

The Evidence Base of Bond Blocks Counting to 10 & 20

Defining 'Evidence-Based'

"Is Bond Blocks evidenced-based?" This is a great question and one we are often asked. However, it is also a term that is often misunderstood. We describe Bond Blocks as being "research-informed" and "using evidence-informed practice". We do this because strictly speaking, "evidence-based" is a research term that requires rigorous controlled trials. This is common in the medical field.

To answer the question "Is this evidence-based?" in an educational setting we refer to Professor Geoff Masters the CEO of the Australian Council for Educational Research (2018).

Evidence-based teaching involves the use of evidence to: (1) establish where students are in their learning; (2) decide on appropriate teaching strategies and interventions; and (3) monitor student progress and evaluate teaching effectiveness. (p. 4)

We recommend reading the entire article.

https://research.acer.edu.au/cgi/viewcontent.cgi?article=1335&context=research_conference

The salient points are that the medical profession, despite having access to controlled research studies, also relies on other tests and evidence, including observations. Doctors try a course of treatment, monitor progress and alter the treatment according to observations. Masters explains that this comprehensive understanding of what an "evidenced based" approach actually is, should also be applied to education.

"Policies and discussions of 'evidence-based teaching' sometimes overlook the importance of this broader, more integrated understanding of the role of evidence in teaching and learning." (p. 4)

Collecting Evidence

Bond Blocks has several tools built in to do what Masters (2018) defines as evidence-based teaching. That is, collect data as evidence to:

- Establish where student are in their learning,
- Monitor student progress,
- Evaluate teaching effectiveness.

All Bond Block resources include assessment and monitoring resources to evaluate the effectiveness of teaching and learning.

For more information refer to the Bond Blocks Counting to 10 & 20 Screening Test and Monitoring Skills Checklists.



Evidence-Informed Mathematics Teaching

Masters (2018) highlights that general, non-subject specific, evidence-based strategies “must be interpreted and implemented in the contexts of the subjects teachers teach... Teachers require evidence about the best ways to implement effective teaching strategies and interventions in subject-specific contexts” (p.5).

The following section outlines evidence informed principles that are embedded in both the “Bond Blocks Counting to 10 & 20” Kit and the “Bond Blocks Core Kit”.

Mathematics Specific Evidence-Informed Teaching Strategies

Bond Blocks incorporates the following key principles that have been identified by Sullivan (2011), and Anthony and Walshaw (2009), as effective for the teaching of **mathematics**.

Articulating Learning Goals*	The learning goals of every activity are provided.
Making Mathematical Connections	Connections are made between the concrete, representational and abstract elements of learning basic addition and subtraction facts through to pre-algebra and word questions.
Differentiated Teaching*	Activities are differentiated ‘a little harder’ and ‘a little easier’ alternatives.
Structuring Lessons*	The Bond Blocks session fits into standard lesson structures.
Promote Fluency and Transfer	The goal of the system is to do away with the Bond Blocks in favour of automatic recall. Activities are structured to move from using the blocks, to diagrams, to finally using numbers only.
Mathematical Language	Mathematical language is specified in the teacher notes for every activity and is modelled in the teaching videos.
Assessment for Learning	Tools include a placement test that is used to ascertain prior knowledge and monitor progress and a variety of recording sheets to document observational notes.
Improving Teacher Knowledge	Clear succinct teacher notes are provided for every activity and concept along with Professional Learning opportunities.








*Key principles that are also identified as general High Impact Teaching Strategies (Victoria Department of Education, 2020).

Bond Blocks incorporates these general High Impact Teaching Strategies:

Explicit Teaching	Explicit teaching is modelled in the videos that are provided for every activity.
Multiple Exposures	Bond Blocks activities are organised in cyclical chapters so that students return to the same concept, spaced over the teaching period.

Sequentially Built, Cyclically Reviewed

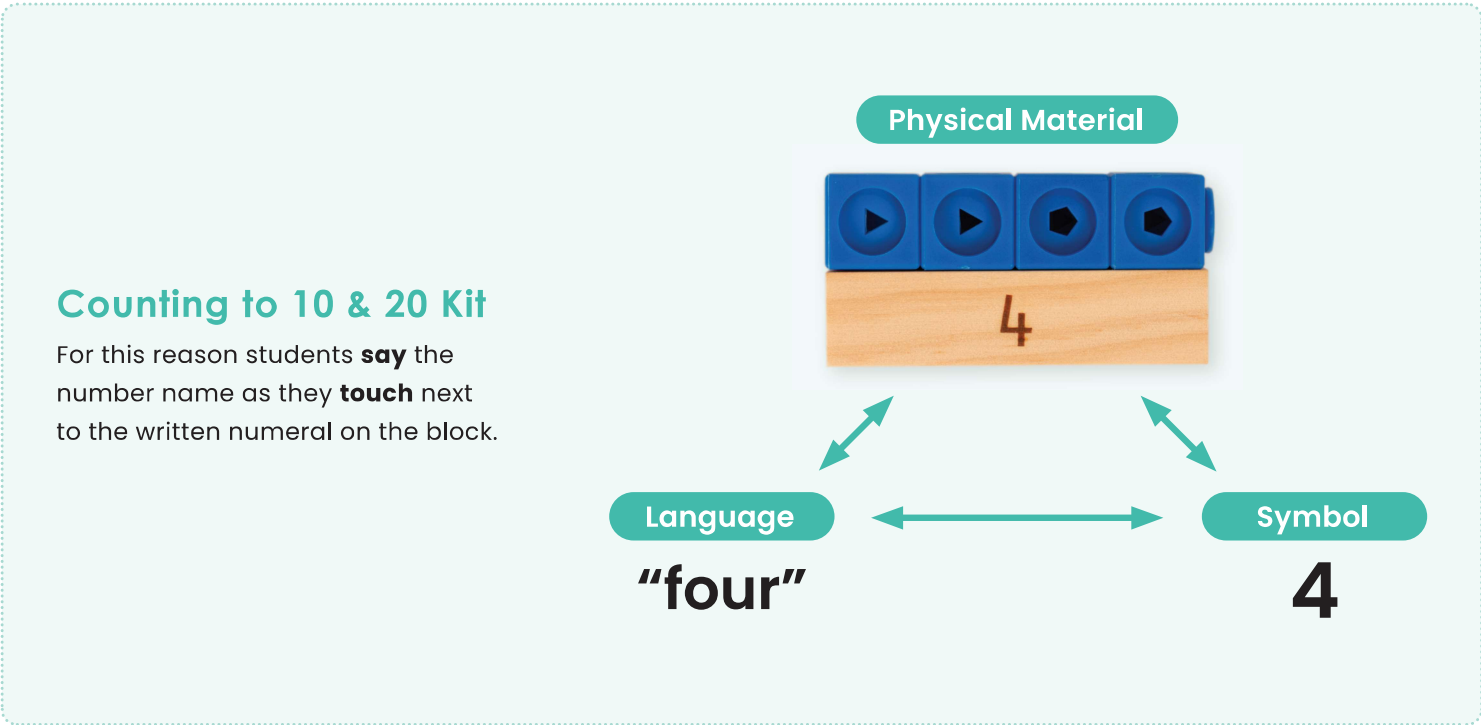
Bond Block activities are sequenced based on prerequisite knowledge to ensure students have the required prior knowledge to build new understandings. Doing this reduces the risk students will rely on counting to calculate which is a major indicator that students will be at risk in mathematics. The activities are cyclically reviewed every chapter.

Mathematical Focus of each Counting to 10 & 20 Activity									
Activity Chapter	Counting in order using • Cubes • Words • Numbers	Counting With a Missing Number	Number Track	Counting From Any Number	Number After/Before: Number Line	Number After/Before: Number Track	Locate Numbers: Number Line	Number After/Before: Number Line	Fluency Ordering
'A little easier'  Counting Forwards 1 to 5	1  2 	3 	4 				8 		10 
1) Counting Forwards 1 to 10	1, 2	3	4	5	6	7	8	9	10
2) Counting Backwards 10 to 1	11	12	13	14	15	16	17	18	19
3) Counting Forwards 10 to 20	20, 21, 22	23	24	25	26	27	28	29	30
4) Counting Backwards 20 to 10	31, 32	33	34	35	36	37	38	39	40

Numbers represent Teacher Led Activity boards.

Mathematical Language and Connections

Mathematical understanding is strengthened when connections are made between the physical materials, mathematical language and symbols (written numerals).



Concrete-Representational-Abstract

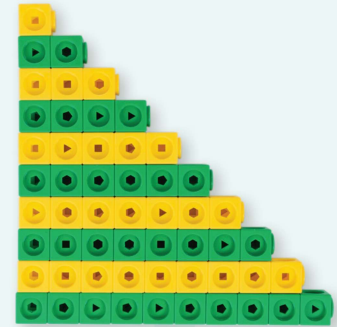
The Bond Block system is built using the **Concrete-Representational-Abstract approach**. This stems from the work of Bruner (1966). Bond Blocks are a **representational manipulative** that bridge the gap from concretely counting by ones to abstractly working with numbers and symbols.

Counting to 10 & 20 Kit

Concrete

Counting using Discrete Measure

Students begin counting discrete manipulatives with one-to-one correspondence. Many students don't progress from counting (for example, fingers or collections of objects) to compare numbers.



Representational

Developing Number Line Thinking and Magnitude Comparison using Continuous Measure

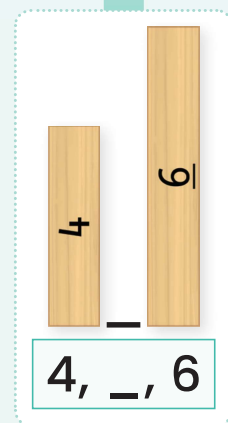
Bond Blocks Counting to 10 and 20 has been designed to help students:

- compare the **size of numbers**, relative to each other, using **number line thinking** (as opposed to counting by one from one).
- **count forwards and backwards from any number**, including identifying missing numbers.

Bond Blocks can help students develop these concepts because:

- they are **length based**, like the number line, which is continuous measure. They are not scored with discrete countable unit lines.
- they have the **numeral written** on them that the length represents. This helps students make connections between the abstract numeral, physical length and spoken number name.

"I can see 7 is greater than 4, because it is longer and closer to 10."



Abstract

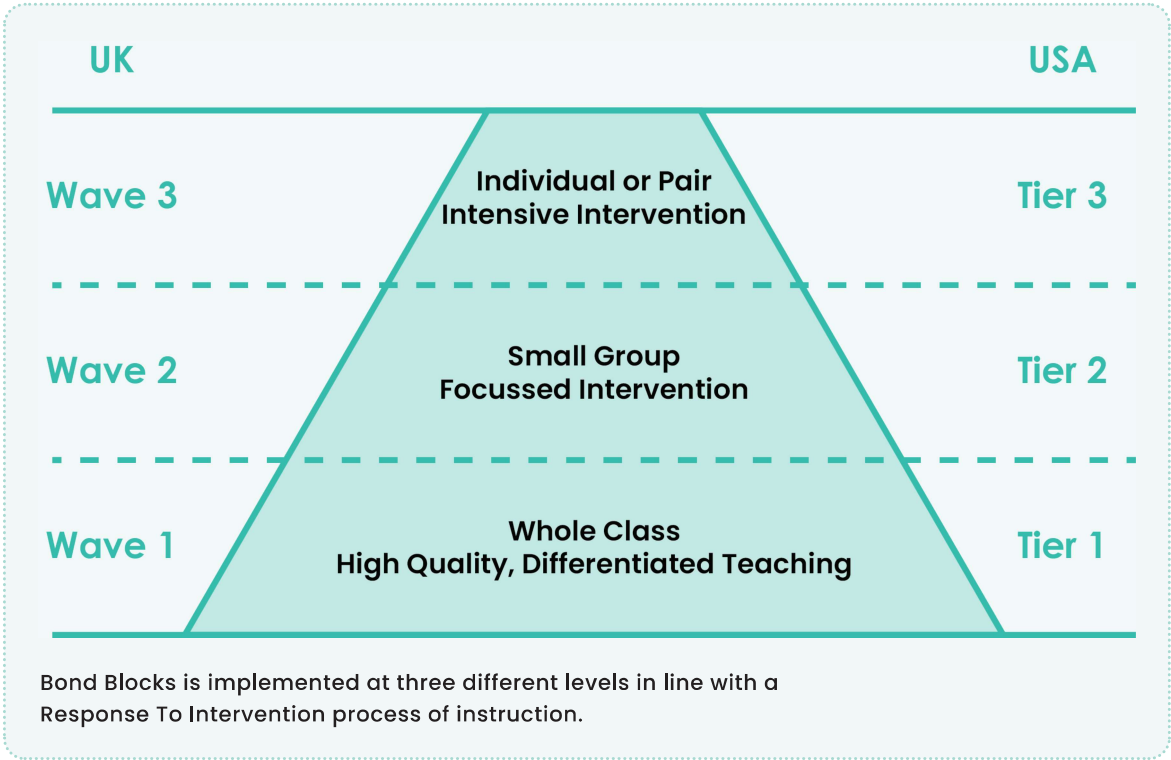
Developing Number Line Thinking and Magnitude Comparison using Numbers

Students can count on and back from any number and can abstractly compare numbers to identify which is greater or less.

Evidence-Informed Intervention

Implementing Bond Blocks using Response to Intervention

The Bond Blocks System has been designed to be implemented at a whole school level. Implementation occurs at three different levels in line with a Response To Intervention process of instruction.



Firstly, Bond Blocks Counting to 10 & 20 is implemented at a **tier one whole class** level as part of a whole school approach to teaching counting in **Pre-Foundation** and **Foundation**.

Secondly, Bond Blocks Counting to 10 & 20 is implemented at **tier two and three** as an **intervention program** for students who have specific difficulties counting.

Using Bond Blocks in these early years as a high-quality, differentiated teaching resource will reduce the numbers of students who require intervention.

The GRATTAN Institute

For more information about implementing Bond Blocks refer to the implementation guides. The GRATTAN Institute’s report (2023) **“Tackling under-achievement: Why Australia should embed high-quality small-group tuition in schools”** strongly endorses using tier two intervention in **small groups of four** students, as is recommended in the Bond Blocks implementation guide, as a cost effective way to help reduce the gap between advantaged and disadvantaged students. The report also recommends intervening as early as possible, before the gap increases. Bond Blocks targets the skills that are predictors of difficulty in maths from the first years of schooling, identified by research, and provides a high-quality differentiated resource to help close the gap.

Learning Difficulties Information Guide Numeracy

Using a **Response to Intervention** approach is endorsed by the State of Victoria Department of Education and Training (2019) "Learning Difficulties Information Guide Numeracy". You can download this guide free from their site. One of our favourite quotes from this guide is, **"There is no 'one size fits all' approach to supporting students with learning difficulties in numeracy"** (p. 14). Instead Intervention needs to be differentiated based on the needs of the learner. For this reason every Bond Block activity has differentiation options. This quote is also in line with Masters (2018) definition of evidenced-based teaching. The effectiveness of the intervention needs to be constantly evaluated for every student. This is why the Bond Block recording sheets for monitoring progress at a tier two and three level have significant space for recording anecdotes.

Response to Intervention Recommendations

Implementation of Bond Blocks for tier two and three intervention enacts the top four recommendations of the Institute of Education Sciences for RTI in Maths (Gersten et. al., 2009, p. 5).

Recommendation	Level of Evidence	Bond Blocks
<p>Instruction during the intervention should be explicit and systematic.</p> <p>This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.</p>	Strong	<ul style="list-style-type: none"> • Explicit, video modelled teaching of every activity. • Systematically sequenced activities based on required prior knowledge and curriculum standards. • Verbalisation of mathematical process and content specified for every activity. • Mathematics is cyclically reviewed every chapter of activities. • Guided practice using gradual release model.
<p>Interventions should include instruction on solving word problems that is based on common underlying structures.</p>	Strong	<ul style="list-style-type: none"> • Word problem instruction uses underlying additive structures of part-part-whole and comparison problems, solved using Polya and the bar model. In depth teacher notes provided for professional learning.
<p>Intervention materials should include opportunities for students to work with visual representations of mathematical ideas and interventionists should be proficient in the use of visual representations of mathematical ideas</p>	Moderate	<ul style="list-style-type: none"> • Bond Blocks are a representational manipulative that is proportional. In each chapter students move from using the using physical Bond Blocks, to drawings of Bond Blocks, then to non-proportional part-part-whole diagrams.
<p>Interventions at all grade levels should devote about 10 minutes in each session to building fluent retrieval of basic arithmetic facts.</p>	Moderate	<ul style="list-style-type: none"> • Bond Blocks intervention specifies a minimum of four, ten minute sessions per week.

Research Informed

Each Bond Block resource has been designed to target the major predictors of maths difficulties, identified by research, with evidence-based teaching strategies. Therefore, Bond Blocks doesn't cover every area of the curriculum but focuses on:

- initial counting (Pre-Foundation and Foundation) using the "Bond Blocks Counting to 10 & 20" Kit and
- addition and subtraction (Year 1 to 3 level) using the "Bond Blocks Core" Kit.

Critical early quantitative competencies that children must possess to learn mathematics include an understanding of the relation between number words, Arabic numerals, and the underlying quantities they represent, as well as skill at fluently manipulating these representations; knowledge of the mathematical number line; and basic skills in arithmetic (i.e., skilled use of counting procedures, decomposition, and fact retrieval in problem solving). These skills are easily assessed in young children and many have been shown to be highly responsive to instructional interventions. (Geary, 2011, p. 15-16)

Counting to 10 & 20

In the early years of schooling before Year One, the **top two predictors of difficulty** in maths are (Geary et al., 2009):

1. **Fluently** identifying which is the **greater** of two numbers. That is, not counting from one.

"Which is bigger, meaning is worth the most things?"

8

5

Students at risk take a long time to answer, often counting from one. They lack a sense of how numbers relate to each other on a mental number line.

2. Being able to identify a missing number in each of these positions:

5, 6, _

After

5, _, 7

Between

_, 6, 7

Before

15, 16, _

After

15, _, 17

Between

_, 16, 17

Before

Reid's paper "Changing Minds: Discussions in neuroscience, psychology and education – Counting on it: Early numeracy development and the preschool child" (2016, p. 4) prepared for the Australian Council for Educational Research lists the following content, as cited by Griffin (2004, p. 174), as requisite for number sense for five-year-old children:

- knowing numbers indicate quantity and thus have a magnitude
- understanding and using relative terms such as more, less, bigger and smaller
- knowing numbers in the counting sequence have a fixed position
- understanding the sequence of numbers, e.g. three comes before four
- knowing higher numbers reflect greater quantities, e.g. four is greater than three
- knowing each counting term represents a unit increase

Bond Blocks: Counting to 10 & 20 systematically targets each of the skills identified by Geary and Griffin as essential for students in Foundation.

We will conclude with our favourite quote from John Hattie (2016).

"Almost everything in published research works at least some of the time with some students. Our challenge as a profession is to become more precise in what we do and when we do it. Timing is everything, and the wrong practice at the wrong time undermines efforts." (p. 103)

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