WHAT STUDENTS NEED TO KNOW AND UNDERSTAND ABOUT ALGEBRA

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Introduction
The following sections contain information about what your students need to understand about patterns and algebra, what happens when they do not understand, how to recognise this, and what to do about it.
In the early years, the ability to notice patterns and describe them helps to develop algebraic thinking and an understanding of function. Students observe concrete examples of balance, learn how to maintain balance when variables change and apply these understandings to equivalence and equations. Learning in the early years can be organised into three main topics including:
1. Patterns
2. Equivalence and Equations
3. Functions

Patterns

Concepts students need to understand:
- Students need to be able to observe and identify:
  - The type of pattern: repeating, simple growing patterns, spatial patterns that radiate outwards
  - The common features of the pattern – what part is repeated (repeating patterns), what regular changes are made to get from one position in a sequence to the next (growing patterns)
- Students need to be able to describe patterns by:
  - Telling how the pattern begins
  - Telling how to get from one position in the pattern to the next
  - Using appropriate language – bigger, larger, smaller, more, less, fewer, order, first, last, before, after, next.
  - Making generalisations about the rule that is used to make the pattern. In order to be a rule, it should be true for every step in the pattern. Students confirm the rule by testing it against subsequent steps in the pattern. Sometimes, it is difficult to identify the rule as more than one rule will fit the pattern.

Strategies to help develop understanding:
- Young students need many opportunities to observe patterns in their environment.
  - To identify patterns, they notice regularities in the way things are arranged.
  - Most frequently, students recognise patterns comprised of colour, shape, size, actions and sometimes, number.
  - Just as important are the differences they note between items within a pattern and between patterns.
- Students construct patterns by:
  - Following rules provided by others (visually, verbally, kinesthetically)
  - Copying or extending patterns made by others
  - Creating patterns of their own design
  - Translating given patterns by following the rule to construct the same pattern using different objects, actions or numbers.

Equivalence and Equations

Young students' early experiences should be related to concrete demonstrations of balance (e.g. seesaw or balance scale). Students learn that, in order to balance one of these objects, equivalent sets need to be placed on either side. Later, this understanding can be applied to equations.

Concepts students need to understand:
Students apply their knowledge of balance to equations in order to:
- Develop the understanding that what is on one side of the equals sign is equivalent to what is on the other side.
- Understand that the equals sign describes the relationship between the two sides of an equation.
- Use other mathematical symbols to show the relationship between the two sides of an equation.

Common difficulties or misconceptions:
- Young students, through previous experience with equations, may have inferred that what is on the right is always the answer. For this reason, it is important to provide a variety of examples including equations with missing addends or unknowns in various positions.

Strategies to help develop understanding:
- Equivalence should be introduced using realistic situations, concrete objects and pictures prior to any symbolic representations.
- Students use language to describe the relationship between the two sides of equations including: equal to, same as, not equal to, different from.
- Later, students come to see that, when the sides of an equation are not balanced, it is appropriate to use greater than (>), less than (<) or not equal to (≠) to show the relationship between the two sides.

Function

Concepts students need to understand:
- Students need to be able to use mathematical terms to identify and describe the relationship between two numbers or sets.
- Students should understand that the value of the second number or set is dependent on the one before.

Strategies to help develop understanding:
- Students create or identify the rule that is used to make the change.
- Function machines are used to illustrate the application of a rule and results can be recorded in a table that shows the starting number (input) and the result (output).