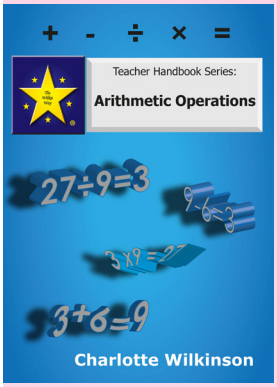
The Wilkie Way

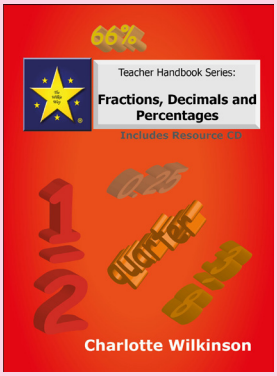
Newsletter March 2020

www.thewilkieway.co.nz

The Literacies of Mathematics

Earlier this week I participated in a webinar hosted by Dr Paul Swan based in Australia. Like myself he is an author, workshop presenter and resource designer.
In this newsletter I have used his headings and further developed his ideas. Specific detail on developing mathematical literacy can be found in The Teacher Handbook Series: Chapter One in the Fractions, Decimals & Percentages handbook and Reading Arithmetic Word Problems Chapter 3 in Arithmetic Operations handbook. Both handbooks are available from the online store at www.thewilkieway.co.nz





Paul referred to mathematics literacy as “the missing link”. Many students cannot access mathematics because they don’t have sufficient mathematical literacy skills to make sense of what is being asked.

He refers to three different literacies which develop in this order:

1. Words - the vocabulary of mathematics: this may be a single word or a group of words for example “twice as much as”
For reading a fiction book students need to know about 95% of the words in a text for comprehension. Mathematical texts are more dense, covering more concepts therefore 95% of words in the text is an absolute minimum and the 5% unknown students will need help with beyond just reading them.

Mathematical vocabulary is made up of three types of words or phrases

- **Technical vocabulary:** These words are only seen and heard in specific content areas. Geometric vocabulary, measurement vocabulary, number and number operation vocabulary. Geometry and measure have a greater vocabulary than other strands of mathematics.

- **General vocabulary:** mathematical words that are used in everyday speech and text. Overall, everyone understands and agrees on the meaning of these words and often teachers make the assumption that students know these words.

- **Specialised vocabulary:** these words may have a general meaning in everyday situations but have a specialised meaning within the area of mathematics. For example: regular - in terms of coffee regular means a smaller cup, but a regular hexagon is not a smaller hexagon but a six sided shape with all sides and angles equal.

Additionally many words are homophones - rows/rose, pair/pear, eight/ate or sound similar to words already in their vocabulary for example symmetry/cemetry.
Many of the little words cause significant problems for English speaking students. The difficulties encountered by students with English as a second language is of course much greater.

The common small words that cause problems are: the, is, a, are, can, on, who, find, one, ones, ten, tens, and, or, number, numeral, how, many, how many, what, write it, each, which, do, all, same, here, there, has, have, of, off

The grammatical structure of the text plays a significant part in comprehension. The order of the words in a text are important. Changing the word order can result in a different problem.
Three girls may divide six muffins but three girls cannot be divided by six muffins.

2. Images, pictures, the visual literacy: We use alot of visual literacy in mathematics to communicate ideas. This can be counters, number lines (ruler, clock, protractor, graphs), tables, charts, pictures, shapes, stylised patterns, (dice, tens frames). The visual images are created by the materials that we use and/or the context in which the problem is set.(materials/imaging) While we had this second step of mathematical literacy in the numeracy project and in the curriculum (meaningful context) insufficient attention is paid to words - and in particular the geometric and measurement language that underpins a conceptual understanding of number.

3. Symbols: All symbols are representations. Numbers represent a quantity, and within the number system the position of the digit represents its value. Some symbols represent operations, the operation itself represent multiple concepts. Other symbols represent a relationship. Using symbols can be thought of as part of the number property phase in the numeracy project teaching model.

Using symbols with understanding is a complex process. When encountering mathematical symbols students face a multilevel decoding process:

- Firstly they need to recognise and separate out the mathematical symbols with out any phonic clues.
- Next they need to translate each symbol into words or a word, then they need to connect the symbol to a concept for which the word or words have meaning.
- Finally they need to carry out the operation indicated if it is an operation symbol or look for the relationship. (Most students think the = symbol is an operation symbol meaning give the answer)

Inorder to use symbols with understanding students need both the other mathematical literacies first.

Without a focus on language students are being shut out of the mathematics & statistics learning area;

Use the NZ curriculum to remind yourself of at the progressions through the levels in the mathematics achievement objectives: Using equations and expressions. You will see a progression from words and pictures, to words and diagrams to an increasing use of symbols. However language (words) must be a focus at all levels to increase and deepen conceptual understanding.

Remind yourself Language and learning areas (page 16)
The learning area has its own languages. As students discover how to use them, they find they are able to think in different ways, access new areas of knowledge and see their world from new perspectives. **Students need specific help from their teachers .....**

Remind yourself of the key competency: Language, symbols and texts. (page 12)
This is about working with and making meaning of the codes in which knowledge is expressed. Languages and symbols are systems for representing and communicating information, experiences and ideas.

Ways to focus on developing vocabulary throughout all year groups

1. Develop a list of words or groups of words. Consider is there a progression?
In the juniors I might ask students to line up from **smallest to largest** but in the seniors I should be asking them to line up in **ascending** order.

It is important to introduce appropriate language with a focus on extending a students vocabulary not just using the words they already know.

Are you progressing the mathematical language throughout your school.

Start a list and keep adding to it. Encourage students to voice when they do not know what a specific word or phrase means. If it is not addressed at the time the student or students are locked out of the lesson.

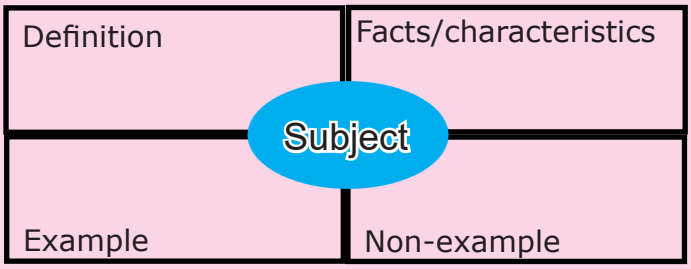
When developing a list of words for geometry consider the three geometric questions:

- What is it? shape/appearance
- Where is it? location
- How does it move or change? - transformation

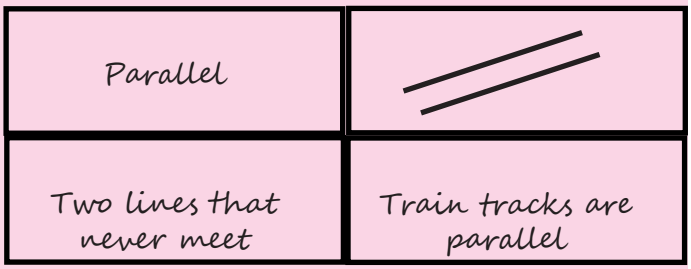
2. Using story books - there is a list of picture books for developing mathematical ideas and language on the NZMaths website.
Many of the stories have further activities associated with them.

3. Use graphic organisers to develop an understanding of the word, for example
- The Frayer Model - which takes a word and looks at the essential characterisitics, an example (What it is) and a non example (what it isn't) and from these a definition can be written.
- Verbal-Visual Association Card

Frayer Model



Verbal - Visual Association Card



4. Mystery Bag - put an object in a bag for the student to feel and describe the characterisitcs they can feel. (Ideal for identifying properties of two and three dimensional shapes)

5. Which one doesn't belong? See website: http://wodb.ca

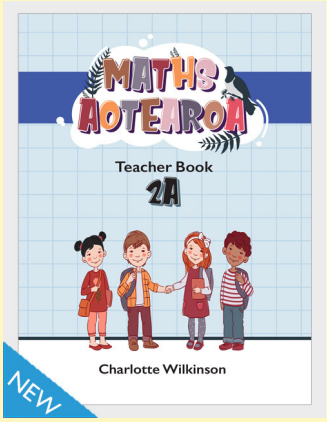
6. Maths dictionaries - provided students understand all the words used in the definition.

Resources for Wilkie Way members

School subscription just $275 p.a
contact charlotte@ncwilkinsons.com to subscribe by invoice
Individual subscription $30 via paypal at www.thewilkieway.co.nz

The site is getting overloaded with resources so we have started the process of redesigning the complete website. Subscriptions will have to increase slightly when the new site is launched. One of the challenges will be to migrate the current data base. School subscriptions by invoice will not be an issue as they are manually entered. Any school wishing to subscribe before the launch of the new website will have the current price of $275 for a full year.

Are there any features that you would like to see included in the new site? My designer is looking at adding a search feature to the membership content area.



Maths Aotearoa Level 2 is now available. The most up to date mathematical texts written specifically for the New Zealand curriculum and NZ Numeracy learning progressions. This is an updated version of Pearson Mathematics and the new books can be used in conjunction with the older version - don't throw them away. The new teacher books contain more professional learning support for teachers and a focus on conceptual learning and knowledge building as well as specific learning intentions for activities.

I am currently working on the level 1 books and activity cards. Level 3 and 4 will follow.

Books are available from www.edify.co.nz

All orders for Pearson Maths and Maths Aotearoa will go through this company. Any orders sent direct to me will be forwarded on.

The Wilkie Way Teacher Challenge

Let's try some good old multiplication algorithms

In the following questions the letters represent digits. Each different letter is a different digit. Find the value of each letter.

1.
$$\begin{array}{r} A\,1 \\ \times\ A \\ \hline 2\,A\,A \end{array}$$

2.
$$\begin{array}{r} 4\,B \\ \times\ B \\ \hline 2\,7\,B \end{array}$$

3.
$$\begin{array}{r} C\,D \\ \times\ 3 \\ \hline 6\,9 \end{array}$$

4.
$$\begin{array}{r} C\,E\,F \\ \times\ 6 \\ \hline 1\,4\,8\,2 \end{array}$$

A = _____ B = _____ C = _____ D = _____ E = _____ F = _____

