YuMi Deadly Maths

Year 7 Teacher Resource:

NA – What's the link?

Prepared by the YuMi Deadly Centre
Faculty of Education, QUT

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Growing community through education

ACKNOWLEDGEMENT

We acknowledge the traditional owners and custodians of the lands
in which the mathematics ideas for this resource were developed,
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Year 7 Number and Algebra

What's the link?

Learning goal Students will create algebraic expressions to describe number sequences.

Content description Number and Algebra – Patterns and algebra

- Introduce the concept of variables as a way of representing numbers using letters (ACMNA175)
- Create algebraic expressions and evaluate them by substituting a given value for each variable (ACMNA176)

Big idea Number – patterns, variable/pronumeral

Resources Buckets of cubes, pencils, counters, cards with algebraic expressions, set of steps

Reality

Local knowledge Discuss places where patterns are seen, e.g. fabric designs, tiling patterns, artwork, borders on writing paper, china, pottery, number patterns.

Prior experience Check on understanding of repeating and growing patterns, e.g. divide the students into two groups with half of each gender in the two groups. Have the first group make a pattern of one boy followed by two girls (or vice versa depending on the gender balance). Ask the second group to make the same pattern but in a different way. For example:

BGG BGG BGG …

or

BG BG BG
 G G G …

If these patterns are repeated, how many boys will there be in a total of 261 students? [⅓ of 261 = 87. Boys are one of the three students in the repeating pattern.]

Kinaesthetic Have some buckets of different materials on display. Students form groups to represent these expressions: 3 students and y counters, $3 + y$. (Emphasise that "y" stands for an unknown number of counters, a handful that hasn't been counted; say: *Let "y" be the number of counters*.) 5 students and m pencils, $5 + m$. *Let "m" be the number of pencils*. Reverse: Students create an expression for others to make.

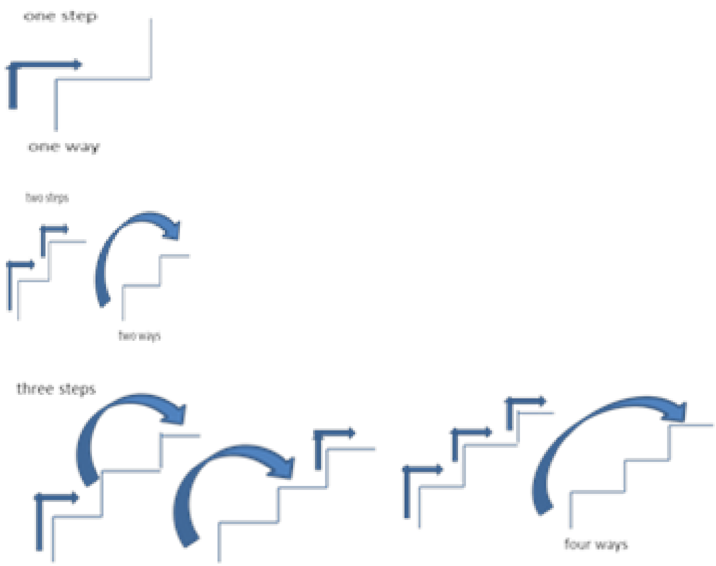
Students model these expressions: Harry is half as big as his Dad – one student lies on the ground and two more lie vertically beside him: Harry = Dad ÷ 2 or $H = D \div 2$ where H stands for Harry and D stands for Dad.

Show cards with algebraic expressions and have students model them and tell a story that the expression may represent.

Abstraction

Body Students assemble at the bottom of a set of stairs. *How many ways can we go up one step?* Walk up one step [one way]. *How many ways can we walk up two steps?* [Walk and count the two ways.] Three steps [walk and count the four ways], four steps [walk and count the eight ways], or any number of steps. *Can you see a pattern in the number of ways taken to walk up the steps?* [Each time we walk up another step, the number of ways is doubled.]

Hand Draw the pattern of walking up the stairs, for example:



Students create a table, draw then record the number of steps and the ways of walking up the steps, then write as a power of 2. For example:

Number of steps walked	Number of ways	Power of 2
1	1	2^0
2	2	2^1
3	4 or 2 × 2	2^2
4	8 or 2 × 2 × 2	2^3
5	16 or 2 × 2 × 2 × 2	2^4
6	32 or 2 × 2 × 2 × 2 × 2	2^5

Is there any connection between the number of steps walked and the exponent or power of 2? [The power or exponent is always one less than the number of steps.] Let "n" be the number of steps walked. The number of different ways will be 2^{n-1}. So if we walk up 8 steps, the number of different ways will be the power of 2 that is one less than eight: 2^7 or $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 128$.

Mind Close your eyes and walk up three steps in the four different ways. You may like to draw these ways on the desk taking small jumps for one step and big jumps for two or three steps at a time.

Creativity Students create their own word stories, algebraic expressions and drawings that represent the word stories.

Mathematics

Language/ symbols variable, expression, equation, exponent, power

Practice

1. Create growing number patterns using toothpicks, paddle-pop sticks or counters and record the progression in a table. Look for a pattern and describe it in as many algebraic ways as possible.
   (a) Even/odd numbers
   (b) Triangular numbers
   (c) Fibonacci numbers

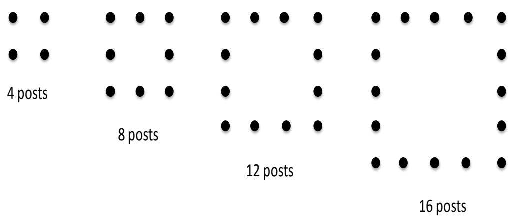
2. Provide word stories for which algebraic expressions may be written in different but equivalent ways, e.g. students write different algebraic expressions for "the day's catch for five families" [$f + f + f + f + f$ or $5 \times f$ or $5f$].
3. Reverse 2 above: Give algebraic expressions and students compose word stories for the algebraic expressions.
4. Word story: Students create their own thinkboards to tell a word story, draw the pattern, write its algebraic expression and solve the equation. E.g. *For every step Dad took, Sue took 2 steps. If 384 steps were taken by both on their walk, how many steps did Dad take?* [Let Dad's steps be x. So $x + 2x = 384$.]
5. Write algebraic expressions for their partner to tell stories about; e.g. *Tom had 6 packets of Smarties. He gave 2 packets to his sister and 2 packets to his friend. After eating 12 Smarties, he counted that he had 64 left in total. How many were in an unopened packet of Smarties?*

Connections Relate to function machines, tables, graphs.

Reflection

Validation Students share their thinkboard with a partner. They also tell stories that represent the algebraic expressions that their partner has written.

Application/ problems Provide applications and problems for students to apply to different real-world contexts independently, e.g. a fence problem: *A farmer wanted to make square paddocks of different sizes for different purposes. He followed this pattern*:



How many posts would be used for a square paddocks with: (a) 10 posts a side, (b) 100 posts a side, and (c) 1000 posts a side? How could you write this number pattern algebraically? (See Teacher's notes.)

Extension **Flexibility**. Students write as many equivalent algebraic expressions as they can for the same word problem and tell many different word stories for a given algebraic expression.

Reversing. Students are able to move between telling a word story for an algebraic expression ↔ acting it out ↔ writing and representing it in equivalent algebraic expressions ↔ interpreting patterns and making generalisations in algebraic terms, starting from and moving between any given point.

Generalising. *A letter or symbol may be used to represent an unknown value. Variables or pronumerals stand for something that is not immediately known. Patterns have a basic part that either repeats or grows in a set way. Patterns may be written in equivalent algebraic forms.*

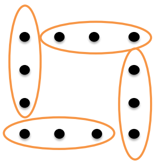
Changing parameters. Students solve algebraic equations with one variable, two variables.

Teacher's notes

- Ensure that students have a sound understanding of how to determine the pattern in repeating and growing patterns so that they are then able to generalise and write an algebraic expression that represents the pattern. Emphasise that there may be more than one way to express the pattern algebraically. A variable or pronumeral stands for an unknown numeral or value.

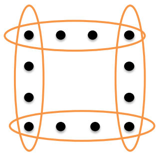
- In the Application problem above, the following patterns may be seen:

(a)



4 on each side is $4 \times 3 = 12$ posts
100 on each side is $4 \times 99 = 396$ posts
Let the side be “S”: Number of posts $= 4 \times (S - 1)$

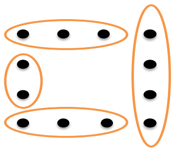
(b)



4 on each side is $4 \times 4 - 4 = 12$ posts
100 on each side is $4 \times 100 - 4 = 396$ posts
Let the side be “S”: Number of posts $= 4 \times S - 4$

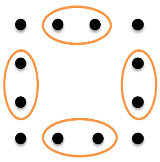
A **pattern seen as multiples of 4**: $(S - 1) \times 4$; $4(S - 1)$; $4S - 4$

(c)



4 on each side is $4 + 3 + 3 + 2 = 12$ posts
100 on each side is $100 + 99 + 99 + 98 = 396$ posts
Let the side be “S”: Number of posts $= S + (S - 1) + (S - 1) + (S - 2)$

(d)



4 on each side is $4 \times 2 + 4 = 12$ posts
100 on each side is $4 \times 98 + 4 = 396$ posts
Let the side be “S”: Number of posts $= 4 \times (S - 2) + 4$

- Students need to be taught the skill of visualising: closing their eyes and seeing pictures in their minds, making mental images; e.g. show a picture of the letter x, students look at it, remove the picture, students then close their eyes and see the picture in their mind; then make a mental picture of the algebraic expression $x + 1$.
- Suggestions in Local Knowledge are only a guide. It is very important that examples in Reality are taken from the local environment that have significance to the local culture and come from the students’ experience of their local environment.
- Useful websites for resources: www.rrr.edu.au; https://www.qcaa.qld.edu.au/3035.html
- Explicit teaching that **aligns with students’ understanding** is part of every section of the RAMR cycle and has particular emphasis in the Mathematics section. The RAMR cycle is not always linear but may necessitate revisiting the previous stage/s at any given point.
- Reflection on the concept may happen at any stage of the RAMR cycle to reinforce the concept being taught. Validation, Application, and the last two parts of Extension should not be undertaken until students have mastered the mathematical concept as students need the foundation in order to be able to validate, apply, generalise and change parameters.

