator–being a smooth and almost automatic user of mathematical ideas in familiar contexts,
- The mathematical learner–using mathematics in an unfamiliar context to learn or understand something new, and
- The critical mathematician–questioning and judging the appropriateness of how mathematics is used in a given context.

'Finding the Maths'

The aim of using this strategy was to encourage students to develop the three types of thinking referred to in the numeracy framework and to assume the roles of the 'mathematical learner' and 'critical mathematician'. It was conducted along the lines suggested in the student task sheet at the beginning of this article. Essentially, 'Finding the Maths' is aimed at focusing students on the specific mathematical ideas contained in whatever context they have chosen. They first need to recognise that there is mathematics embedded in the context in order to choose

it. Specifically, they were asked to 'describe the mathematical ideas in the samples' and to 'describe how to use the mathematical ideas to learn or explain other things about the sample'. They were also encouraged to pose questions about how the mathematical information was used and what it could tell them about related issues. These aspects of the task relate to the various elements of the numeracy framework. Work samples that follow consist of the actual pieces collected by students and their verbatim responses to the task instructions. This strategy was used in tandem with Debriefing the Numeracy which is described later.

Student work samples

Sample 1 - Bessie

1. Simple bag

Cut two 126cm x 56cm rectangles.

Place the two rectangles right sides together. Lay the coathanger at the top of the bag, then trace and cut around the curved shape. With right sides together and allowing 1cm seams, stitch the front and back together, leaving the lower edge open and 2cm in the top edge for the hook. Turn the bag right side out. Press under 1cm on the lower edge, then press under another 5cm and stitch the hem in place.

Finish the bottom edges with velcro or buttons, if desired. Remove hook from hanger, slip hanger into bag, then insert hook through top hole and screw into place.

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Student comments and/or questions

1. Would it work if the numbers were different? (i.e., the 126cm X 56 cm)
2. What would be the price difference if you either made the bag or bought it?

Anecdotal Comments

Bessie has displayed contextual thinking. She has posed a question based on a particular aspect of the embedded mathematics about the possible effect of changing the dimensions of the bag. She has also displayed strategic thinking by suggesting the need to compare the difference in cost between making and buying a ready-made bag. This would require some research and some evaluative thinking.

Sample 2 - Jessica

Student comments and/or questions

How many kilometers do they mean by 'very good km's'?

Anecdotal Comments

Jessica has displayed strategic thinking by inferring that the interpretation of terminology used in the context of the advertisement is subject to the opinion of the reader.

$8,990

1997 MITSUBISHI EXPRESS VAN
Perfect for the Tradesman who's starting out. This van features smooth automatic transmission, icy cold air conditioning, power steering, very good kms & is ready to start making money. Don't miss out.   1ACR 645

Sample 3 - Pete

Student comments and/or questions

How would you get to the restaurant from my house?

Go to the top of Barrisdale Road and turn into Glencoe Road. Go to the top of Glencoe and turn right into Risely Street. Then go to the bottom of Risely Street and keep going on that road across Canning Highway. At the end of Risely Street, keep going into MacLeod Road. Cross Kintail Road and you will be in Ardross Street. Drive until you get top Number 36.

Another way that you could go is by going to the bottom of Barrisdale Road and then crossing onto Gunbower Road. Keep going until you can turn onto Henley Road and then cross onto Ardross Street. Keep on this street until you get to Number 36.

I worked these directions out by using the address on the front of the menu and a road map.

Anecdotal comments

Pete has displayed strategic thinking by interpreting an aspect of the embedded mathematics related to the restaurant location and then investigating in order to answer the question he posed.

GUCCE
FINE ITALIAN CUISINE

GUCCE For FUNCTIONS
GUCCE For CATERING
GUCCE For TAKEAWAY
GUCCE For DINE-IN

Take Away Menu

36 ARDROSS ST. APPLECROSS WA 6153
PH: (08) 9316 9311
Dinner: Wed to Mon - 5.00pm till late
Lunch: Friday from 12.00 noon

FULLY LICENSED
BOOKINGS ESSENTIAL.

Public Holiday surcharge: 10% on total bill
(Effective 10/2/05)

Sample 4 - David

RONDO BUNK SUITE SINGLE BUNK, ADD ON DESK, BEDSIDE & DRESSING TABLE
This versatile bunk creates a fun kids' room. Make the perfect retreat with optional built-in desk and multiple chest and shelving options. Available in White with Red, Blue, Purple, Pink, Teal or White trimmings. Sizes: Single or King Single. **Was $2397 Now $1999**

Student comments and/or questions

1. How do buyers know that there's exactly 15% off? – They would work out 15% of the original price to see if the sale price is accurate. For example, the Rondo suite was $2397, but the sale price is $1999.

   Maths: 2397 X 0.15 = 359.55
   and   2397 − 359.55 = 2037.45.

   What they're offering is actually a greater than 15% discount. It is actually 16.6%.
2. Why are they having a sale? – Maybe they want to clear out old stuff and bring in new things.

Anecdotal comments

David has displayed strategic thinking by evaluating aspects of the embedded mathematics for accuracy and by posing a question related to the reason behind the sale.

Sample 5 - Brett

Student comments and/or questions

London costs $1675 at Flight Centre and Harvey World Travel is $24 more than Flight Centre.

Harvey World Travel Singapore flight costs $579, to and back, and Flight Centre is $575 includes return airfare and 2 nights accommodation. It has better value.

Flight Centre have flights what take you there and then return, airfare and accommodation.
And it's still less than Harvey World Travel.

Anecdotal comments

Brett has displayed contextual thinking by comparing aspects of the embedded mathematics. He has also displayed emerging strategic thinking by evaluating aspects of the information to make an informed decision about the relative value of the two advertisements.

Sample 6 - Cassie

Student comments and/or questions

1. How much would it cost to buy one of each size?
2. If the sheets were their normal prices, how much would it cost to buy one of each size?
3. How much bigger is the double bed sheet compared to the single bed sheet?

Anecdotal comments

Cassie has displayed mathematical thinking by posing questions that require the use of a single mathematical operation. She has also displayed emerging contextual thinking by raising the issue of different sized sheets, possibly inferred from the different costs for the two sizes.

Debriefing guidelines for students

The following sheet is a copy of the 'debriefing guidelines' that were used before and after the Finding the Maths task was done. The aim of this strategy was to focus student thinking on the embedded mathematics in a particular context.

DEBRIEFING GUIDELINES

How can I use the mathematical information to help me work something out, or to tell me something else?

- *Is there some information that seems to be a part of something else?*
- *Tables of information usually show sub-totals and you can use these to compare things within the table.*

Some typical questions to ask yourself

- *Do the figures show an increase or a decrease, or do they stay the same?*
- *Do some figures seem to go up, or down, more so than other figures, when thinking proportionately?*
- *Are there different figures or sets of figures that are about the same thing? If so, do they all "tell the same story" or are they saying something different?*
- *Can the figures be better represented by putting them into a chart or table?*

You don't necessarily have to be able to ANSWER the questions you pose. The important thing is to look into the mathematics to find questions that you CAN pose about the mathematical information.

Conclusion

It was apparent from the student contributions that the 'Finding the Maths' strategy engaged them in thinking about how the mathematics they knew was embedded in a range of contexts. This was emphasised by asking them to choose a context that contained some mathematical ideas so they first had to recognise that their chosen context contained some mathematics. The directed questioning also focused their thinking on what the mathematics told them about the context. In being to pose questions about how the mathematics was used, students were also encouraged to adopt the roles of the 'learner' and the 'critical' mathematician, as described in the numeracy framework. The debriefing strategy further focused students' thinking on recognising the embedded mathematics, what it said about the context, and the fact that its use could be questioned.

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