THE MATHEMATICAL ASSOCIATION OF VICTORIA

THE COMMON DENOMINATOR 1/22

DISRUPTING TRADITIONAL LEARNING

INSIDE

Dr Jayson Cooper - Melbourne Graduate School of Education, University of Melbourne

EVERYDAY MATHEMATICS

Mathematics is an integral part of everyday life as it empowers people to contribute to society through mathematical ways of knowing and being that are grown over time. A simple example found in the everyday, is shopping. This ordinary task requires expertise in using and applying the concepts of mathematics, it might be using number, considering chance generating data, applying measurement, and considering space or any combination of these concepts. Children participating and engaging with adults on shopping experiences have the opportunities of being part of the money exchange process including change being returned and the use of other forms of payment, as well as making lists and comparing prices. Children also commonly play shop, enacting their own experience with mathematical concepts.

Continued on page 5

FROM THE PRESIDENT

Michael O'Connor

THE COMMON DENOMINATOR
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EYE OF THE BEHOLDER

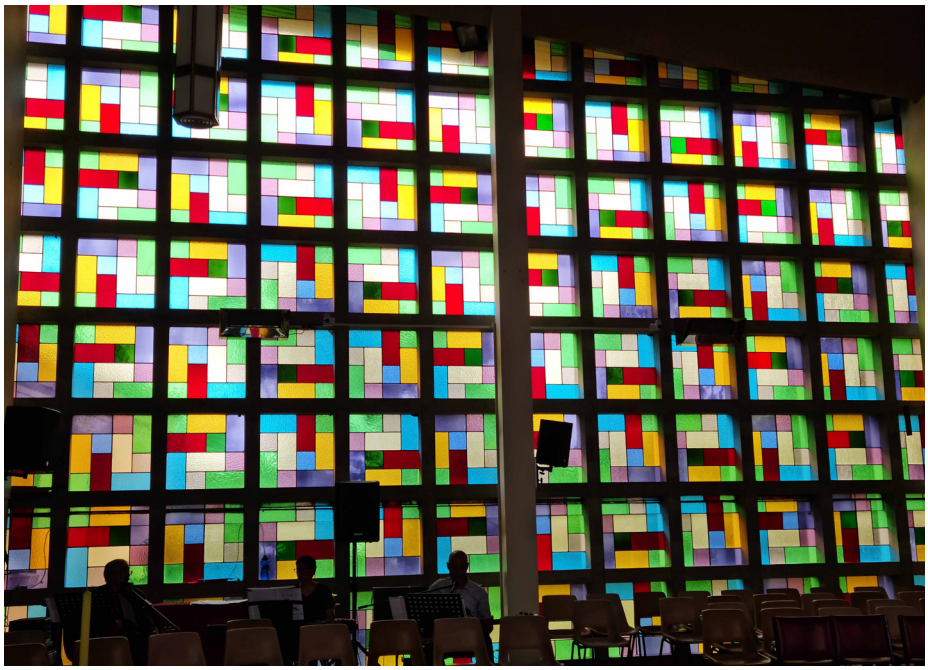
In December, I attended an end of year event. The venue was framed on both sides by striking stained glass windows. While waiting for the proceedings to begin I took the time to notice the beauty and structure they contained. The more I looked, the more I found. Each pane was perfectly positioned to produce multiple patterns, horizontal, vertical and diagonal. It was a gorgeous example of mathematics on many levels.

Where, though, does the mathematics reside? It obviously began with the architect's vision. It relied on the builders and glaziers understanding and paying close attention to detail and placement. When the job was finished, then what? The patterns and placements are set in concrete, but without someone to engage with it, is there any maths?

I started to think about sharing this experience and wanted to provide a clean and neat example of the image instead of the quick picture I took with my phone. So I opened the original in Photoshop and very quickly had a cropped and transformed version. More mathematics! And not an equation in sight. But truckloads of them behind the curtain!

Do we stop and wonder at how so many elements in our lives are underpinned by mathematics? Do we allow ourselves to be awed by it? Do we go further and try to puzzle out how it works? Do we persevere with our enquiries?

It is not my intention to answer these questions, just to raise them and hopefully draw you in. Many of you already know about the 'What do you notice, what do you wonder' prompts. I encourage you and your students to take time to notice, wonder, puzzle out and explore. The universe abounds with mathematical encounters waiting to be discovered.



UPCOMING MAV EVENTS

For more information and to reserve your place at any of the events below, visit www.mav.vic.edu.au.

EVENT	DATE	YEARS	PRESENTER
VCE Mini Conference	11/2/22 Virtual	VCE	Various
VCE Mini Conference	14/2/22 Gippsland	VCE	Various
SAC workshop - Mathematical Methods	22/2/22 Burwood	VCE	Various
SAC workshop - Further Maths and Specialist Maths	23/2/22 Burwood	VCE	Various
VCE Mini Conference	25/2/22 Bendigo	VCE	Various
SAC workshop - Maths Methods, Specialist Maths and Further Maths	8/3/22 Caroline Springs	VCE	Various
SAC workshop - Mathematical Methods	15/3/22 Virtual	VCE	Various
SAC workshop - Further and Specialist Maths	16/3/22 Virtual	VCE	Various
Meet the Assessors	21/3/22 Williamstown	VCE	Various
Meet the Assessors - Maths Methods	22/3/22 Burwood	VCE	Various
Meet the Assessors - Further Maths and Specialist Maths	23/3/22 Burwood	VCE	Various
Meet the Assessors - Maths Methods	29/3/22 Virtual	VCE	Various
Meet the Assessors - Further Maths and Specialist Maths	30/3/22 Virtual	VCE	Various

MAV CONSULTANCY

MAV's mathematical education consultants are ready to work with you and your school in 2022. The team can create a customised professional learning plan for you.

There are a range of topics that MAV can assist you with, including:

- Organising a differentiated classroom
- Focus on specific content areas (i.e. teaching fractions, geometry etc.)
- Assessment and reporting - using student data to achieve sustainable improvement
- Practical activities for building the proficiencies
- Innovative pedagogies
- Building teachers' and leaders mathematics teaching and leadership capacity
- Misconceptions in mathematics learning and intervention
- Effective use of technology.

MAV has several modes of professional learning delivery including:

- Coaching, mentoring and individualised support
- Supporting professional learning teams with planning and implementation
- Modelled mathematics teaching
- Whole staff professional learning curriculum days
- Developing mathematics leaders and leadership capacity, and
- Working with clusters of schools within a region.

Whatever your needs are, MAV's mathematical education consultants can customise a plan aligned to the goals of your school.

To learn more, contact Jen Bowden, jbowden@mav.vic.edu.au.

TAKE DISORDER OUT OF OPERATIONS

Jess Mount - Mathematics education consultant, MAV

TAKING THE DISORDER OUT OF ORDER OF OPERATIONS

The problem on the right looks relatively simple. The operations are not difficult nor are the values large and algebra is nowhere to be seen. A problem such as this shouldn't scare too many people away regardless of their mathematical ability. So, what is the answer? (And yes, there is one correct answer).

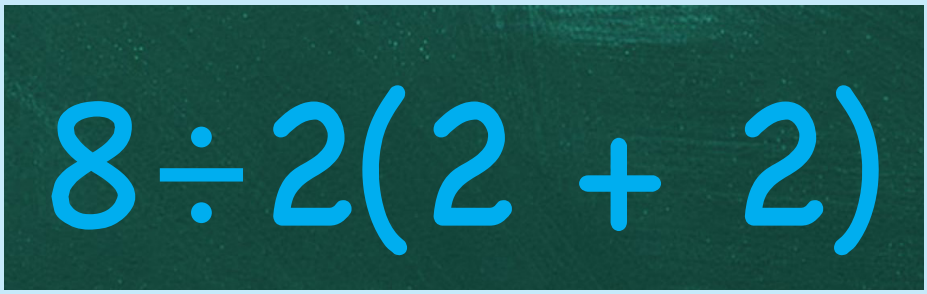


Figure 1.

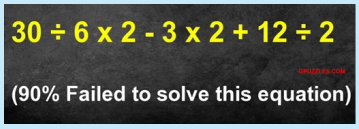
This problem had people in a spin on social media. The question was passed around the world with friends challenging each other to solve it and seeing who would be clever enough to get the problem first go. The challenge was often accepted willingly as the problem didn't look that hard until the question would be asked – 'What do I do first again?'. The challenge here lies in a concept you would have been taught in primary school mathematics: order of operations.

Teaching Year 7 mathematics for a few years, I quickly saw how many misconceptions there were among students in understanding and applying order of operations. Asking the class what they knew about order of operations usually resulted in many different ideas. Students would offer the famous acronyms: BODMAS or BOMDAS or BIDMAS or BIMDAS. Here starts the first problem.

The class would then argue why their acronym was the best or easiest. As I would let students debate it out in class, you could see students starting to confuse themselves. Some wouldn't know what each of the letters stood for, some couldn't agree on which acronym was correct or if all the acronyms were correct. Eventually I would need to halt the discussion before students ended up really muddled.

It is easy to see why teachers have used these acronyms. They appear helpful and an easy way to assist students in remembering the order. But they don't seem to be doing the job. Students and adults upon recalling these acronyms can't use them to answer the problems such as the one stated at the beginning of this article. Most can remember that brackets (B) come first but then have trouble remembering what the O or I stand for. Then comes the confusing multiplication and division and what is calculated first. If you were taught BODMAS then you may think that division comes first however if you were taught BOMDAS then does multiplication come first? You can see the problem. Whilst the acronym may help get you started it causes more confusion than assistance and usually results in people having multiple answers to the one problem.

THINK ABOUT THIS PROBLEM



What answer do you get if you do the division before multiplication? What about if you do multiplication first? Mathematics is the subject known for logic and precision and therefore these problems frazzle people when they can't determine what the answer is. They know there are rules to follow with order of operations but can't remember what they are or can't apply them correctly. Hence the enormous number of quizzes and jokes on social media involving order of operations!

We need to move away from teaching BODMAS, BOMDAS, BIDMAS and BIMDAS or any other acronym for order of operations. These 'hints' appear to be disordering student thought rather than ordering it. Students need to be taught four steps of which to use to solve problems. No acronym or catch phrase – just the four steps.

1. Brackets
2. Orders (Powers, Square roots)
3. Multiplication or division – working left to right across the problem
4. Addition or subtraction – working left to right across the problem.

The last two steps are very important to highlight. Division does not come before multiplication (and vice versa). After brackets and orders, then multiplication and division can be calculated working from the left-hand side of the problem and calculating them in the order they appear.

The same strategy is applied for addition and subtraction. It was always refreshing to see 'aha!' moments in my students when I showed these steps in my classes. Most of the debates they were having just moments ago can be put to rest when they read these instructions. So many students particularly say how confused they would be about multiplication and division and never understood why they would get some problems right and others wrong. I am usually met with comments such as 'That makes more sense now – I never knew which parts to solve first.'

Reflect on the problem in Figure 1. Think about all the ways to solve the problem if the order of operations was muddled up. I hope you can see why this problem went viral on Twitter and had so many people debating why their answer was correct.

Reading comments on the Twitter post people stated, 'Multiplication before division – think BOMDAS' or 'No it's BODMAS – division first'. It was rare to see a comment stating that multiplication and division are the same step just working left to right. People used their qualifications to convince others that their answer must be correct as they have completed years of mathematics study. Still, at times they couldn't calculate the right answer or precisely explain how to solve the question correctly. The Twitter feed, whilst entertaining, highlighted that the acronyms certainly were a cause for confusion.

So, after all this: Is the answer 1 or 16?

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CONT. FROM PAGE 1.

This is numeracy, and these kinds of approaches provide wonderful opportunities for children to become and be numerate with their everyday.

Recently I spent time with a group of young children creating a restaurant where they designed the menu and employed an assistant to help run their business. The child would tell the educators about her father's restaurant and the ways they share time with each other when sharing food when in their home and including what is involved in the commercial aspects of running a business. Her father would often cook and share his food, as a chef, with all the children and educators at the learning centre. These kinds of connections provide children with real-world opportunities to become numerate.

Another instance is when children are working in the garden, which is a common learning environment in many early childhood centres and primary schools. In the garden, children monitor and care for plants that they help to grow, they harvest and eat, they preserve, they save seed, take cuttings and compost. They learn about worms, including selling worm juice and castings, along with other produce at monthly stalls where children design merchandise. Through gardening, children learn about ways we can care for the places we live and love, we learn to live in relation to these places and make sustainable communities. In this there are thousands of opportunities to heighten mathematics knowledge and skills. In these ordinary moments of being in the garden, mathematics is all around us.

All mathematics has a foundation in our everyday lifeworlds of children and adults (Yelland et al., 2014). Traditionally mathematics in schools has consisted of learning rules and in many instances rote learning and the remembering of number facts, counting accurately, using the operations and remembering the times tables, focusing on computational logics. In contemporary times, mathematics has become more complex and we know that real world connections assist in making what is abstract, more 'concrete' and relevant to everyday lives. Mathematics in the early years isn't a singular discipline like it can be found in primary and secondary schooling.

That is, the Victorian Early Years Learning Development Framework (VEYLDF) takes a holistic view towards curriculum, children are to grow their literacies (numerate, linguistic, artistic, scientific, and more) in entangled ways. Early years curriculum is an integrated curriculum, in a similar way to STEM is conceptualised, and of course mathematics is part of STEM. Holistic pedagogies, when used in relation to the everyday opens and invites opportunities for the co-creation of inquiry, with children and communities. Numeracy doesn't need to follow a timetable; it doesn't need explicit learning outcomes and success criteria, rather it can be generative, and emergent. This kind of pedagogical approach takes the stance that children are capable learners and 'citizens of the now' and teachers are researchers alongside children (Iorio & Yelland, 2021) and together we pose questions problems and work out ways to solve these, while making this learning visible through documentation.

Iorio and Yelland (2021) urge in their recent industry report, *Defying Deficit: Children as capable citizens of the now*, to start sharing and making alternative narratives in early childhood, 'an alternative narrative, one that moves away from the conception of children as incapable, dependent or needy, to a recognition that children are capable. This perspective can then act as the underpinning of teaching practices, policy and structures and the research that informs them'.

This calls for a critical re-thinking of what pedagogy is, and what the images of the child are that we hold as educators, with the image of teachers also impacting our professional roles when working with children. How we create numeracy learning ecologies with children can look very different to traditional mathematics pedagogies. What are the alternatives? What is the deeper learning happening here? How can we work with the whole child?

Children are not empty buckets awaiting our wisdom as teachers, we all have funds of knowledge (Moll et al., 1992). These funds of knowledge are social, cultural, political, ethical, and environmental and they are not

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left at the front door of the centre. They come and get up close and personal for they are part of children's identities.

Children, like adults, are in processes of lifelong learning. To write new narratives about how we do the work of mathematics education that requires us to encourage diverse learning environments that stimulate questions. Learning environments that are supportive and challenging and are inclusive of problem making and solving, children's wonderings and curiosities, and filled with play and creation.

The role of the teacher is to create the spaces for children's inquiries to emerge. Children's inquiries guide the ways we can intensify the foundations of mathematics, located within the lifeworlds of the everyday, both inside and outside the classroom.

Opening inquiry to allow children to be responsive to the worlds they live within is a gift these kinds of early childhood pedagogies and ways of being offer. The role of the teacher is one where the teacher becomes a researcher with the child, co-participating, listening, noticing, and posing questions with children. Further to this standpoint and approach, mathematics learning can be situated alongside Indigenous worldviews through these lived, everyday experiences with Country.

For many years mathematics education presented a certain kind of cultural view. Often the early years are seen as preparing children for school and closing epistemological gaps. Iorio and Yelland (2021) note that most of the research that informs early childhood policy and practice is founded on children as deficit and are children become products of benchmark tests designed within traditional views of development.

For example, at the age of two Jayson should be able to demonstrate...
This can be seen with high stakes testing cultures and processes in all sectors of education, classifying and rating children as they enter primary school. Mathematics education like literacy education is often approached in a clinical way, where interventions are performed, and dosages are prescribed to ensure children have a 'healthy start' to school. Mathematics isn't an illness, it is exciting, stimulating and children are always already being numerate. How then, can we work from this stance with children?

Following Iorio and Yelland (2021), we can think about early childhood as not catering to birth to five and then the children go to school, stuck in some playful mysterious pre-school space filled with innocence, rather early childhood is birth to eight years of age. This conversation urges both early childhood and primary schooling sectors to navigate this false boundary. This acts as a provocation on how we as teachers create learning environments to provide authentic transitional spaces and pedagogies for all children across kindergarten and primary school that might go beyond entry tests that get prescribed doses of learning to meet benchmarks.

Like Iorio and Yelland (2021), Skovsmose (1994) uses 'critical mathematics education' to describe attempts to reconceive school mathematics as a site of political power and ethical contestation. Critical mathematics has pursued this agenda in different ways. Skovsmose and Borba (2004) are careful to suggest that the critical approach must always attend to the 'what if not' of school mathematics – that we must investigate the possible, consider the otherwise and explore what could be' (p. 211). They argue educators must imagine alternatives that trouble current situations by actively and creatively generating visions or descriptions of a mathematics education that is more inclusive, more artful, fuller of surprises. This approach 'confronts what is the case with what is not the case but what could become the case' (Skovsmose & Borba, 2004, p. 214).

Learning mathematics is not just simply the acquisition of facts, concepts, or using processes. It occurs in relation with the teacher, the materials, the desk, the classroom, the classmates, etc. It is important to challenge the classical view that 'the world is populated by independently existing things with determinate boundaries and properties that move around in a container called 'space' in step with a linear sequence of moments called 'time' ' (Barad, 2011, p. 144).

There are different ways in which the foundations for mathematical understandings can be established in early childhood contexts.

These, as I have highlighted in this short piece, are around informal and play-based ordinary moments that are emergent when listening to children in holistic ways. In this, the knowledge of the teacher may be consolidated to highlight relationships that are fundamental to mathematical thinking and understanding.

In the early years we want to think about the beginning mathematical processes and the early thinking skills that require specific language to enable young learners to communicate describe and articulate their ideas about their lifeworlds.

When children do this, they're describing attributes, they're matching, they're comparing, they're ordering, sorting and patterning.

Life, mathematics, and learning is everywhere, how can we create numeracy learning ecologies by being present and noticing, listening and responding to the whole child and their lifeworlds.

ACKNOWLEDGEMENTS

I acknowledge the land I work and write from as being the traditional lands for Wurundjeri-Woi Wurrung peoples of the Kulin Nation in Victoria, and I respect the deep spiritual relationships Kulin elders, families and community maintain with their Country which has never ceded sovereignty.

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AUTHENTIC TASKS

TOP 5 TIPS FOR TEACHERS

An authentic mathematical task will support building and extending important knowledge, skills and understandings, and develop productive dispositions towards mathematics. Here are our top 5 tips for selecting these tasks.

1. PROMOTE FEEDBACK AND METACOGNITION

Tasks should promote self and peer reflection targeted at specific aspects of the work. This includes knowledge about how mathematical thinking has changed as a result of a lesson, as well as skills like problem-solving, persistence, and collaboration.

2. CHALLENGE STUDENT THINKING

Authentic tasks can often be a well-constructed, unfamiliar problem that challenges student thinking. Students hypothesise, compare, justify, interpret and generalise to overcome obstacles and build understanding.

Many authentic tasks suggest enabling and extending prompts to help teachers adjust the task to appropriately challenge all students.

3. ENCOURAGE MULTIPLE STRATEGIES AND SOLUTIONS

Authentic tasks are generally open-ended. Look for a low floor (all can get started) and high ceiling (students go as far as capable). This pedagogical approach encourages students to attempt solutions based on known strategies and explore more ways to find a solution. Students develop more sophisticated strategies as they make connections.

Look for questions in a task like:

- What are some possible solutions?
- How are these strategies connected?
- Which method is most efficient?

4. STIMULATE INTEREST

Authentic tasks pique interest. When students are engaged and curious, they are more likely to persevere when challenged and respond positively to explicit teaching. Some different ways to stimulate interest include challenges, investigations, puzzles, games and stories. Tasks which stimulate curiosity may connect to an authentic context or student interests. They might utilise technology, offer student choice or provide an opportunity to engage in outdoor, kinaesthetic, multi-age, or transdisciplinary learning.

5. PROMOTE COLLABORATION

Authentic tasks make students challenge each other, the computer, the teacher and observe how they work mathematically.

They make decisions in groups, share reasoning, communicate findings, engage with different ideas, monitor and regulate each other's thinking.

MAV's website has quality examples of authentic tasks.

THE MATHEMATICAL ASSOCIATION OF VICTORIA

www.mav.vic.edu.au

USING PROBLEM BASED LESSONS

Ashleigh Koo - Mathematics learning specialist, Victoria University Secondary College
Thomas Moore - Education Consultant EngageME Mathematics

TEACHING IN ACTION: USING PROBLEM BASED LESSONS TO DEVELOP STUDENT CAPABILITIES IN MATHEMATICS

Mathematics is so much more than learning rules and formulas and applying them in isolation. It is about the joy of learning, collaborating with others, and learning to understand and embrace new ideas that help to explain the world around us.

The focus of MAV's 2021 Conference was based around the capabilities, as outlined by the Victorian Curriculum and Assessment Authority (n.d.). Specifically, our keynote used a sporting parody to demonstrate Smith and Stein's (2018) five practices for orchestrating mathematical discussion, and how they can be utilised to foster student collaboration within a classroom.

In my classroom, I utilise problem-based lessons, where students are presented with unfamiliar problems, and are required to collaborate with their peers to pose a solution.

For this particular lesson, students were given a similarity problem (Figure 1), which was adapted from a Jacaranda textbook (Boucher et al., 2017). I incorporated the five practices (Smith & Stein, 2018) to assist me with fostering productive mathematical discussions with the students throughout the lesson. These five practices are addressed below.

1. ANTICIPATING

Anticipating, for me, is the most important stage in a problem-based lesson; it is the 'pre-season', if you will. This is where I meet with my colleagues to plan out the lesson, considering:

- What is the aim of the lesson?
- What problem type would lend itself to the lesson aim?
- How can we pose the problem to challenge students at the appropriate level?
- What guiding questions might we ask the students?
- What different strategies could present themselves and how will we respond?
- Are there any misconceptions that could arise? How can we address these?

Slide PBL

A waterslide is 9 metres high and has two supports, one is 9 metres and the other is 6 metres. The horizontal distance between the two supports is 4 metres. If a student reaches the shorter support after travelling 5 metres down the slide, how long is the slide?

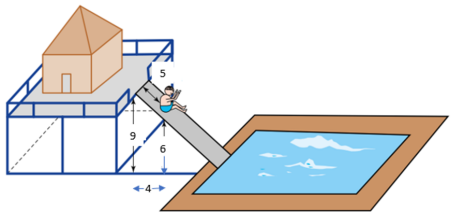

Figure 1.

Monitoring chart

Please note, blank spaces have been left to allow for any strategies that were not previously identified.

Scale drawings	Additive thinking	Multiplicative thinking (doubling)	Multiplicative thinking (tripling)
PLACE NAMES HERE	**PLACE NAMES HERE**	**PLACE NAMES HERE**	**PLACE NAMES HERE**

Congruence	Doubling – length =10	SPARE	SPARE
PLACE NAMES HERE	**PLACE NAMES HERE**	**PLACE NAMES HERE**	**PLACE NAMES HERE**

Figure 2.

Through anticipating the lesson collaboratively, we can more effectively consider and plan for a range of variables within the lesson, ensuring our responses are consistent and in line with the learning goal/s. For this similarity problem, I needed to not only anticipate the different strategies that may arise, such as scale drawing, additive and multiplicative thinking, and doubling/tripling, but how I would prompt students who were struggling to get started. I needed to also anticipate what my response would be if the idea of scale did not arise. This is all documented in the lesson plan to help to ensure a guaranteed and viable delivery amongst the classes in the school.

2. MONITORING

After posing the problem, it is time for the students to work independently. During this time, I roam the room, noting down which students have used which of the strategies I anticipated on a monitoring chart (of course leaving room for any unanticipated strategies too!). Now, I can sort the students into collaborative groups, see Figure 2.

3. SELECTING

During the collaborative phase, students work together to produce an artefact to present to the class. Many of these artefacts may be similar, so it is important that I am selective and choose pieces that lead to the learning goal. This will often include choosing at least one example of each strategy, as well as highlighting misconceptions to encourage rigorous mathematical discussion, whilst also ensuring safe and respectful conditions are embedded. In this lesson, students mainly drew scale drawings, or thought additively about the problem. It was important to highlight these strategies, whilst also

USING PROBLEM BASED LESSONS (CONT.)

drawing focus to the idea of doubling or tripling to find the side length, in line with the learning goal. Some students utilised the Pythagorean theorem, which I deliberately did not select. It did not align with the learning goal, and I thought it would bring an unneeded complication into the lesson. See Figures 3, 4 and 6.

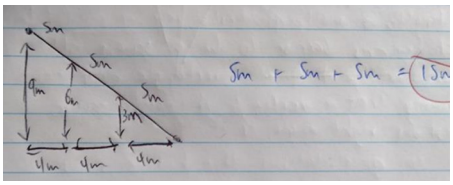

Figure 3.

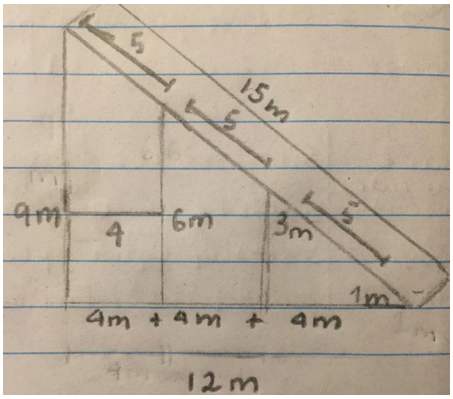

Figure 4.

4. SEQUENCING

Once I have selected the idea, I need to sequence so they tell the story of the mathematics concepts being explored. I like to sequence the ideas using the concrete-visual-abstract method, where responses build up in eloquence, creating a low floor, high ceiling learning environment. I followed this method for the similarity problem, focussing first on the scale drawings, into additive and multiplicative thinking, and then to the abstract idea of 'scale factor'. All strategies were perfectly valid, but this sequence helped to show the different levels of eloquence.

Scale drawing

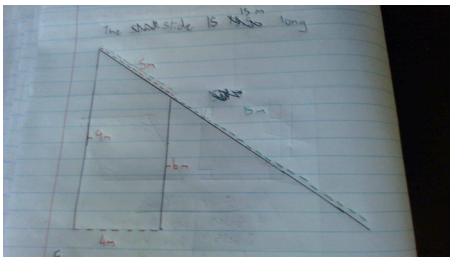

Figure 5.

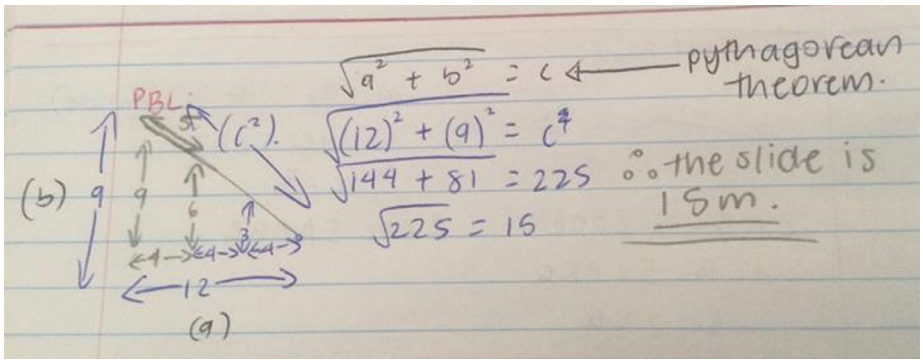

Figure 6.

Scale factor

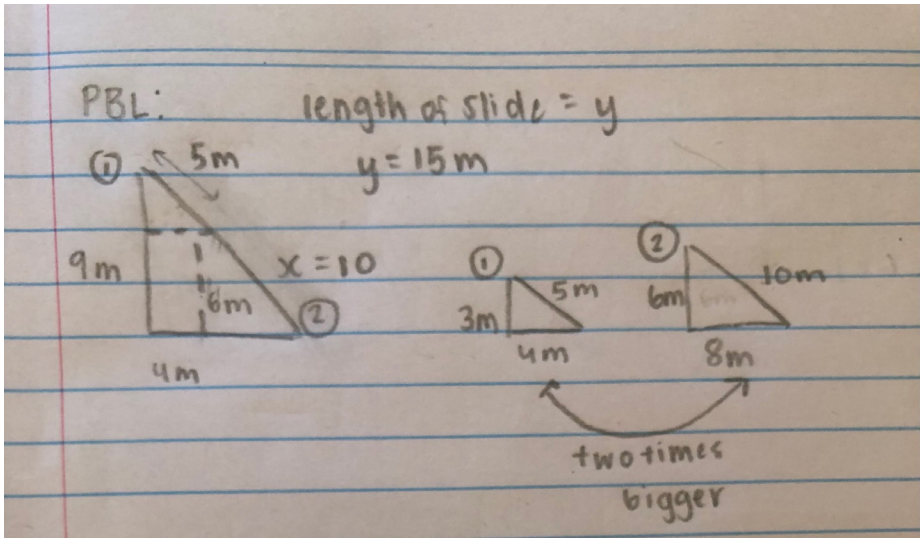

Figure 7.

Additive

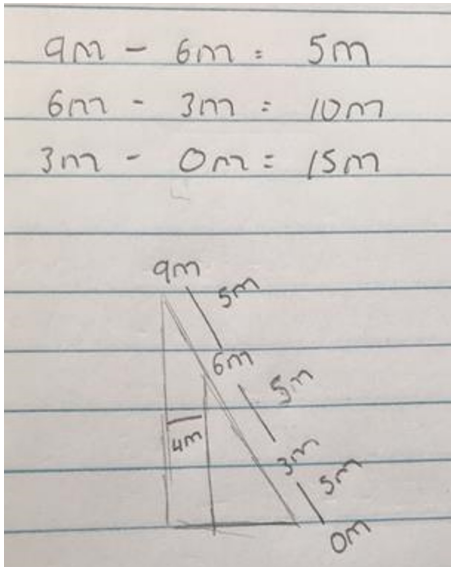

Figure 8.

Multiplicative

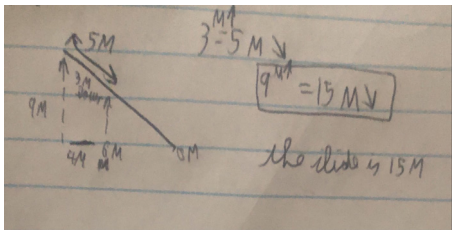

Figure 9.

5. CONNECTING

In this phase, I guide the students towards understanding the connections and relationships within the mathematics, and between each idea discussed. They can compare and contrast the strategies, recognising the strengths of each strategy, whilst acknowledging their different efficiency levels. The aim here is for students to discover for themselves the story within the mathematics that was identified in the sequencing phase.

In this lesson, students were able to use the drawing to identify the relative sizes of the other triangles in the problem and see how the additive and multiplicative strategies described the process.

EXPLICITLY TEACHING COLLABORATION

Whilst these five practices act as a great framework for promoting whole class discussion, students also need to be able to work well with partners and in small groups to experience success with these problem-based lessons.

Collaboration is often expected to happen organically, with little time spent on explicitly teaching students how to collaborate effectively. Before any productive collaboration can take place, it is imperative that the safe and respectful conditions are created and that students feel empowered to take part.

To assist, I used *Building thinking classrooms in Mathematics* (Liljedahl, 2021) to inform my practice by first asking students to brainstorm what effective collaboration looks like to them, and then using their responses to create a rubric for them to peer and self-assess against.

REFLECTION

Collaboration is the cornerstone of every classroom. Like I always say to students, 'the student who is talking is the student who is learning'. However, it is not enough that we expect young people to know, straight off the bat, how to collaborate effectively with one another.

Remote learning initially threw a spanner in many of the grand plans I had to foster collaboration in my classroom. Although, I feel that I may have learned more about collaboration over the past two years than I ever have before. It allowed me, and my students, the chance to delve deeper into what collaboration can look like online, and how we can still have rich mathematical discussions. The students were able to design and create the conditions that they wanted to be the fundamental aspects of our learning environment and use the rubrics to set personal goals for their own collaboration based off feedback from both themselves and their peers.

The five practices (Smith & Stein, 2018) offered a valuable pathway into collaboration, even online. Through anticipating the variables within the lesson, it allowed me to consider the possible different strategies and questions to ask that provoke thought in different student groups, sparking discussion and enhancing learning. Being selective when sequencing and presenting ideas allowed students to have the opportunity to ask each other questions, while making sense of the mathematics and connecting ideas together.

No lesson is going to be perfect, but through anticipating, monitoring, selecting, sequencing, and connecting, we can help to develop the conditions for collaboration and resilience in any classroom.

If you would like to see a problem-based lesson in action or access to any of the resources discussed throughout this article, please do not hesitate to contact Ashleigh, ashleigh.koo@education.vic.gov.au.

ACKNOWLEDGEMENT

Special thanks to Chris Coombes and Lindsay Wehrwein who introduced us to the problem-based lesson structure that this lesson follows.

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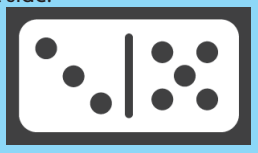
STIMULATING THINKING

Education consultants, The Mathematical Association of Victoria

A picture sparks 1000 maths concepts! Use this picture as a prompt to stimulate thinking. If you have other ideas for investigations or lessons that could stem from the ideas here, add them to the conversation on our social channels. You can find us on Facebook, @mathematicalassociationofvictoria and on Twitter, @mav_info.

EARLY YEARS - YEAR 2

- Without counting each, in one guess how many dominoes are in the picture? How do you know?
- How many 'doubles' are there? How many 'near doubles'?
- Can you organise the dominoes into a different array?
- Can you find dominoes which have the same amount of dots on them?
- Which dominoes could you use to make 12?
- Make a pattern with the dominoes and explain how it works.
- Notice how five dots are arranged on a domino, it is the same way we see five dots on a dice. How else could we have five dots?
- Place value: if the number on the left is worth ten and then the number of dots on the left is worth one what is the value of this domino? Complete the task with five more dominoes.
- Find some dominoes where the number of dots on the left side is two less than the number of dots on the right side.



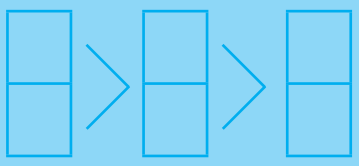
- Farmer Sam had a paddock with 15 animals. If the dots represent animals how many different paddocks of 15 can you create?

YEARS 3 AND 4

- Find a domino that has two lines of symmetry.
- What is the least amount of dominoes you can use that add up to 32? What is the most you can use?
- Using the dominoes, how many different ways can you make a total of 25?
- Could you draw the next column of dominoes? How do you know what they would look like?
- What is the total of each row of dominoes? How did you figure it out?
- How many dominoes have the same total?
- Can you make a rectangle where each column and row adds up to the same number?
- How many dominoes have one side that is an odd number of dots and the other side an even number of dots?
- Is zero an odd or an even number? Why?
- Arrange the dominoes so each column has the same amount of dots.
- Farmer Sam had a paddock of 15 animals. If the dots represent feet, which dominoes could be in the paddock and what animals are they? Explain your reasoning with equations. Can you find more than one answer?

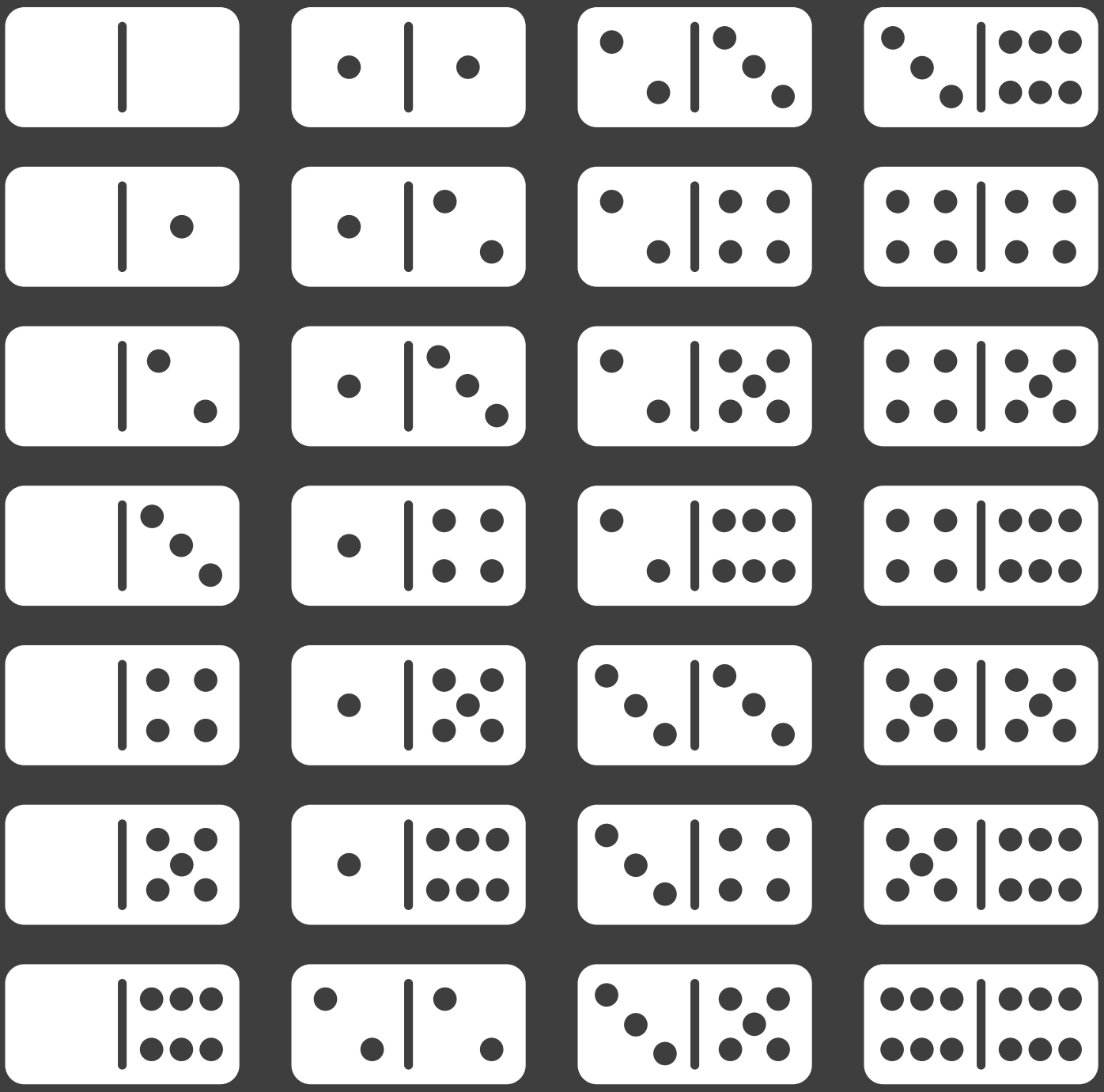
YEARS 5 AND BEYOND

- How many dots are in the image? How do you know without counting each one?
- Using the four operations, how many ways can you make the total 18?
- The answer is 21. Use the dominoes to represent the question.
- Place the dominoes vertically to make a fraction and find as many different ways to make this statement true */* > */*
- Using the dominoes as fractions, can you add two to get close to 1? How many ways can you do this? Explain how you know that these fractions are close to 1. What strategies did you use?
- Using the domino as a fraction, make the image below correct.



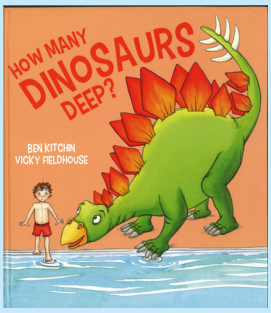
- Think outside the box. A positive number is represented by a dot, for example the number 5 is five dots. How would you represent a negative number on a domino?
- Try to arrange the dominoes so each column and each row has the same amount of dots! Can it be done?
- Odd and even number addition. Explore using the dominoes what patterns you can find when adding odd + odd, odd + even and even + even.

MAV education consultants can come to you and create a professional learning plan to build the capacity of teachers at your school.



BOOK REVIEW: HOW MANY DINOSAURS DEEP?

Alicia Clark - School maths leader, St. Mary's School Whittlesea



How Many Dinosaurs Deep? has many applications for the contemporary mathematics classroom. The first reading of the story, a clear social and emotional learning focus is obvious, as the story describes a boy who is afraid of going in the swimming pool. By comparing the water to dinosaurs, his mother helps him overcome his fear – a great way to talk to kids about how they can overcome their own fears and build their confidence.

This picture story book is a great springboard for some engaging mathematics lessons! Dinosaurs are loved by young children, and most children enjoy saying the long names of the dinosaurs and can often recall fascinating prehistoric facts at a young age.

The story compares the depth of the water to the height of dinosaurs and is a great way to begin to explore measurement concepts. The vibrant illustrations further support this concept by showing different dinosaurs of different heights in water of different depths. The text also uses words such as 'middle-sized' and 'deepest' to encourage the development of measurement vocabulary. The book contains a section called *Everything you need to know about dinosaurs* which has many mathematical applications for slightly older children. This section has factual information and measurements about different types of dinosaurs – including their height (in feet and metres) and weight (in pounds and kilograms). Two possible lessons are outlined here.

EARLY CHILDHOOD/FOUNDATION

Victorian Curriculum: Level D (towards Foundation)
Responds to contexts involving 'heavier/lighter' than and 'holds more/less than'

Victorian Curriculum: Foundation Level
Use direct and indirect comparisons to decide which is longer, heavier or holds more, and explain reasoning in everyday language.

I read the story to the students, after the first read, we went back and looked at the different types of dinosaurs in the story. Using pictures of different dinosaurs, we compared the size of each dinosaur. We discussed which were taller, shorter, and longer. This vocabulary was written on the whiteboard and on flashcards. Students were able to order the dinosaurs from shortest to tallest. We looked at different toy dinosaurs, discussing which were tall, short or long.

After this, we explored measurement in a hands-on, fun (and messy!) way. Students were given a variety of containers filled with differing amounts of water. Students were asked to find *How many dinosaurs deep?* each container of water was. Using the toy dinosaurs, students placed them in the water. It was wonderful to hear the conclusions they were making.

'This water is up to the triceratops neck!'

'The water is as deep as two dinosaurs on top of each other.'

'The water is as deep as the Brachiosaurus' ankles.'

'This tub is four tiny dinosaurs deep.'

Children explored and measured the depth of the water using the dinosaurs, and used the vocabulary from the picture story book to explain their measurements in a very informal and age appropriate way.

YEAR 3

Victorian Curriculum: Level 3
Measure, order and compare objects using familiar metric units of length, area, mass and capacity.

A story book can be a springboard for increasingly complex investigations and problem-solving experiences for middle primary school children. Here is a lesson aimed at level three, with activities for enabling and extending prompts to cater for varying abilities within this level. As a class, we read the story. We then paid particular attention to the last page, which lists all the dinosaurs, a few facts about them and their measurements.

This lesson was focused on length and perimeter (it could be easily adapted for mass as well). We read the dinosaur facts, highlighting the lengths and heights of each dinosaur. We split up into three groups:

Group 1: Enabling prompt

Choose three dinosaurs, and use a tape measure to cut a piece of string them same length as the dinosaur. Don't forget to label the string with the dinosaurs' name! Order the dinosaurs from shortest to longest. Place these lengths on a number line.

Group 2: Working at Level 3

Provide students with some pictures of dinosaurs and a ruler. Measure each dinosaur picture to the nearest centimetre. Order the dinosaurs from shortest to longest and write two sentences comparing the dinosaurs, for example, the Stegosaurus is shorter than the Brachiosaurus.

Group 3: Extending prompt

Measure the perimeter of the school basketball court. Work out a combination of dinosaurs that would make up the perimeter of the basketball court – try to get as close to an exact measurement as you can! As the lengths are listed in metres, you could also ask children to convert to centimetres (and as a real challenge to millimetres or even kilometres).

How Many Dinosaurs Deep is available from the MAV shop, www.mav.vic.edu.au/mav-shop

Would you like to write a book review for *Common Denominator*? Contact Jen Bowden if you are interested, jbowden@mav.vic.edu.au.

STRENGTHENING YOUR SCHOOL'S APPROACH TO FINANCIAL EDUCATION

Dr Carly Sawatzki and Dr Jill Brown - Deakin University and Peter Saffin- The Mathematical Association of Victoria

Several states have banned financial institutions from delivering banking and branded education programs in schools, paving the way for school-led programs free from commercial interests. There is a growing number of new resources and solution providers pitching to the school market. In this article we outline some guiding criteria to help schools consider ways to strengthen their financial education programs.

WHAT IS FINANCIAL CAPABILITY?

Students are financially active from a young age – from observing financial transactions when shopping, to making their own decisions with cash and gift cards they have received for special celebrations. Later, they might work in a family business or secure their first job, giving them a taste of financial independence.

It is important that schools, families and communities provide meaningful learning experiences that support young people to develop financial capability. Students need strong bearings to navigate what is an increasingly complex financial world and there are many connections that schools and teachers can make with students' existing understandings about money. Lessons that help students make sense of their world and develop new knowledge, skills and capabilities also build their confidence to manage their money in ways that protect their future.

WHAT MIGHT A HOLISTIC FINANCIAL EDUCATION AT SCHOOL LOOK LIKE?

Typically, financial education at school focuses on personal administration of money matters. Students might prepare to apply for a job, get a tax file number, and develop strategies for managing an income (including making savings). They might learn about interest, fees and charges associated with different forms of credit – i.e., buy now pay later services, credit cards, payday or fast cash loans, HECS-HELP loans (to help pay for tertiary studies) and more traditional loans.

Technological innovation or 'fintech' is changing the way we transact and manage our money. It is therefore important that students here in Australia learn to transact safely and securely online and via apps, from mobile banking to the MyGov and Medicare services.

Students might also learn about the risks and rewards associated with more complex financial products and services, including different insurance and investment options (i.e., public vs. private healthcare, superannuation and cryptocurrency). In all of the above contexts financial decision making is used, and this involves risks that we want to help students learn to identify and manage.

Of course, our financial reality and the financial choices that are available to us are influenced by the health of the society and economy in which we live, including the cultural and social factors that shape our first experience of money. For this reason, it is important to explore issues of financial education early in school, and continue to engage in financial education throughout

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school and beyond. Financial impacts are significant for individuals, and also for local, national and global economies (emissions targets and renewable energy projects are a good example).

There are simple ways to expand the traditional individual focus of financial literacy to develop an awareness of the impact of personal financial decisions on society and the planet. For example, learning about taxation as a social contract between individuals and governments can foster the sharing of resources. Likewise, lessons that explore ways to spend and invest sustainably, and giving to worthy causes, convey the view that how we use our money can make a difference to others. Related to this, students might explore how social enterprise can contribute innovative solutions to a fairer, more sustainable world. Projects that promote a circular economy through recycling and upcycling resources orient students to reduce their environmental footprint.

While challenging and sensitive, students also need to explore the 'dark side' of finance if they are to develop scepticism and resilience, but also an ethics of care in how they use money. Young people face new risks in the form of scams and unethical business practices. Studying cases of financial deception, corruption and fraud in Years 9 and 10 can help students to identify abuses of privilege and power.

A desire to 'fit in' and spending being invisible can lead to costly mistakes. Young people benefit from opportunities to develop awareness of their financial motivations and behaviour and conversations focused on self-regulation strategies. Being a 'shopaholic' and feeling addicted to video games (with in-game purchases) and sports betting are topical examples for exploring financial motivation and self-regulation in Years 9 and 10.

CAN A COMMERCIAL RESOURCE OR SOLUTION BENEFIT YOUR STUDENTS?

There are a growing number of free and commercial (fee for service) resources and solutions available to schools seeking help to develop their financial education program.

These solutions may include downloadables, incursions for students, workshops for teachers, online platforms and games. Often these solutions are charged on a per student basis, with pricing ranging from $20 to $80 per student per year. The onus is on schools and teachers to judge the quality of the offering and the value-add to students' education. If your school is considering one of these solutions, there are some questions to consider:

Who designed the program?

Do they have a background in Australian school education? Have they collaborated with education experts to ensure their solution is informed by educational research? Is the program linked to the curriculum? Has the approach been independently evaluated?

Is the program inclusive and respectful?

Does it consider all students' financial realities and perspectives, including their socioeconomic and cultural background? Are all students included and able to achieve success? Or might some students feel judged and marginalised? For example, a mock economy with a reward system might produce unintended consequences for the classroom, like a bargaining attitude or unhealthy competitive behaviour.

Is the program current and contextualised?

Will it explore real financial contexts that are appropriate to your students' current and future needs? Are these contexts rich and engaging, and linked to student interests, and developmental needs in relation to the financial demands of their current and future financial life?

Will the program strengthen your existing approach?

Can the program be adapted and integrated across your school's existing programs?

Are there opportunities for you to develop your teaching practice too?

Will the approach to teaching and learning help you and your colleagues to learn about your students, as well as economics, finance and mathematics concepts?

WHAT ELSE SHOULD I CONSIDER?

There are many curriculum-related considerations, but here are some guiding criteria to keep in mind.

Aligns with learning area content, particularly economics and mathematics

In economics and business, students develop the knowledge and skills that equip them to participate in and contribute to the wellbeing and sustainability of the society, economy and environment. Studying economics and business helps students to appreciate the interdependence of decisions made within economic systems, including the effects of these decisions on individuals, businesses, governments and other economies, and on environmental and social systems.

In mathematics, students benefit from lessons that connect the real and mathematical worlds and help them to develop mathematical proficiencies (understanding, fluency, problem-solving, reasoning). Much of the mathematical knowledge and skills taught at school can be applied to economic and financial contexts. For example:

- Mathematics prepares students to make sense of personal financial statements where information and calculations are presented in tables, graphs and charts.
- Proportional and algebraic reasoning underpin loan and investment scenarios.
- The study of data and statistics prepares students to think critically about social and environmental issues that affect economic prosperity.

Develops financial numeracy

Students who are numerate are better equipped to make informed financial decisions. Students become numerate as they develop the knowledge and skills to use mathematics confidently across learning areas at school and in their lives more broadly. At school, they might learn to make sense of bank statements, bills and payslips.

Helps students develop financial language and literacy

Students benefit from exploring real-world problems where financial language is used. For example, when planning an enterprise, students learn terms like revenue, expenses and profit, or supply and demand. When exploring important public services like healthcare and transport, they learn about concession pricing. And when investigating credit, they learn to distinguish between simple and compound interest and fees.

Note that these examples also involve calculations, highlighting the connectedness of financial literacy and numeracy.

Prepares students to make critically-informed decisions

Quality financial education instils a healthy skepticism that can protect against risk. People who are financially capable can locate and make sense of complex information. They can think critically, pose good questions and discern quality, trustworthy answers when thinking about government policies and interacting with big organisations. These skills help them to make informed decisions. A good example is finding out about a new financial product or service and considering whether it is the right fit for your personal circumstances. Questions might include:

- 'Will I be locked into a contract?'
- 'What are the terms and conditions?'
- 'Are there any hidden fees and charges?'
- 'Could I lose my money?'
- 'How could I better use or protect my money?'

CONCLUDING REMARKS

Selecting quality financial education resources and solutions that will meet your students' needs is not an easy thing to do. We encourage you to look for a level of sophistication that can support true learning and development towards active and informed financial decision making.

LEARN MORE

- Deakin University's Economics + Maths = Financial Capability research project includes a professional learning series for teachers.
- The eSafety Commissioner provides a range of education resources to promote safe and enjoyable online experiences.
- If you have concerns about a student being negatively impacted by financial hardship, financial abuse, or online gaming or gambling, seek advice from the school psychologist or school counsellor. Students can also contact Kids Helpline or Headspace.

ACKNOWLEDGEMENT

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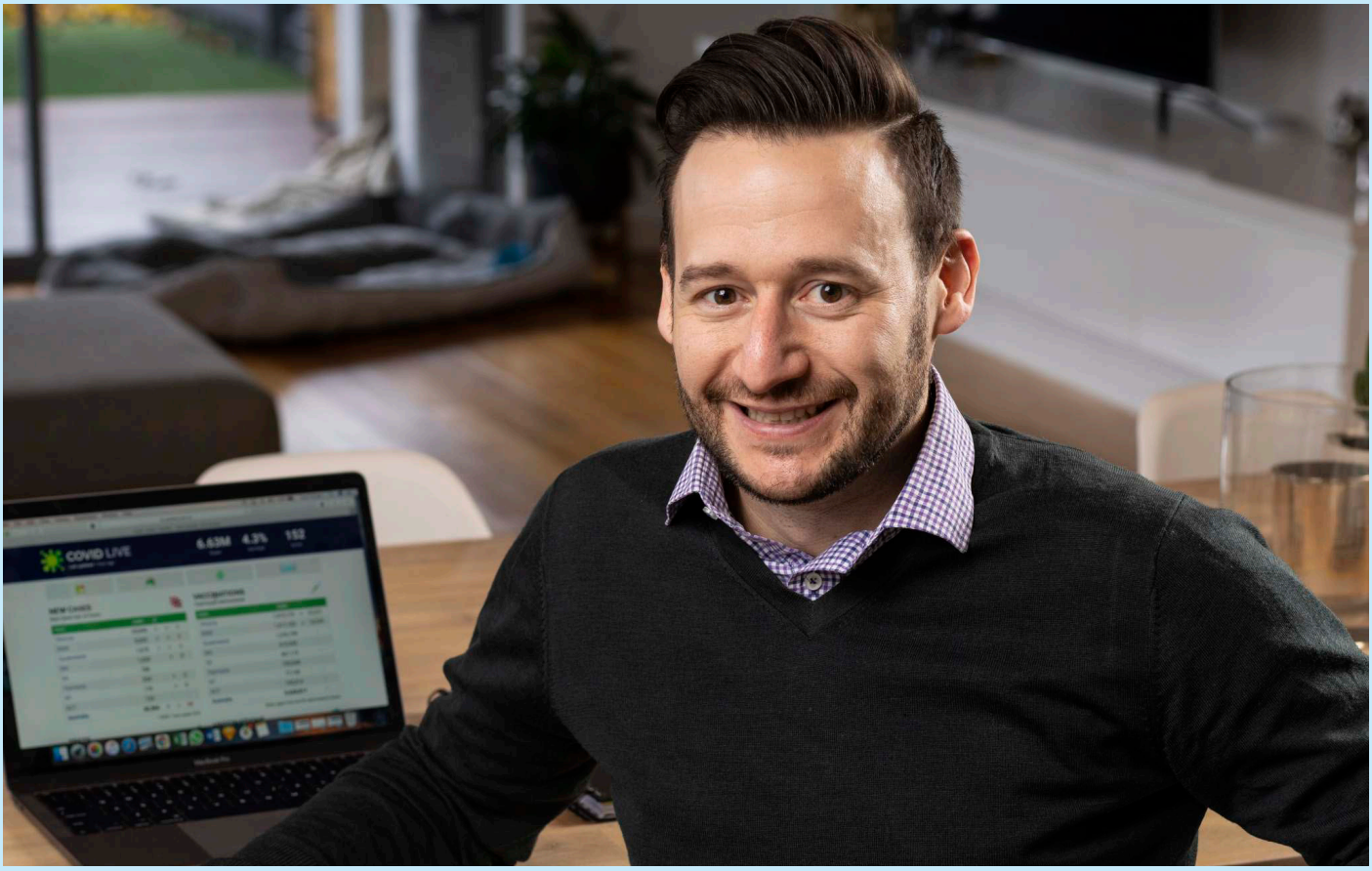
ONE MINUTE WITH ANTHONY MACALI



I'M....

Anthony Macali, previously a Reporting Manager at Sensis and now Founder of COVID Live. I specialise in application and systems development, data programming and analysis.

COVID LIVE STARTED BECAUSE...

Because I had a determination to view near real-time data on the COVID situation in Australia. Check it out at https://covidlive.com.au/about.

I STUDIED...

Information Technology at Swinburne and always had a passion for the more technical side. After a short work placement, I landed a job at Sensis. Initially my role was in application development, but slowly migrated into the database space as we migrated internal systems.

I NEVER THOUGHT...

Tracking the pandemic would become a full-time job and still be going strong.

THE PANDEMIC...

Provided the opportunity to think further about how data should influence policy making and public behaviour. During the start of the second wave in Victoria, the message given to the public was that decisions were 'driven by the data'. But, these data sets were not readily available to the public. That piqued my curiosity, I felt that the data needed to be very transparent – and so COVID Live was born.

I BELIEVE TRANSPARENCY...

Helps to calm fear and anxiety. People were very nervous about case numbers and each day were waiting for the numbers to be made public. COVID Live provides a consistent and timely source of truth.

I SOURCE DATA FROM ...

Federal and state dashboards, media releases. COVID Live displays numbers of cases, tests, source of infections, exposure sites, vaccine rollout. It also gives localised data such as age group breakdowns, postcode and LGA specific data.

I'D NEVER WEAR...

Sneakers without socks.

DATA AND ANALYTICS ...

Has the power to provide access and give control back to the user, and empowers users to make well-informed decisions A good example during COVID was displaying case numbers by postcode. Analytics helps to discover new insights by interrogating large data sets over time.

SINCE COVID LIVE LAUNCHED...

The site receives over 100,000 visitors per day. It's used by the media, MPs, local government councils, and worldwide organisations including Johns Hopkins University, Google, Our World In Data.

I'D LOVE TO TRAVEL TO…

New York. So many film locations to explore. My hobby before I started tracking COVID Live was reviewing films, check out filmdude.com.au.

COLLABORATION IS IMPORTANT...

Honest feedback is invaluable and listening to a fresh perspective is the best way to learn and grow.

DATA ISN'T JUST ABOUT THE NUMBERS...

Presentation was crucial to ensure everybody could understand such critical health data. I knew quite early that designing for mobile was critical, as many users will check the numbers daily similar to the weather report.

The COVID Live design was based on simple tables showing daily change each day as context and historical trends are very important for tracking COVID.

I've always been passionate about graphic design, so utilising icons and colours for each individual state/territory all help to identify distinct data sets very quickly.

AN ITEM ON MY BUCKET LIST IS…

To watch my favourite football team Liverpool play at Anfield.

MY ABSOLUTE FAVOURITE INDULGENCE IS….

Gelato.

I'M LISTENING TO….

EDM and coding go well together.

LAST YEAR I READ….

So many journals and studies. Sadly only news for me... no books.

2022 WILL SEE ME….

Continue to track the pandemic. The omicron variant was a surprise and has developed very quickly. I'm exploring other public data sets to see how they could serve the public. Perhaps reporting on climate change might be my next project.

Who would you like to see profiled in *Common Denominator*? Email suggestions to office@mav.vic.edu.au.

CONNECTING LEARNING TO WORK

MAV has launched a series of mathematical investigations titled: *Mathematics in Careers*. The publication of the investigations was made possible with funding from the Australian Centre for Career Education and the Victorian Department of Education and Training, under the *Connecting Learning to Work* project.

The aim is to help teachers of various disciplines make clear and direct connections to the valuable careers in their subject areas for students. The *Mathematics in Careers* investigations help students experience what careers in leading STEM companies can look like, by undertaking collaborative projects to solve real word problems using real data and tools.

The investigations have been developed and tested by MAV with industry partners; Victorian Space Science Education Centre (VSSEC), FORD, Reserve Bank Australia (RBA), Texas Instruments (TI) and BIARRI.

These industries have been partners of the MAV Maths Camp for high potential regional Year 10 students (funded by the Victorian Department of Education and Training, Strategic Partnership Program) and have, together with MAV, created these investigations based on actual problems industry partners deal with in their workplace.

The investigations demonstrate the creative and critical thinking skills and other key skills industry requires. Through a contextual investigation based on real industry issues/scenarios, the investigations demonstrate how mathematics is applied in a variety of careers. Each investigation includes both a student version and a teacher guide and include the career focus areas, the core mathematical skills focus, links to the Victorian Curriculum and the relevant mathematics proficiency focus.

Additionally, the investigations all include an extensive table of careers related to the investigation and the appropriate links and tasks for students to further investigate careers they may find of interest.

The investigations are ideally designed for students to collaborate in small groups to allow them to utilise and develop the skills required by industry including problem solving, critical and creative thinking, communication and teamwork.

The investigations have been successfully trialled with students at the Year 10 maths camp and have been adapted for use with all Year 10 students. They can also be used for engaging VCE students. Investigations have varying degrees of complexity and the teacher guide provides support for easy implementation, including enabling prompts and extension ideas. The investigations are summarised in the table on page 21.

MAV will provide a free webinar in Term 1 to launch the investigations, if you are interested, or would like further information contact Helen Haralambous, hharalambous@mav.vic.edu.au.

All investigations can be downloaded online at www.mav.vic.edu.au/resources/mathematicsincareers.

INVESTIGATION	CAREER FOCUS	MATHEMATICAL FOCUS	INDUSTRY PARTNER
Bone Mineral Density (BMD)	Health and biomedical sciences	• Use appropriate methods to sort, organise, and manipulate data. • Create graphs to show patterns in data. • Explore the connection between algebraic and graphical representations of relations.	VSSEC
Body Mass Index (BMI)	Sport scientist, dietician, personal trainer	• Using formulas to solve problems. • Re-arranging expressions to make a specified variable the subject. • Using authentic data to construct scatter plots, make comparisons and draw conclusions.	VSSEC
Cell size	Biologist, zoologist, environmental scientist	• Using formulas to solve problems. • Re-arranging expressions to make a specified variable the subject. • Using authentic situations to apply knowledge and understanding of surface area and volume.	VSSEC
Collision	Engineering and design	• Solving simple equations arising from formulas. • Re-arranging expressions to make a specified variable the subject. • Calculate speed, time, and distance. • Represent word problems with simple linear equations and solving them to answer questions. • Comparing and analysing data to draw conclusions. • Kinetics (physics).	Ford
Designing a snap fit clip	Engineering and design	• Solving simple equations arising from formulas. • Represent word problems with simple linear equations and solving them to answer questions. • Comparing and analysing data to draw conclusions.	Ford
Exploring changes in the cash rate and its effect on the economy.	Economics, commerce	• Represent word problem with simple linear equations and solving them to answer questions. • Solving simple equations arising from formulas. • Re-arranging expressions to make a specified variable the subject. • Associating the solution of simultaneous equations with the coordinates. of the intersection of their corresponding graphs.	Reserve Bank of Australia
Food industry and coding	Software engineer, coding, information technology	• Using formulas to solve problems. • Using authentic situations to apply knowledge to solve real world problems. • Implement algorithm.	Texas Instruments
Panel cutting	Software engineer, coding, information technology	• Using formulas to solve problems. • Implement algorithms. • Using authentic situations to apply knowledge to solve real world problems.	BIARRI
Pet alarm	Software engineer, coding, information technology	• Using formulas to solve problems. • Using authentic situations to apply knowledge to solve real world problems. • Implement algorithms.	Texas Instruments
Vehicle safety	Engineering and design	• Represent worded problem with simple linear equations and solve them to answer questions. • Solving simple equations arising from formulas. • Calculate speed, time, and distance. • Comparing and analysing data to draw conclusions.	Ford

BOOK REVIEW: BUILDING ENGAGEMENT IN MIDDLE YEARS MATHEMATICS

Martin Holt - Primary maths education consultant

With 200 hours (best case) to teach maths each year, which tasks are worth spending time on?

As teachers, our response to this question will determine the success of the learning environments we create.

Peter Sullivan's *Building Engagement in Middle Years Mathematics* makes a convincing argument for spending time teaching learning sequences where students in Years 5-8 are confronted with a series of well-constructed, open-middled problems over the course of one to two weeks.

Each task reflects and builds on the learning from the previous task within the sequence, a pedagogical approach based on variation theory (see Kullberg, Runesson, & Mårtensson, 2013) where gradual adjustments to the context or the concept enables students to consolidate and extend their learning over series of developmental steps. Learning happens as students share and see different approaches adopt more sophisticated thinking and strategies over time.

As hinted at in the title, Sullivan sees student engagement as an essential component of learning. The resource uses several research-informed approaches for lifting student engagement including providing opportunities for students to collaborate, engage in discourse, link concrete, visual and symbolic representations and to choose their own strategies.

Furthermore, each task has multiple entry and exit points which means that the entire class is working on the same problem. Differentiation occurs through enabling and extending teacher prompts which are provided in each sequence and ensures that all students remain connected to the thinking which surrounds the big mathematical idea in focus. While many problems evoke plausible real-life contexts, Sullivan prioritises mathematical problems which are robust, open-middled and which stimulate curiosity, recognising that maths is intrinsically interesting and doesn't need to be dressed-up in twee contexts that can have the opposite effect when it comes to engaging our students.

KEY CHARACTERISTICS OF LEARNING SEQUENCES

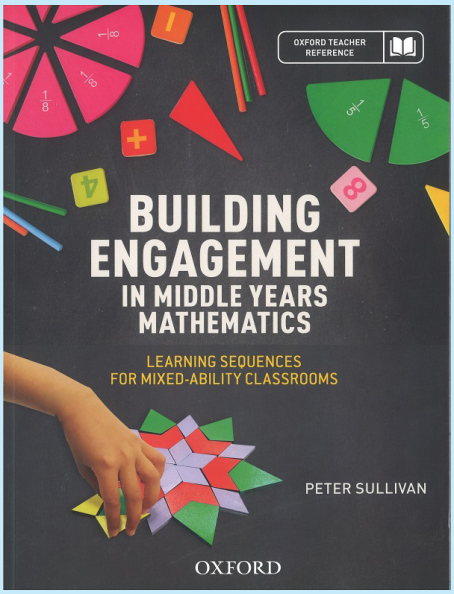
1. Represent one to two weeks of classroom work.
2. A collection of similarly structured tasks which focus on the same or related big mathematical ideas and curriculum foci.
3. Facilitate movement from concrete to pictorial to symbolic/mental images.
4. Feature problems which students will not initially know how to solve.
5. Include multiple entry and exit points (often using enabling and extending prompts).
6. Allow students to make choices about range of methods and solutions.

It is important to note that the sequences are not lesson plans, and it would be helpful to familiarise yourself with an instructional model such as the Launch, Explore, Summarise (see Russo 2020, Designing and Scaffolding Rich Mathematical Learning Experiences with Challenging Tasks) to complement the pedagogical approach of the resource. With that said, each sequence includes an overview which describes the curriculum focus, the big mathematical ideas that students will understanding and the assessment focus, which can form the basis of a lesson plan and accompanying learning intentions.

Each of the three strands of the Victorian Curriculum are featured including six chapters devoted to whole number and rational number concepts.

Regardless of the middle years class that you teach, you will find a learning sequences within each topic that is appropriately challenging for your year level.

Building Engagement in Middle Years Mathematics is well worth your student's time.



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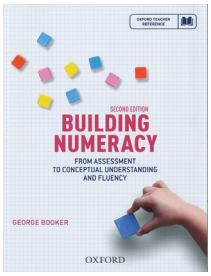


BUILDING NUMERACY SECOND EDITION

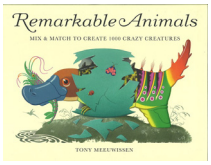
3–10

Building Numeracy has been designed to assist all teachers, at all levels, to develop expertise and confidence in diagnosing student difficulties.

This book uses evidence-based, peer-reviewed intervention strategies that help teachers to:

- understand how mathematical concepts and processes are constructed and connected
- overcome mathematical misconceptions and inappropriate ways of thinking
- plan and implement appropriate intervention programs to build students' competence and confidence.

$73.50 (MEMBER)
$88.20 (NON MEMBER)



REMARKABLE ANIMALS

F–6

What is a Treevipus? A fantastic creature with the head of a trunkfish, the body of a weevil and the tail of a platypus, of course! In this reissue of this popular novelty title, a host of creatures presented in humorous pictures and informative captions take on new names, and a hilarious new identity when their heads, bodies and legs are swapped around as the pages are flipped.

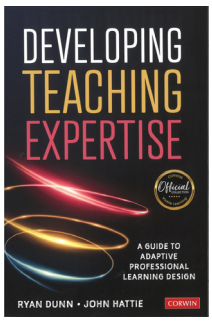
$21.50 (MEMBER)
$26.50 (NON MEMBER)

ROOM ON THE BROOM

F–4

The witch and her cat fly happily over forests, rivers and mountains on their broomstick until a stormy wind blows away the witch's hat, bow and wand. Luckily, they are retrieved by a dog, a bird and a frog, who are all keen for a ride on the broom. It's a case of the more, the merrier, but the broomstick isn't used to such a heavy load and it's not long before... SNAP! It breaks in two! And with a greedy dragon looking for a snack, the witch's animal pals better think fast.

$14 (MEMBER)
$17 (NON MEMBER)



DEVELOPING TEACHING EXPERTISE

F–VCE

Do teachers have the expertise to produce the best outcomes in every context? Do they confidently and intentionally inquire, adapt, and change based on student needs? This book offers a deep exploration into cultivating a culture of design thinking - a proactive process where teachers work through iterative design cycles and understand how to make what works best work.

- Explore how specific design and leadership approaches can form a framework for leading teacher professional learning
- Learn to navigate through complex educational environments
- Learn from illustrative action items, vignettes, and real-life examples and results

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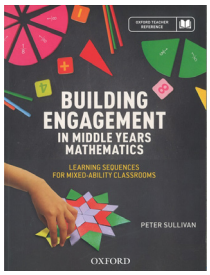

BUILDING ENGAGEMENT IN MIDDLE YEARS MATHEMATICS

4–10

Building Engagement in Middle Years Mathematics provides teachers with a range of original learning sequences focused on the mainstream content of the Australian Curriculum.

Each sequence has been developed in line with the most recent research into mathematical learning and is designed to have a low floor and high ceiling, with multiple entry points for Years 7-8 students of varying abilities.

The first task in each sequence activates existing knowledge and creates awareness of the need for new learning, while subsequent tasks consolidate and extend this learning, helping students see the 'bigger picture'.

$68 (MEMBER)
$81.60 (NON MEMBER)

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