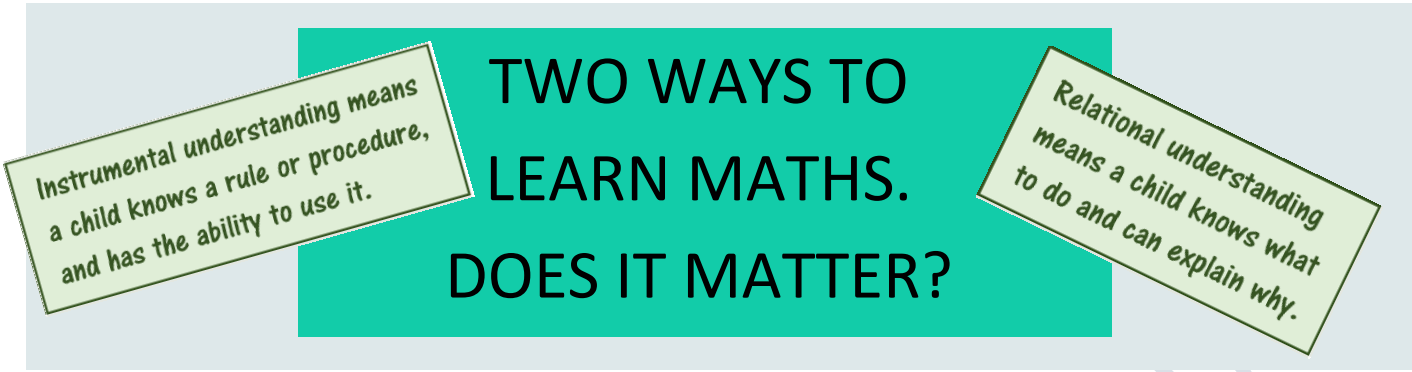
# PRIMARY MATHS




*Richard R Skemp* believed that children could learn intelligently from a young age. He defined two ways of teaching and learning which he called **Instrumental Understanding** and **Relational Understanding**. Skemp explains this much better than we can, but to summarise:

> Instrumental understanding means a child knows a rule or procedure, and has the ability to use it.

**Instrumental** understanding means a child knows a rule or procedure, and has the ability to use it.
Examples of rules and procedures include, but are not limited to:

- algorithms for addition, subtraction, multiplication and division.

Other examples of instrumental explanations can be easily found on other websites. Unfortunately, the instrumental approach to teaching and learning maths is widespread. The learning theory was that children practise the rule or procedure, and understanding will follow.

Current learning research tells us that in many cases,

- understanding never followed, or
- incorrect understanding followed, or
- if correct understanding did follow, the child did not know if it was important or related to any other parts of maths.

> Relational understanding means a child knows what to do and can explain why.

**Relational** understanding means a child knows what to do and why. The child develops deep understanding of concepts, and the relationships between concepts.

Examples of relational understanding include, but are not limited to:

- thinking additively about place value to add and subtract, thinking multiplicatively about place value, and the distributive property to multiply and divide, and relating division to fractions.

Maths abounds with related concepts.

Skemp identified the short- and long-term effects of teaching and learning instrumentally and relationally:

| Teacher \ Child | Instrumental Understanding | Relational Understanding |
|---|---|---|
| Instrumental Understanding | Short-term effect: All appears well as there is a match between child and teacher goals. Child and teacher 'does' Maths. Child does not know if their answer is correct until the teacher tells them.<br>Long-term effect: The child learns ever more rules, developing shallow understanding of mathematical concepts, causing problems when a question does not fit a 'rule' Child may continue to study Maths to pass a test but drops Maths as soon as they can. | Short Term Effect: Child tries to understand relationally that which is being taught instrumentally... . Child tries to develop deep understanding of concepts that are being taught shallowly<br>Long Term Effect: Child feels that they are not smart enough to understand mathematics... , disengages... , drops Maths as soon as they can... , tells their children they can't do Maths...<br>Current curriculums are designed to teach relational understanding... are they being taught just as instrumentally as the curriculum they replaced? |
| Relational Understanding | Short-term effect: Frustration for teacher – child doesn't want to know why... Frustration for the child – 'just tell me how to 'do' it!'<br>Long-term effect: Child (and teacher) develop their relational understanding of mathematics. Child continues to study Maths and works in a Mathematics related career | Short Term Effect: Child and teacher develop deep understanding of both what to do and why<br>Long Term Effect: Child and teacher develop relational understanding of mathematical concepts. Child continues to study Mathematics, builds a career in a mathematics related field and saves the world! |

DIVERGENT AND CREATIVE THINKING DECLINES AS CHILDREN AGE.

**Divergent and creative thinking declines as children age.**

The creative and divergent thinking of 1600 3-5 year-olds were assessed using the same assessment that NASA used to select engineers and scientists.

- At 3-5 years old - 98% scored at the genius level in divergent and creative thinking.

The same children were re-assessed 5 years later.

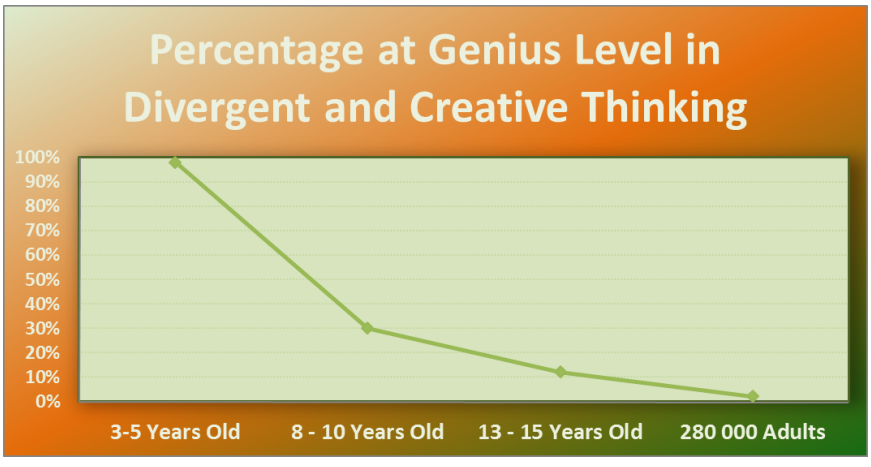
- At 8 – 10 years old - 30% scored at the genius level in divergent and creative thinking.

The same children were re-assessed 5 years later.

- At 13 – 15 years old - 12% scored at the genius level in divergent and creative thinking.

280,000 adults over 25 were assessed.

- 2% scored at the genius level in divergent and creative thinking.



Land and Jarman concluded that 'non-creative behaviour is learned.' Creative behaviour is un-learned through instrumental teaching and learning. Relational teaching and learning allows and encourages children to think creatively and divergently. *Breakpoint and Beyond: Mastering the Future Today, by George Land and Beth Jarman* George Land TedX Talk 5:30 is when he begins to talk about this research

REASONING IS MISSING FROM MATHS LEARNING.

The Australian National Numeracy Review found:

- 'Students need to learn mathematics in ways that enable them to recognise when mathematics might help to interpret information or solve practical problems, apply their knowledge appropriately in contexts where they will have to use mathematical reasoning processes, choose mathematics that makes sense in the circumstances, make assumptions, resolve ambiguity and judge what is reasonable.'
- 'Students are asked to follow procedures without reasons'

While Instrumental teaching and learning involves following rules and procedures without reason, relational teaching and learning allows and encourages children to apply reasoning to their learning.

Relational teaching and learning develops the students' deep understanding of mathematical concepts, and the students' meta-language and capacity to explain!

**21st century learning - children need to know some knowledge, but also how to locate more knowledge, assess and adapt to new knowledge, communicate knowledge, and to use knowledge to create more knowledge.**

21st century learning tells us that when a child asks a mathematical question, it is no longer an adult's role to answer it! With the amount of knowledge in the world doubling every 18 months, it would be impossible for an adult to be the keeper of knowledge!!!

Children have all the knowledge in the world available to them. Children need to know some knowledge, but also how to locate more knowledge, assess and adapt to new knowledge, communicate knowledge, and to use knowledge to create more knowledge.

When a child asks a mathematical question, they are ready to investigate to find the answer! They use the knowledge that they already have to investigate to locate more knowledge, to assess the new knowledge, to communicate their knowledge – they have used their knowledge to create more knowledge!

When a child asks a mathematical question, they will not just be asking an adult - they will be asking other students! Vygotsky's research into the zone of proximal development tells us that an adult's level of understanding may be so far from the child's level of understanding that the

child cannot learn from us! The child needs to be learning with others within their zone of proximal development – other children!

This means that children may not now be taught the way adults were taught! We may have been taught 20th century learning where knowledge was delivered in a sequential, logical, controlled way.

But we need not fear being taken out of our comfort zone! Because children will be in their comfort zone! And as they question and investigate with others within their zone of proximal development, we teachers will find our own knowledge and understanding increases.

**21st century learning is relational.**

21st century learning is relational.

What exactly does relational teaching and learning look like? It looks like

- questioning, investigating and explaining!
- thinking mathematically.
- problem solving!
- formative embedded assessment!
- 21st Century learning!

All Resources- every Video, Investigation, Reflection and Problem at Primary Maths involve questioning, investigating and explaining to allow children (and parents) to develop relational understanding of concepts.

The concept pages, provide information and guidance to related concepts to ensure children are explicitly investigating and explaining the relationships between concepts.

And as we watch the Videos, plan the Investigations, Reflections and Problems that our children will engage in, we parents will find our own knowledge and understanding increases.