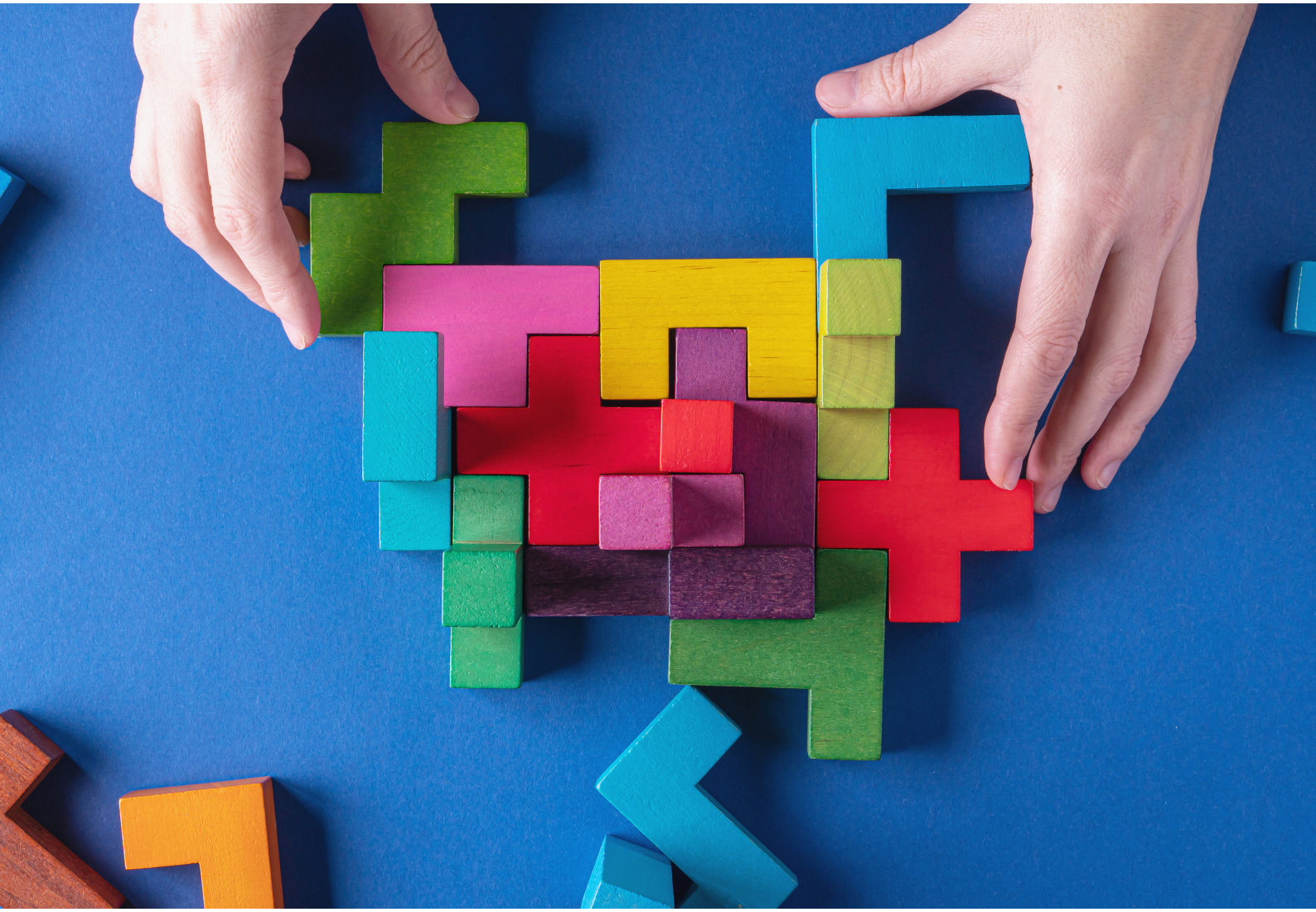
THE MATHEMATICAL ASSOCIATION OF VICTORIA

THE COMMON DENOMINATOR 2/25

WHAT IS PROBLEM SOLVING?



INSIDE

Professor Amie Albrecht, University of South Australia

How would you define mathematical problem solving? Take a few moments to think before reading on.

I've posed this question to hundreds of teachers. Responses include getting the right answer, using given information, solving real-life problems, tackling challenging tasks, thinking critically, and working with unfamiliar situations.

Mathematics education is full of terms that mean different things to different people, complicating discussions at all levels. Conflicting definitions of problem solving have plagued us for decades, and yet we still seem to be in a state of collective misunderstanding about what problem solving actually means in mathematics education.

Continued on page 4

THE COMMON DENOMINATOR
The MAV's magazine published for its members.

Magazine 295, April 2025

The Mathematical Association of Victoria, 61 Blyth Street, Brunswick VIC 3056

ABN: 34 004 892 755
Tel: 03 9380 2399
office@mav.vic.edu.au

President: Kerryn Sandford
CEO: Jennifer Bowden

The Common Denominator is edited and produced by Louise Gray, Stitch Marketing.

Print Post Approved Publication No: PP100002988

Stay connected

mav.vic.edu.au
@maths.vic
@maths_vic
@maths-vic
@maths.vic

FROM THE PRESIDENT

Kerryn Sandford

A recent report commissioned by the NSW Department of Education highlights the growing administrative demands placed on schools and teachers and the impact these have on workload. Today, mathematics teachers are not only curriculum and pedagogical experts but also data analysts, wellbeing supporters, technology integrators, documentation specialists, and motivators. We are expected to design engaging, needs-based learning experiences while also addressing student motivation, attendance, and wellbeing — challenges compounded by increasing anxiety (both general and mathematics-specific), mobile phone and gaming distractions, rising levels of dysregulated behaviour, persistent workforce shortages, and broader societal uncertainty. All of this exists alongside evolving departmental initiatives and policies that require constant adaptation.

It is no surprise that, at times, this can feel overwhelming. So how do we sustain our passion for teaching mathematics? One of the most effective ways is to reconnect with what drew us to this profession in the first place. Engaging in professional learning, such as the *Leading Mathematics* program from VATL, can provide fresh perspectives and the opportunity to collaborate with like-minded colleagues. Mentoring an early-career or out-of-field teacher, while an additional commitment, can be incredibly rewarding and help strengthen our profession. Creating or joining a community of practice — whether within your school or across schools — can foster meaningful collaboration and support.

As we move into Term 2, it is worth reflecting on our own 'why', the passion that led us to mathematics education. Prioritising student engagement and fostering a love of mathematics not only benefits our students but also enhances our own teaching experience. After all, when students are engaged and excited about learning, that energy is contagious.

Let's continue to support one another, advocate for what matters, and find joy in the moments that remind us why we do what we do.

MAV AGM

Notice is hereby given that the Annual General Meeting for The Mathematical Association of Victoria will take place on Wednesday 21 May 2025. The AGM will be held at The Hellenic Museum, 280 William Street, Melbourne.

RSVPs close Monday 12 May, RSVP at www.mav.vic.edu.au/events. Email Jen Bowden to arrange a proxy vote, jbowden@mav.vic.edu.au.

Agenda

- Welcome
- Minutes of previous meeting
- Annual report
- Financial reports
- Announcement of appointed Directors
- Thank you to retiring Directors

Following the formalities, you are warmly welcome to join us for informal dinner, drinks and networking at The Mint.

All members and interested parties are welcome.

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	PRESENTERS
Maths Talent Quest	30/4/25 (Virtual)	F–10	Danijela Draskovic and Renee Ladner
Open ended tasks	5/5/25 (Virtual)	7–10	Jess Mount
Exploring GenAI as a tool to support mathematics teaching	6/5/25 (Virtual)	F–12	Scott Cameron and Carmel Mesiti
MAV regional conference (Colac)	9/5/25	F–10	Various
MAV AGM	21/5/25	All	MAV
Melbourne mathematics conference: Leadership stream	4/6/25	F–12	Various
Melbourne mathematics conference: Primary teachers stream	5/6/25	F–6	Various
Melbourne mathematics conference: Early childhood stream	5/6/25	EY	Various
Mathematical modelling	12/6/25 (Virtual)	F–10	Jill Brown
MAV regional conference (Clifton Springs)	20/6/25	F–10	Various
MAV annual conference: Thriving in mathematics	4/12/25 5/12/25	All	Various

WHAT IS PROBLEM SOLVING?

Professor Amie Albrecht, University of South Australia

CONT. FROM PAGE 1.

As mathematician Paul Halmos famously said, problems are 'the heart of mathematics'. Before we examine problem solving in more detail, we need to first consider what we mean by problems themselves.

ROUTINE EXERCISES AND PROBLEMATIC TASKS

I like to think of problems along a line representing their level of perplexity. At one end we have problems as **routine exercises** — typically practice questions designed to test mastery of a particular technique, usually one that was recently taught. Paul Zeitz distinguishes between perplexity and difficulty, saying that 'an exercise may be hard or easy, but they are never puzzling, for it is always immediately clear how to proceed' and that 'the path towards solution is always apparent'.

The majority of problems found in school textbooks are of this type, particularly when they are located in sections with helpful titles as to the technique that should be practiced! At the other extreme we have **problematic tasks** — problems that are perplexing and cannot be answered immediately as the way forward is typically unclear. These are the types of problems that intrigue research mathematicians.

Can each problem be characterised as either routine or problematic? Unfortunately a simple delineation is, pardon the pun, problematic. Consider the following, from Siemon and Booker (1990):

> 'A farmer had sheep and emus together in a paddock. If the farmer counted 34 heads and 88 legs, how many sheep and how many emus were in the paddock?'

What might a Year 4 student do? What might a Year 11 student do? The former might draw diagrams, use manipulatives, try trial and error; the latter might apply a learned technique such as solving via simultaneous equations. The same task can be routine or problematic depending on the student. Tasks move along our own individual line of perplexity as our knowledge and experience grows.

And this is exactly what we want to have happen in education as students learn.

Should we focus on routine exercises or problematic tasks? Both have their place. Like a gym-goer who builds strength through repetitive exercises and a mountain climber who faces unpredictable challenges, both approaches help students develop mathematical proficiency. The mountain climber might face setbacks and need to retrace their steps, but eventually experiences the thrill of accomplishment. And just as gym-built strength and fitness makes mountain climbing more achievable and enjoyable, students benefit from both types of mathematical experience.

THREE FLAVOURS OF PROBLEM SOLVING

Given that mathematics consists of problems, it seems obvious that problem solving should be central to school mathematics. Yet we often talk at cross purposes, as some teach *for* problem solving, some teach *about* problem solving, and some teach *through* problem solving.

The missing preposition — *for, about, through* — makes it clearer what problem solving could entail.

Teaching *for* problem solving typically follows an 'explicit teaching' approach. A technique is introduced and demonstrated, then exercises are provided for practice. Students eventually apply that knowledge to solve other problems. A strength of this approach is the focus on mastery. A shortcoming is that problem solving is typically only considered after the acquisition of all required knowledge, and so the problem is unlikely to be problematic in the sense I described earlier.

Teaching *through* problem solving turns this upside down. Students start with a rich problem carefully chosen to embody the key aspects of the topic. Knowledge or skills to be learned emerge from students exploring the problem, which is sometimes referred to as 'inquiry-based learning'. A strength of this approach is the focus on engaging students in contexualised, self-generated learning. A shortcoming is that with insufficient consideration given to task selection and learner support, students can struggle unproductively and aimlessly without learning anything.

Teaching *about* problem solving is a powerful but forgotten member of the family. This approach brings awareness to the act of problem solving by articulating, experiencing, and reflecting on mathematical processes. It typically involves frameworks like Pólya's four principles of problem solving or Mason, Burton and Stacey's three phases of work (my personal favourite), and specific strategies such as trying particular cases, being systematic, looking for patterns, and working backwards. This approach typically — and unfortunately — gets far less attention than the other two.

One effective technique for developing metacognitive skills is consistently prompting students with three questions during problem solving: 'What (exactly) are you doing? Why are you doing it? How does it help you?' Alan Schoenfeld's research showed that when teachers regularly pose these questions, students gradually internalise them and develop habits of stepping back to analyse and evaluate their progress — in ways similar to those of experienced mathematicians. Over time, this questioning becomes habitual, helping students monitor and regulate their own problem solving.

INTEGRATING THE THREE APPROACHES

At times it feels like we are divided, where people have declared themselves either 'Team explicit teaching' or 'Team inquiry'. But just as with the gym-goer and the mountain climber, we need both types to develop strong problem solvers. While a snapshot of our teaching at any given point in time might look like explicit teaching or inquiry-based learning, a combination of the two is needed over time to ensure that students become both confident and capable mathematicians. Failing to acknowledge or incorporate the merits of both approaches does our students a disservice.

Rather than pitching a third camp, we need to find ways to integrate all three approaches in our classrooms. Here are a few suggestions:

- Plan a 'balanced workout' that combines routine exercises with opportunities for exploration and genuine problem solving.
- Use 'low-floor high-ceiling wide-walls' tasks that allow all students to engage while providing appropriate challenge.
- Teach problem-solving strategies explicitly but also give students opportunities to develop their own approaches through carefully chosen tasks.
- Help students monitor their own thinking through regular reflection and self-questioning.
- Be careful of using labels like 'hard', 'tricky', 'easy', 'simple'. What is straightforward to one person might be puzzling to another.

As Siemon and Booker concluded their article: 'Each approach has a vital and critical role to play in the acquisition of application of mathematical thinking at all levels. We simply cannot afford to concentrate on any one or two at the expense of all three.'

The real challenge lies in finding ways to thoughtfully integrate these approaches to serve the needs of all our students.

Article adapted from 'What Do We Mean By Problem Solving?' on Wonder in Mathematics (amiealbrecht.com), 2 May 2022

REFERENCES

Mason, John, Leone Burton, and Kaye Stacey. 2010. *Thinking Mathematically*. 2nd ed. Harlow: Pearson.

Polya, G. 1945. *How to Solve It: a New Aspect of Mathematical Method*. Princeton, NJ, US: Princeton University Press.

Schoenfeld, A. H. (2016). Learning to Think Mathematically: Problem Solving, Metacognition, and Sense Making in Mathematics (Reprint). *Journal of Education*, *196*(2), 1–38. https://doi.org/10.1177/002205741619600202

Siemon, Dianne, and George Booker. 1990. 'Teaching and Learning FOR, ABOUT and THROUGH Problem Solving.' *Vinculum 27* (2): 4–12. www.education.vic.gov.au/Documents/school/teachers/teachingresources/discipline/maths/assessment/ppprobsolving.pdf

Zeitz, Paul. 2007. *The Art and Craft of Problem Solving*. 2nd ed. Hoboken, NJ: John Wiley.

To learn more from Amie, join us at the Melbourne Mathematics Conference in June. Amie is presenting a keynote on Thursday 5 June in the primary teachers stream, *Beyond one-size-fits-all: Why pedagogical pragmatism matters.*

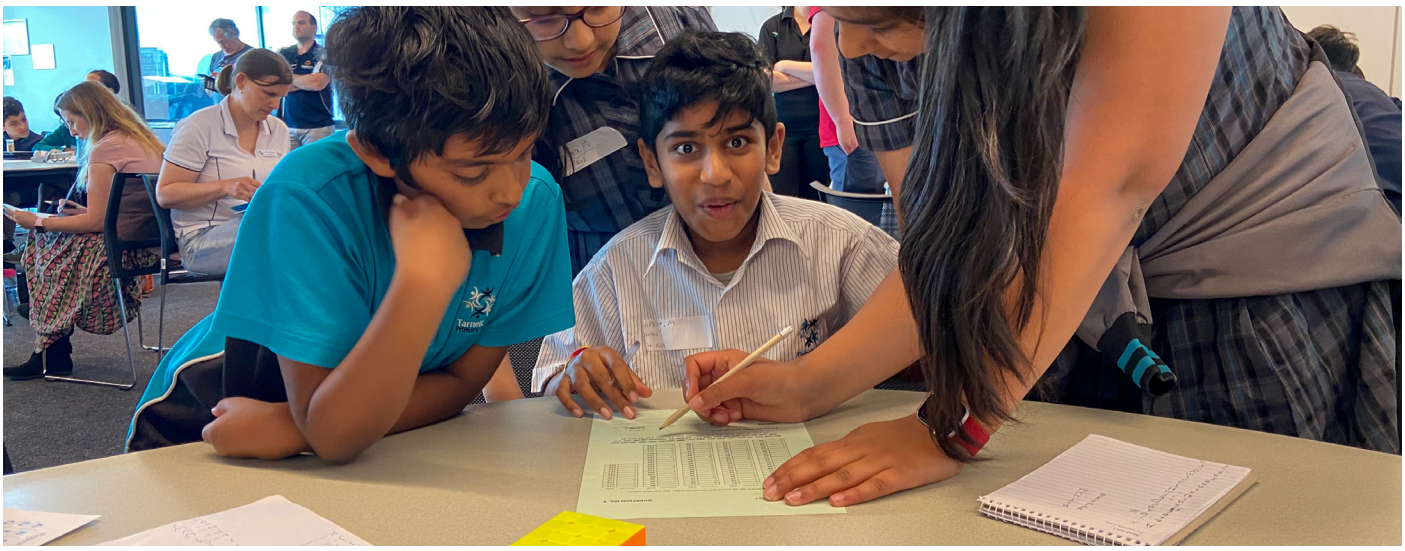
Mathematics teaching shouldn't be about choosing sides in pedagogical battles, yet increasingly, teachers are being told there's a 'right way' to teach. Amie's keynote examines why there can never be one 'best practice' and explores how to make thoughtful teaching decisions based on our classroom contexts.

Register for the conference at www.mav.vic.edu.au.

VICTORIAN CODING CHALLENGE

Calling all high-ability students in Years 5-10.

Do you love solving real-world problems? Are you curious to explore the world of coding?
MAV invites you to take part in the Victorian Coding Challenge (VCC), a two-stage program designed to ignite your passion for coding, sharpen your skills, and stretch your mind!



Stage 1: Virtual coding challenges

What to expect

- A virtual kit with fun and challenging coding tasks.
- Solve real-world problems through coding, some maths, and algorithmic thinking.
- Learn and explore at your own pace, with scaffolding and resources.
- Teachers can access suggested solutions for support.

Details

- Accessible via an online platform from Term 2 until the end of 2025.
- Open to all Victorian schools
- Free for government schools or $12 per student for non-government schools.

Year level categories

- Years 5 and 6
- Years 7 and 8
- Years 9 and 10

Stage 2 (optional extra): Statewide face-to face competition

What to expect:

- Compete in teams of 2-4 against other students in a thrilling, full-day event.
- Solve challenges, play games, and win exciting prizes!
- Open to students who registered for Stage 1

Details

- $50 per team

TEACHERS MUST REGISTER STUDENTS

Stage 1 registrations open in Term 2
Stage 2 registrations open in Term 3

THE MATHEMATICAL ASSOCIATION OF VICTORIA

Victorian coding Challenge

NAVIGATING PRESSING ISSUES

Leonie Anstey - Community and content manager, MAV

NAVIGATING PRESSING ISSUES IN MATHEMATICS EDUCATION MAVCON 2024

At our 2024 annual MAV conference, James Dann, Dr Julia Hill, Mark McLay, Rohani Mohamad and Kerryn Sandford shared their insights, knowledge and amazing expertise and lived experience as mathematics educators. The audience raised several questions that interested them to hear even more. Here is a taste of some of the panel responses. You can read more by heading to the MAV community.

How can teacher workload and the hours worked outside of school be reduced?

Creating a culture of refinement rather than reinvention with regard to curriculum resources can alleviate some of those pressures. I plan all my lessons using the digital platform OneNote to refine rather than recreate, which saves a lot of time.

What strategies can encourage Year 7–10 students, especially girls, to choose advanced VCE mathematics (Methods and Specialist)?

Teachers should acknowledge and work on any biases they might have against male/female students. They could encourage female students' confidence and become great role models. School leaders should support and assign female teachers for advance VCE maths subjects where possible.

This often comes back to high quality mathematical teaching in Years 3-6. primary school principals ensuring that all students from Years 3-6 get at least one exposure to a teacher who loves the teaching of mathematics and focuses on inclusivity, whether that be through the regular class teacher or pinch hitting through specialists/leadership. Setting it up as a strategic goal is important in relation to class structures and staffing choices

What are the best strategies to engage and support reluctant learners?

There is a large spectrum of levels of reluctance, so endeavouring to find out why they are reluctant is critical when it is not a student's normal learning behaviour. I found involving students in real mathematical tasks that the school required (i.e.: how much sand to order for the long jump pit) was a great way of engaging students. Consider how each lesson begins, supportive tasks that engage prior knowledge required for the learning ahead. Carefully select tasks that built confidence where students practice skills, the use of estimation activities and games of chance have been helpful in my career.

How can we motivate students to go beyond the bare minimum and challenge themselves?

Just have teachers who share the love of maths and genuinely get excited by the topic. Setting challenge tasks for teams can assist. The majority of students will be motivated by cause and effect. If students received quality instruction from motivated teachers then the majority will do their best and be motivated by problems they can do or almost do (Zone of Proximal Development). When we have unmotivated and disengaged students in class, I would really get to know them at individual level, work with their wellbeing coach, and keep trying to get them back on track. Getting to the root cause helps us find more effective solutions to help the students.

How might the role of teachers evolve as AI-powered tutors become more advanced?

Regardless of how the students digest the curriculum they will still need teachers who know them and care about their learning outcomes. Technology has already impacted the way in which students receive their knowledge, and the concept of an effective teacher lecturing their students is long gone anyway. Supporting students to use the tools, these are tools like CAS.

Should senior and junior mathematics teachers be separated, or should they teach across all year levels?

I think it would be a goal to have all teachers teaching across Years 7-12, barring the practicalities of skill and qualifications. I have worked with some outstanding maths teachers who teach up to Year 9; I have found that if when I am receptive to their expertise in the these year levels then the conversations can also stem to the importance of certain skills and associated misconceptions when students come to senior maths.

I prefer to teach across all year levels because we become more attuned to Victorian Curriculum and VCE simultaneously. Yet, I understand if school management might have other constraints and has to assign certain teachers at certain year levels.

Join the conversation as part of the MAV online community (www.mav.vic.edu. au/Membership/Community). Share your thoughts and experience to build our wonderings, strategies and how to help our students to have their future in mathematics.

The 2025 MAV conference will be held on 4 and 5 December at La Trobe University. The call for options is open, to learn more, visit www.mav.vic.edu.au.

The Education State

Empowering Victorian educators with ready-to-use Lesson Plans

Teaching can be complex, but finding high-quality, curriculum-aligned lesson plans and resources doesn't have to be.

The **Victorian Lesson Plans** (VLPs) are designed to support teachers in delivering engaging and effective lessons. Aligned with the **Victorian Curriculum 2.0** and the **Victorian Teaching and Learning Model (VTLM 2.0)**, VLPs are written by teachers — for teachers, to strengthen their mathematics teaching and learning programs.

These ready-made classroom resources help lift the burden of duplicative lesson preparation for teachers, ensuring consistency and clarity in the classroom. Guidance integrated within VLPs will be particularly useful for early career teachers and those teaching out of field.

The VTLM 2.0 resources and advice support teachers to refine practices and techniques based on how students learn best.

Victorian educators can access these valuable resources anytime via **Arc**.

Discover more

VTLM 2.0

VLPs

VICTORIA State Government | Department of Education

BOOK REVIEW: MATH-ISH

Renee Ladner, Mathematics educational consultant, MAV

Jo Boaler's *Math-ish* is a bold and transformative exploration of how mathematics can and should be taught. This book challenges the traditional confines of maths education and offers a roadmap for educators, parents, and policymakers to rethink the subject in ways that prioritise curiosity, creativity, and understanding over rote memorisation and rigid rules.

At the heart of *Math-ish* is Boaler's redefinition of what it means to 'do maths.' She dismantles the traditional emphasis on procedures and speed, advocating instead for a broader approach that celebrates problem-solving, collaboration, and creative thinking. Boaler writes, 'Mathematics is not about following rules but about making sense of patterns and relationships,' a perspective that opens the subject to a wider audience and makes it more engaging for all learners.

Boaler's emphasis on making mathematics dynamic and relevant is one of the book's most compelling strengths. Through real-world examples and open-ended tasks, she demonstrates how maths can connect to everyday life and interdisciplinary fields like art and science.

She urges educators to 'show students the beauty and creativity of mathematics,' inviting them to reimagine their lesson plans and foster deeper engagement and meaningful discussions in classrooms.

Another crucial theme in *Math-ish* is its critique of traditional practices such as timed assessments and rigid ability grouping. Boaler illustrates how these methods often foster anxiety and discourage students, particularly those who might need more time to process concepts.

She argues, 'Speed is the enemy of deep thinking in mathematics,' and advocates for prioritising growth, understanding, and effort. This resonates deeply with educators looking to create supportive and inclusive environments where students are encouraged to embrace challenges and learn from mistakes.

Boaler also provides a wealth of practical strategies that can be adapted to various educational settings.

Her advocacy for visual representations, such as diagrams and models, helps demystify abstract concepts, making them accessible to all learners.

She explains, 'Visual mathematics is a powerful tool for understanding,' and highlights how such approaches can transform the learning experience. Additionally, Boaler underscores the importance of fostering mathematical discussions, creating classrooms where students actively collaborate and share ideas.

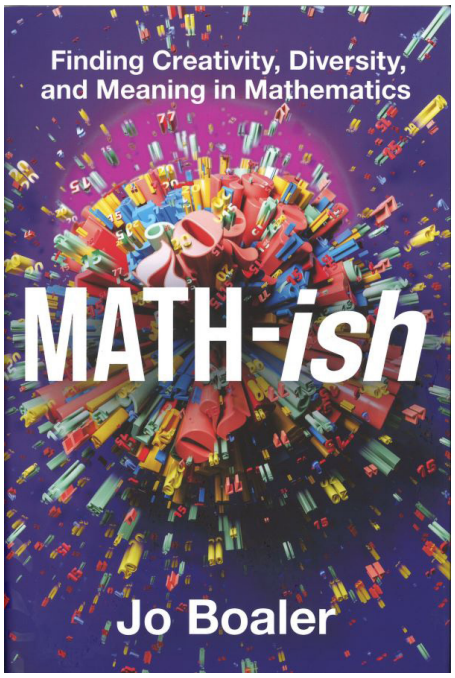
Equity and inclusion are central to Boaler's vision in *Math-ish*. She confronts societal and cultural stereotypes that often marginalise certain groups, particularly girls and minorities, in mathematics. Boaler states, 'We must change the narrative of who can do mathematics,' encouraging educators to reflect on their own biases and adopt inclusive practices. By showcasing diverse mathematicians and creating a sense of belonging for all students, she demonstrates how equity can be embedded into mathematics education.

While *Math-ish* is brimming with innovative ideas, some may find its implementation challenging in the context of rigid curricula or standardised assessment pressures.

However, Boaler offers practical entry points, such as integrating open-ended tasks or shifting the focus from performance to growth, which can be incorporated even within restrictive systems. The book also extends its advice to parents, offering guidance on how to nurture a growth mindset and encourage mathematical curiosity at home. She emphasises, 'Mistakes are valuable; they are the moments when the brain grows the most.'

What makes *Math-ish* stand out is Jo Boaler's infectious passion for transforming mathematics education. Her writing is both accessible and thought-provoking, making complex ideas approachable while inspiring readers to act. This book is not just a guide; it's a call to reimagine maths as a creative, inclusive, and collaborative endeavour.

Math-ish is an essential read for anyone invested in improving mathematics education. Its forward-thinking vision and



actionable strategies make it a valuable resource for educators, parents, and policymakers alike.

Boaler's belief in the potential of every learner is a powerful reminder that with the right approach, maths can be a subject where all students thrive.

Math-ish is available from the MAVshop, ww.mav.vic.edu.au/mav-shop. MAVshop is a great place to shop for all your mathematics education resources. MAV members get a 20% discount on almost everything!

ARE YOU THE GPS?

Leonie Anstey, Mathematics educational leader, MAV

Picture this: A classroom buzzing with mathematical learning, when suddenly a student blurts out, 'We've never seen this before!' Meanwhile, the teacher, half amused and half bewildered, thinks, 'Didn't we cover this last term? What about last year?' Sound familiar?

When we dig deeper, we often discover that students have encountered the concept before – maybe even multiple times. So why does it feel brand new to them? The truth is, teachers work incredibly hard, and students are doing their best with the tools and guidance they're given. But sometimes, we need to ask ourselves: Are we unintentionally a GPS device, providing turn-by-turn instructions?

A PERSONAL GPS STORY

I spent some time working in the ACT and NSW. As a Victorian, I didn't have much knowledge of the area and I remember the the day I had to venture out on my own. Armed with my trusty GPS, I punched in the address, checked the directions, and hit the road. But disaster struck – my GPS froze. I sat in my car, feeling stuck and unsure of my next move. My only strategies were to call a colleague or hope the device reset!

Fast-forward ten weeks. I was heading to Queanbeyan, just 15 kilometres from Canberra. Feeling bold, I ditched the GPS and relied on my previous experience. To my delight, I made it without a single wrong turn. That small victory felt huge!

WHO'S BEING CHALLENGED TO LEARN?

During that trip, I couldn't help but reflect on the classroom dynamics I'd observed. When I'd successfully navigated to Queanbeyan, it felt like real progress for me – but for someone who lives in the area, it's a simple journey. For learning to happen, students need to operate in their own zone of challenge, not someone else's.

When we design learning experiences, we need to ensure every student can grow their knowledge, skills, and dispositions. But growth doesn't happen when we're constantly handing out the answers. There's no question that scaffolding is crucial, but students need the chance to navigate their own learning progress.

Students certainly need to know the learning objective (destination), and what the success criteria are (no U-turns).

If I'd relied on my GPS forever, I'd never have experienced the satisfaction of reaching destinations without assistance. In the same way, students need opportunities to struggle, persevere, and succeed independently. That's where mathematical proficiency and dispositions are harnessed.

ARE WE THE GPS FOR OUR STUDENTS?

This experience made me think: Are we acting as GPS devices for our students, telling them exactly what to do at every turn? If so, how will we enable students to develop their mathematical proficiency to solve problems, reason and justify their ideas?

So, here's the challenge: How can we strike the right balance? How do we scaffold and support our students while stepping back, empowering them to take control of their own learning journey?

Let's create a culture that values progress and celebrates learning as an ongoing process. Let's model the joy of learning and provide safe spaces for students to take risks and reflect on their growth.

READY TO TAKE ACTION?

- Attend the Melbourne Mathematics Conference: Explore strategies, connect with like-minded educators, to build students' mathematics and numeracy skills for their life.
  Register at www.mav.vic.edu.au
- Join the MAV Community Discussion Group: Share your experiences, exchange ideas, and collaborate with other passionate teachers.
  www.mav.vic.edu. au/Membership/Community
- Submit an option to MAVCON 25
  www.mav.vic.edu.au

INQUIRY AND EXPLICIT TEACHING

Leanne Ronalds, Mount View Primary School

MATHS, TOILET PAPER, AND CONNECTING INQUIRY AND EXPLICIT TEACHING

As a Year 4 teacher, one of the most exciting parts of teaching Primary Years Program (PYP) in an International Baccalaureate (IB) school is connecting inquiry-based learning with explicit teaching. Like many teachers, I used to view these two approaches as dichotomies, or as two different approaches to teaching.

The recently released Victorian Teaching and Learning model 2.0 (VTLM 2.0) defines inquiry learning, 'as an approach to teaching and learning that enables students to construct their own understanding through authentic, open-ended inquiry'. It also states 'effective teaching requires clarity of purpose, explicit teaching of concepts, and the intentional use of teaching strategies to engage all students'.

With these two definitions coexisting in current, relevant educational research and literature on effective teaching practice, it is clear to see the potential for ambiguity. I'm seeing experienced teachers unsure, and trying to juggle explicit teaching and inquiry learning as an 'either or' approach.

This is only natural because, on one hand, we understand that explicit teaching involves providing clear instruction, while on the other, we aim to meet the Victorian Curriculum 2.0 achievement standards, which require students to reason, justify, problem solve, and communicate their ideas through exploration, thus developing as both mathematical thinkers and doers.

My experience in the 2024 Mathematics Talent Quest demonstrates how inquiry learning and explicit teaching are not opposing forces at all. Rather, they are necessary and complementary elements that work together to create a dynamic and effective learning environment.

As Archer and Hughes (2011) explain, 'explicit teaching provides the structure and essential skills for learning, while inquiry fosters critical thinking and deeper understanding, ensuring that students not only know what to learn but also how to learn it'.

Explicit teaching is a necessary foundation for and during inquiry, equipping students with necessary tools and skills to actively engage in meaningful exploration and develop deeper understandings.

INQUIRY AND EXPLICIT TEACHING: PARALLEL PROCESSES, NOT OPPOSITES

While it's easy to view inquiry learning and explicit teaching as conflicting, in reality, they serve distinct yet complementary roles. The key is recognising that both approaches offer unique benefits that, when combined, create rich and authentic learning experiences.

Explicit teaching lays the foundation for learning, while inquiry and discovery deepen students' understanding and engagement. Inquiry learning gives students the space to ask questions, explore ideas, and make connections to their own world, while explicit teaching provides the structure, clarity, and foundational knowledge needed to guide students through their investigations.

The focus is on developing deep conceptual understanding within the context of a transdisciplinary theme. For our Mathematics Talent Quest investigation, our class chose toilet paper as the topic for our entry. At the time, we were exploring the *Sharing the Planet* theme. My role was to guide students to develop their own research questions, closely aligned with the theme.

Initially, students came up with questions such as, 'How long is a roll of toilet paper?' or 'How many squares are there?' While these are important questions, they can be solved easily and limit deep mathematical understanding. However our approach offered the opportunity for mathematical modelling as we were encouraging students to explore messy real-world problems.

Explicit teaching was necessary to help students refine these questions into relevant, messy problems (no easy answers) that would foster meaningful exploration and development of mathematical modelling concepts to meet the demands of the Victorian Curriculum 2.0.

Through targeted instruction, students transformed their inquiry into a more open-ended question: 'What could be the best toilet paper to use?' The explicit teaching focused on how to craft research questions that promote critical thinking and exploration, while also providing the foundational knowledge to support their investigations. The combination of student agency in selecting their own research topic and the guidance provided through explicit teaching resulted in a rich and challenging mathematical inquiry tied to our transdisciplinary theme.

SETTING UP INQUIRY USING EXPLICIT TEACHING

In the initial phase, I explicitly modelled how to measure toilet paper and showed students how to calculate area, recapping these concepts from earlier in the year. Using explicit teaching, I helped establish the essential background knowledge needed for the investigation.

However, it was also important that the investigation itself remained open-ended, so students had the opportunity to drive their learning. This demonstrates that explicit teaching is not always a rigid transfer of information. It can be a launching pad for inquiry learning, supporting and guiding students without dictating every step along the way.

This approach meets the demands of the VTLM 2.0 model, which advocates for the use of clear learning intentions and success criteria – principles foundational in explicit teaching. In this investigation, co-creating a rubric with students and aligning it with the success criteria helped to further clarify learning intentions and success criteria. As students progressed through their investigations, the rubric provided a useful tool for self-assessment and guidance, allowing them to evaluate their progress and refine their approaches.

In this phase of the investigation, I used explicit teaching to clarify mathematical concepts and I used the inquiry process to personalise and refine expectations. Once this was established, inquiry learning could drive learning and my job became one of balancing the two approaches.

INQUIRY AND EXPLICIT TEACHING (CONT.)

Leanne Ronalds, Mount View Primary School

Figure 1. Year 4 students engaging in a hands-on mathematics inquiry using rolls of toilet paper.

Inquiry learning gave students the space to develop their mathematical understandings, while explicit teaching offered the essential groundwork for those inquiries.

GUIDED LEARNING: BLENDING INQUIRY AND EXPLICIT INSTRUCTION

During this phase, students worked in small groups to investigate their predictions, documenting their own thinking, reasoning and mathematics. They measured rolls of toilet paper on the school oval, counted the squares, and graphed their results. Students tested their own hypotheses, they formulated questions and they worked collaboratively to collect data.

However, as students progressed, observations of student learning identified the need for explicit teaching. For example, one group struggled with accurately measuring the length of the toilet paper. Rather than taking over their investigation, I used explicit teaching to guide them back on track with effective question prompts for activating procedural understanding of measurement. Dylan Wiliam (2011) emphasises the significance of asking questions that promote deeper thinking, stating, 'the most important thing is to ask questions that move students' thinking forward.' The quality of these questions is essential for guiding students' learning, helping them navigate challenges and deepen their engagement with the inquiry.

In addition to questioning, explicit teaching can involve modeling a process to ensure clarity. Archer and Hughes (2011) further reinforce this idea, stating, 'effective teaching involves not just providing information, but actively guiding students through the learning process, ensuring they understand the concepts and can apply them independently.' This aligns with my approach: using targeted questions and modeling key processes to support students, without taking over their investigations, while encouraging them to apply concepts independently.

I was able to embed inquiry learning and explicit teaching through this mathematics investigation. Students were driving the inquiry, while I was there to guide them with specific, targeted mathematics instruction when needed, without doing the mathematics for them. Inquiry gave students the space to explore their questions, and explicit teaching gave students the tools and guidance they needed to succeed.

REFLECTING ON THE INQUIRY THROUGH EXPLICIT TEACHING

In this phase, we gathered as a class to reflect on our findings. Students shared their results and explained the reasoning behind their investigations. This was an ideal moment to return to explicit teaching, using the class discussion to connect their findings back to the key mathematical concepts we had explored: measurement, estimation, and data analysis. By revisiting these concepts in the context of their own work, students were able to see how they applied in real-world scenarios and strengthened their understanding of mathematics.

INQUIRY AND EXPLICIT TEACHING: A POWERFUL COMBINATION

This investigation demonstrates that inquiry-based learning and explicit teaching are not opposing forces but complementary ones. Each approach plays a distinct yet interconnected role in fostering a rich learning environment. Explicit teaching equips students with the foundational knowledge, strategies, and skills necessary for meaningful learning. While inquiry learning provides opportunity apply knowledge, explore ideas, and develop critical thinking. Together, they nurture students as mathematicians.

It is hoped that this brief discussion helps many teachers recognise where they are already using both inquiry and explicit teaching and to fearlessly identify the connections between the two. For those who may not yet be integrating them, I hope this article provides the support and confidence needed to begin exploring how to use these approaches in tandem with the VTLM 2.0 instructional model.

Recognising how they work together will not only strengthen our teaching practice but also enrich the learning experiences we offer our students.

REFERENCES

Archer, A., & Hughes, C. (2011). *Explicit Instruction: Effective and Efficient Teaching*.

Hattie, J. (2009). *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement*.

Victorian Teaching and Learning Model, (2023). 'Quick Guide to the Victorian Teaching and Learning Model 2023', accessed at www.education.vic.gov.au/Documents/school/teachers/teachingresources/practice/Quick_Guide_to_the_VTLM-Aug-2023.pdf 2024.

Wiliam, D. (2011). *Embedded formative assessment*. Solution Tree Press.

MAV's Mathematics Talent Quest provides the opportunity for students to complete a mathematical investigation individually, as a group or as a class. Students come up with weird and wonderful investigations like *Do chickens like to be held?*, *Japan claw machines*, *The fastest way to get to Saturn*, and *The best method to wash your car*.

Every investigation is judged and students are recognised at an award ceremony in October. All participating students receive a certificate and the very best investigations are submitted to the National MTQ competition.

If you are interested in participating in the MTQ, contact mtq@mav.vic.edu.au.

MAVCON25: CALL FOR PRESENTERS

MAV invites educators, researchers, and industry professionals to submit options for the MAV25 annual conference, *Thriving in Mathematics*. The conference will be held on Thursday 4 and Friday 5 December 2025 at La Trobe University, Bundoora (onsite only). This major conference will explore the dynamic areas of teaching, learning, careers, and the societal role of mathematics. Presentations should align with the conference sub-themes:

- Contemporary challenges and successes
- Pedagogy and curriculum
- Innovation and inspiration
- Leadership and agency

WHY PRESENT?

This is a unique opportunity to inspire change and connect with passionate professionals in mathematics education. Presenting at MAVCON25 allows you to share your expertise, contribute to shaping the future of education, and foster meaningful discussions. Presenters can build valuable networks that will advance collective success in mathematics teaching.

Don't miss your chance to be part of this transformative event! Submit your proposal and join us in celebrating the power of mathematics to inspire and thrive.

WHAT'S IN IT FOR YOU?

Connect, inspire, gain feedback, access resources to enhance teaching, and advance mathematics education with our diverse community. The main presenter receives a complimentary conference registration.

The Call for Options is open now and will close on 30 June 2025. Notification of acceptance will occur in mid to late July.

Learn more at: www.mav.vic.edu.au/Conference/Annual-Conference

STIMULATING THINKING

Jessica Kurzman, Maths leader, St Patrick's Primary School

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 and Instagram @maths.vic, LinkedIn @ maths-vic and on X, @maths_vic.

This image is one of Thomas Dambo's *The Giants of Mandurah* sculptures. He is the world's leading recycle artist. From a young age, Thomas was taught the value of recycling, sustainability, and unlimited imagination. And so, to share that message and inspire people to get out into nature, Thomas creates larger-than-life sculptures from recycled wood, and places them all over the world. There are six scuptures that form this body of work and they are located in Mandurah, Western Australia. The sculptures are well worth visiting!

EARLY YEARS

- Do you think you are taller than this giant? Why or why not? What are some things that you think would be taller than this giant? What are some things that would be shorter than this giant?
- How many fingers can you see on this giant? Go outside and find that same number of leaves, rocks, bark, flowers, sticks, shells or anything else you can find! Put each group in a line so it is easy to count.
- This sculpture contains lots of rectangles. Can you see any rectangles around you? Try drawing some. Draw some of them big, some of them small, and use lots of different colours!
- How many eyes does the giant have? Can you think of numbers that are more than 2? Try writing those numbers and drawing the matching number of eyes underneath each number you write! For example, 3 is more than 2, so I can write '3' and draw 3 eyes.
- If this giant could walk, he would be very slow! Show how you can walk very slow, and then walk very fast! Do each of the following things very slowly (one at a time), and then very fast: jump 3 times, clap 5 times, sit down, stand up, turn around, touch your toes, shake hands with someone and say your name.
- What things can you see in the picture that are behind the giant? What do you think might be in front of the giant?
- The giant has big hands! Look at your hand. Can you find some things that are smaller than your hand? Can you find some things that are larger than your hand?

FOUNDATION - YEAR 2

- Describe the shapes that have been used to create this giant. What is the same about the shapes you can see? What is different about the shapes you can see? What sort of shapes *are not* used to make this giant? Choose 2 shapes that you can see on this giant, and draw the shapes to make a repeating pattern.
- This giant has 2 eyes. How many eyes would there be if there were 3 giants? 5 giants? What about even more giants? Draw pictures to show the amount of eyes for each number of giants.
- We surveyed 10 people to see if they liked this sculpture. Some said yes. Some said no. More people said yes than no. How many people do you think said yes? How many do you think said no? Show the possible responses in a table and then on a graph.
- It took Jamie exactly 1 hour to travel from school to the sculpture. What time might he have left school? What time might he have arrived at the sculpture?
- 20 students visited the sculptures. Their teacher divided them into equal groups so they wouldn't have to walk around altogether. How many groups could the teacher have made? How many students would be in each group? Use counters to make each possible combination and then draw them.
- One of the giant's fingers is 25 matchsticks long. Find at least three items that are shorter than the giant's finger. Find at least three items that are longer than the giant's finger. Use matchsticks to measure each item and prove that your answers are correct.

YEARS 3 - 6

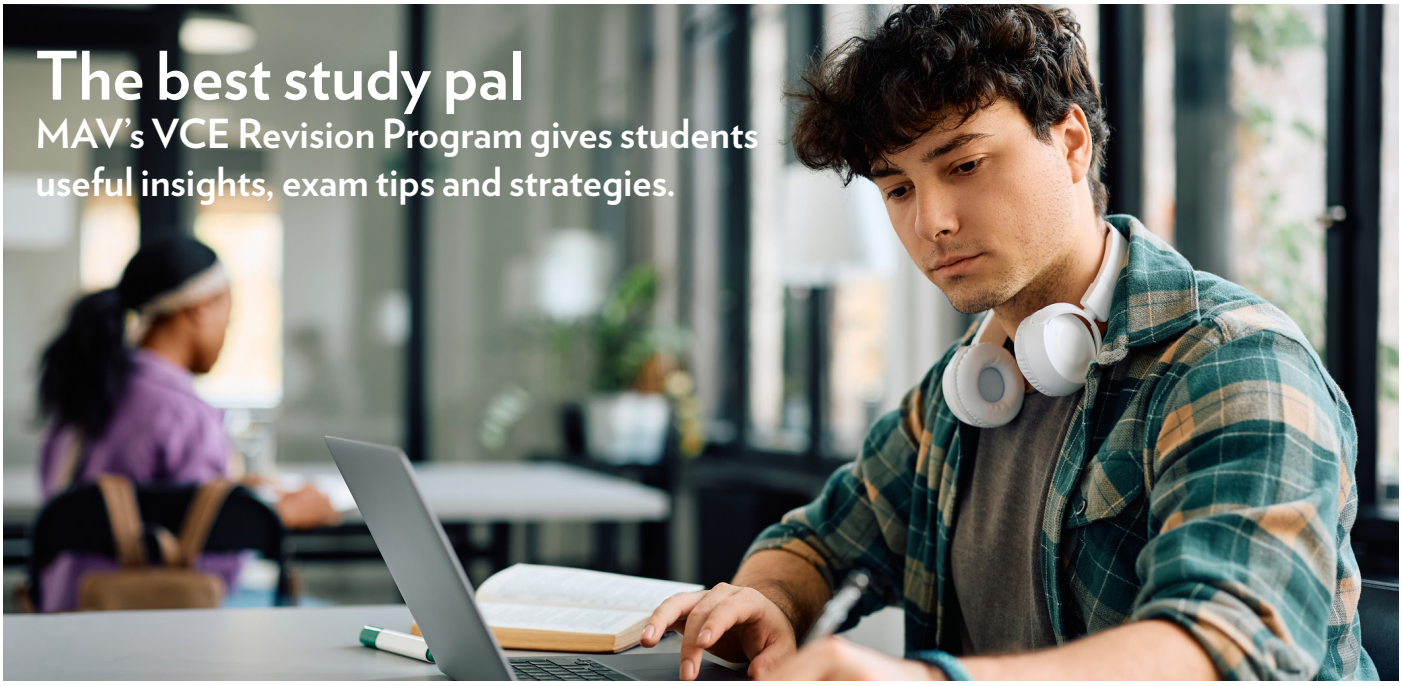
- It takes about 85 minutes to explore the sculptures in Mandurah. If your visit lasts exactly 85 minutes, what time might you arrive, and what time would you finish? How many different possibilities can you come up with?
- The combined length of one hand and one foot is 117 cm. What could the length of each be? What if both the lengths include decimals and no whole centimeters? Record at least 5 different combinations.
- This sculpture weighs 575.5 kg. If you built another one that was exactly the same weight, what would the total weight be? What about for 3, 4 or 5 sculptures?
- Many of the angles in the pieces used to create this sculpture are right angles. Can you find any other types of angles in the picture? Try drawing and labelling some angles, their degree measurements and names.
- If this giant stood up, how tall might it be? Record your estimation in m, cm and mm. How many centimetres taller is your estimate of the giant's height compared to your own height? Now, imagine the giant was four times your height – how tall would that make it? What if, instead of a giant, the sculpture was a tiny creature only one quarter of your height? How tall would it be?
- Over 50 visitors to the sculptures were surveyed about whether they would return to see the sculptures more than once. 85% said yes, 10% said maybe, and 5% said no. How many people do you think were surveyed? Based on your estimate of the total number of people surveyed, determine how many people gave each response. Calculate these numbers for at least three different possible survey sizes.

YEARS 7 AND ABOVE

- Estimate the length, width, and height of each body part of the sculpture (legs, arms, body and head). Use these measurements to calculate its surface area and volume. If you doubled each of the measurements, how would that impact the surface area and volume?
- How far is Mandurah from your current location? If you travelled at an average speed of 80 km per hour, how long would it take you to get to Mandurah? What if you increased your average speed to 90 km per hour? How much sooner would you arrive?
- Choose 5 other locations and calculate the time it would take to get from each of them to Mandurah when travelling at 80 and 90 km per hour.
- If Thomas Dambo took 150 hours to create this sculpture when working alone, how long would it take if he had 2, 3, 4 or 5 others helping, assuming they all work at the same rate? Calculate the time for each scenario.
- What percentage of the whole image is the giant? Prove it!
- In the first week the sculptures were open to the public, 250 people visited. News spread about how amazing the sculptures were, and the number of visitors increased by 6% each week. How many people visited the sculptures on the 5th, 8th, 10th and 13th weeks? Plot this information on a graph to show the growth in visitors over time. In which week did the 10,000th visitor arrive?

MAV education consultants can come to you and create a professional learning plan to build the capacity of teachers at your school. Reach out to our friendly team: primary@mav.vic.edu.au or secondary@mav.vic.edu.au.

VCE REVISION PROGRAM 2025



The best study pal

MAV's VCE Revision Program gives students useful insights, exam tips and strategies.

WHAT'S INCLUDED?

- Watch over 3 hours of presentation videos from VCAA assessors.
- Hear where students tend to go wrong.
- Loads of common exam questions and how to solve them.
- Insights into a VCAA maths exam and how to smash it!
- The program is broken up into areas of study and sub-topics, making it easy to locate your handy resource or video.
- Test your understanding with our exam-style multiple choice quiz questions.
- Videos from TI-Nspire and Casio experts demonstrating how to maximise your use of CAS technology in General, Methods and Specialist exams.
- Access to exclusive live webinars with VCAA assessors where you get the chance to ask them questions.

All four mathematics study designs are offered: General, Methods, Specialist and Foundation. Delivered digitally and on-demand.

DETAILED REVISION NOTES

All students who register receive a comprehensive book of revision notes including:

- Tips for exam success.
- Tricky past exam questions with solutions.
- Common exam questions with solutions.

Pricing starts from $69. 20% discount for bulk bookings.

"I love how the presenters go through past exam questions and areas where students went wrong by breaking them down into steps that are easy to grasp."

REGISTER NOW

www.mav.vic.edu.au/student-activities/VCE-revision-program

THE MATHEMATICAL ASSOCIATION OF VICTORIA

IS YOUR SCHOOL MATHS ACTIVE?

Being a part of MAV's Maths Active Schools program is a great way to formally recognise the commitment made by your school leadership, teachers, students and community to engage with and enhance mathematics learning.

MAV loves to celebrate all schools and feels that those who reflect all that we value should receive some special entitlements too. Our most recent member school to become a Maths Active School is East Bentleigh Primary School. Numeracy Leader, Tanja Boxelaar reflects on what it means to be a Maths Active School:

WHY DOES EAST BENTLEIGH PRIMARY SCHOOL VALUES BEING A MATHS ACTIVE SCHOOL?

By being a Maths Active School, we recognise and support our school community by demonstrating effective learning and teaching practices in mathematics.

As a small school with a dual curriculum, it has inspired us to develop our mathematics capacity and collaboration. It has provided us with a stronger mathematics focus, which has motivated us to explore new trends and best practices in mathematics and deliver these to our students.

This year we have delivered PDs to our staff to build confidence and engagement, we are seeing every child and their needs, and we are passionately delivering high level mathematics learning and teaching at school.

We have started creating a mathematics trail, which will provide a focus on our wider community. Thank you for believing in us, as it has really helped us believe in ourselves.

MAV'S MATHS ACTIVE SCHOOLS AMBASSADOR: DAVID COOK

We are adding an exciting element to our Maths Active Schools program this year. MAV warmly welcomes David Cook who is our Maths Active Schools Ambassador, David will engage with our Maths Active Schools by showcasing their wonderful work and educational outcomes.

David brings over 36 years of experience in primary education, including 15 years as a principal and roles as a university tutor, lecturer, and mathematics consultant. His diverse background spans rural, metropolitan, and international settings, where he has developed expertise in mathematics education, collaborative practice, and system change.

David's passion for teaching mathematics is rooted in his hands-on experience and life-long curiosity. As a consultant, he has created innovative curriculum content, digital tools, and teaching resources to support schools and families. He has also authored resources on multiplication, place value, and number recognition.

David is excited to showcase the inspiring work of our Maths Active Schools and to help schools foster deeper engagement and excellence in mathematics learning.

MATHS ACTIVE ACCREDITATION

MAV invites schools to apply for Maths Active School Accreditation. To learn more, email Renee Ladner, rladner@mav.vic.edu.au or visit www.mav.vic.edu.au.

Schools who become accredited as a Maths Active School are able to use the *Maths Active Accreditation* logo. This is a great way to signal to your school community and prospective families that your school is a leader in mathematics education.

PROMOTING RESEARCH

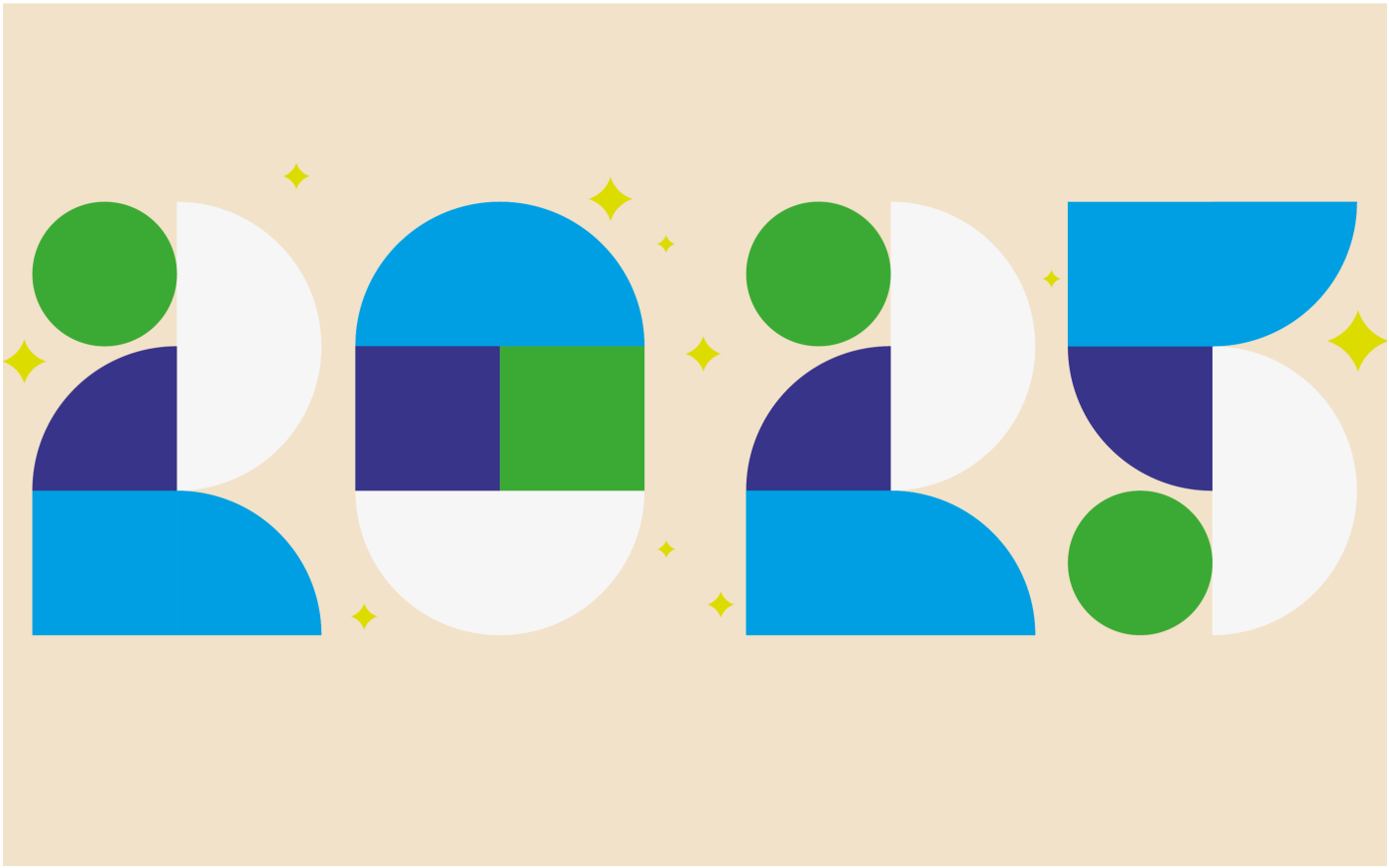
If you are conducting research and would like to advertise it in *Common Denominator*, please follow these guidelines:

- Keep your writing succinct and brief (maximum 250-350 words).
- Provide Human Ethics Research Committee (HERC) approval number (non-negotiable).
- Clearly state the purpose and objectives of the research project.
- Outline the participant criteria (e.g. teachers, students, parents, age range).
- Briefly describe what will be involved for participants (e.g. surveys, interviews, classroom observations).
- Indicate the expected time commitment required from participants.
- Highlight the benefits of participating.
- Provide details on confidentiality and privacy protection for participants.
- Include the researcher's affiliation and contact information.
- Specify any relevant deadlines.
- Provide a QR code for readers to follow for more information and/or linking to your study.
- Submissions should be in a Word document and emailed to office@mav.vic.edu.au.

At the conclusion of your study, we warmly invite you to consider submitting an article to either of our journals, *Vinculum* (secondary) or *Prime Number* (primary), to share your research findings with the mathematics education community.

2025: BE THERE AND BE SQUARE

Roger Walter



Yes it's 2025 and we are there, already 25% of the way through the twenty-first century. Mathematically, 2025 is a very special number with some very interesting properties.

The first interesting fact is that 2025 is a square number, the square of 45, in fact. So what, you may ask. Well, it's the only 'square' year that you will see in your lifetime, so make the most of it. The next square year is $46^2 = 2116$, a mere 91 years later, and the previous one was $1936 = 44^2$, 89 years ago. 2025 is a very interesting number, and your students may be interested to learn some of its properties. There are fascinating patterns in the natural numbers, which many of your students may be interested in exploring.

Some activities arising from this article may be more suited to primary school students, while others may have a more secondary school orientation. It may be possible to get around unfamiliar concepts. For example, if primary students are unfamiliar (or do not fully understand) cube numbers, you could set out an activity similar to the following for the sum of cubes property.

Ask the students which numbers are used to make up all our numbers. These are called digits. List all the digits from 0 to 9 underneath each other on the left side of a page. Next to 0, write 0 × 0 × 0 = and calculate the answer (0). Repeat for 1 up to 9. This could double as a practice session for short multiplication. Add up all the answers. What do you get? Wow!

The next property of 2025 is that it is, in a sense, the square of itself, since $(20 + 25)^2 = 45^2 = 2025$. How many other years share this property? The first year CE (or AD), 0001, is an obvious choice because $(00 + 01)^2 = 0001$. How could you find out if there are any others like this?

The first option might be to check with a spreadsheet, or other software, but there are a lot of combinations to check! The more mathematically minded will see that if the two double digit numbers are a and b, then $(a + b)^2 = 100a + b$.

We know that you cannot solve one equation in two unknowns, but you can express a in terms of b. (b can take values from 0 to 99, whereas the values of a are unlimited.) Expanding brackets enables us to express this as $a^2 + (2b - 100)a + b^2 - b = 0$. Solving for a (in terms of b) gives

$$a = 50 - b \pm \sqrt{2500 - 99b}$$

If we check this for $b = 1$, we get

$$a = 49 \pm 49 = 0 \text{ or } 98.$$

$(98 + 01)^2 = 99^2 = 9801$

We can easily set this up on a spreadsheet such as Excel. Since $2500 - 99b$ must be positive, $b \leq 2500 \div 99$. Actually $b \leq 25$, since b is an integer.

In the first row, put headings b, $a1$ and $a2$, since there are two values of a for every value of b. In the next column, put 0, 50 – A2 + SQRT(2500 – 99*A2), 50 – A2 – SQRT(2500 – 99*A2). Drag down to $b = 25$. The only other integer solutions are $b = 25$, $a = 20$ or 30. So there are only two more years *ever* like this, 3025 $(30 + 25)^2$ and 10 000 $(100+00)^2$.

THE SUM OF CUBES AND THE SQUARE OF A SUM

2025 is obviously the only number equal to the sum of cubes of all the digits (0 to 9).

$0^3 + 1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3 + 9^3 = 2025$

This is quite remarkable and can be easily verified with a calculator. 2025 is also the sum of all the digits squared.

$(0 + 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9)^2 = 45^2 = 2025$

This is actually no surprise as the sum of the first n cubes will always equal the square of the sum of the first n integers. Interestingly, this can be demonstrated geometrically, as shown in Figure 2

The area of the yellow square is clearly $(1 + 2 + 3 + \ldots + 9)^2$. The L shapes will have areas $1^3, 2^3, 3^3, \ldots 9^3$. The reasoning below shows that the area of any L shape of side length k will be k^3. This simple demonstration should be clear to most students with a reasonable understanding of area and basic algebra. More senior students can verify this using arithmetic progressions.

Less dramatically, 2025 can be expressed as the sum of three squares, $40^2 + 20^2 + 5^2$. There may be other combinations of powers producing 2025. Please let me know if you or your students find any others.

OTHER NUMBER SETS

Students may have explored happy numbers. To check if a number is 'happy', form a new number by adding the squares of its digits. Then repeat for this number, and continue until you either end up with 1, or find yourself in a loop. If you end up with 1, the number is happy, otherwise it is sad. Unfortunately 2025 turns out to be sad. Students could work this out for themselves and also find the next 'happy' year. 2025 is also not one of Euler's lucky numbers. However it *is* a harshad (or Niven) number. Harshad numbers were invented by the Indian mathematician D. R. Kaprekar. The name comes from the Sanskrit harsa (joy) and da (give), meaning joy giver.

A number is a harshad number if it is divisible by the sum of its digits.
2 + 0 + 2 + 5 = 9 and 2025 is divisible by 9.

2026 will not be a joy giver because the sum of its digits is 10 and 2026 is not divisible by 10. Was last year a harshad number? When is the next harshad year? Do you think harshad numbers are common or rare? Can you think of any rule(s) which would always produce harshad numbers?

2025 is also a powerful number because for every prime factor of 2025, the square of this factor is also a factor of 2025. The prime factors of 2025 are 3 and 5, and both 9 and 25 are factors of 2025. Hopefully students can connect this with powers of numbers and see that every prime factor in a powerful number must be raised to at least the power of 2.

So although 2025 is neither happy or lucky, it is a very powerful joy giver. This is a bit of fun, although none of the students should take harshad numbers, lucky numbers or happy numbers too seriously.

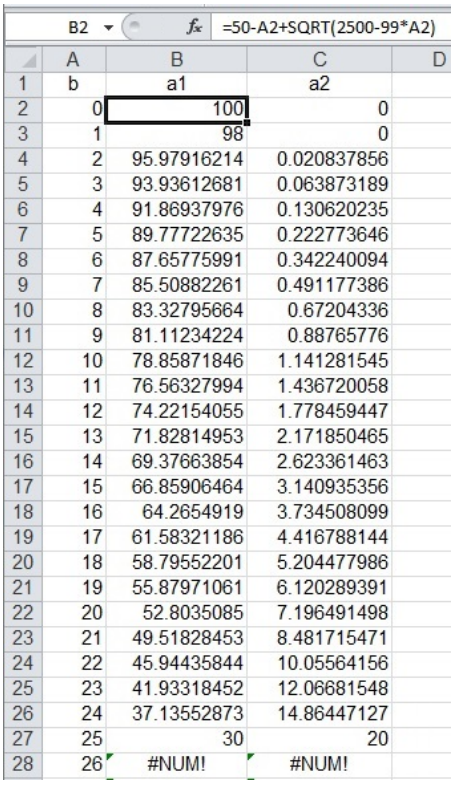
PI DAY AND OTHER DAYS

In America, pi day is March 14, or 3/14/2025, as they write dates. In Australia we must be content with January 3, and wish April had 31 days. There is also an e day on the second of July (in Australia). These days occur every year, including 2025, however I would like to suggest a few special days for 2025.

Square day is May 5, showing that 25 is 5 × 5. Pythagoras day could be July 24, as this date (USA or Australia) represents the Pythagorean triad 7, 24, 25. There is also September 16, revealing the squares of the 3-4-5 triangle, which could maybe be named Pythagoras square day.

There is at least one palindromic date each year. In 2025 it was the fifth of February.

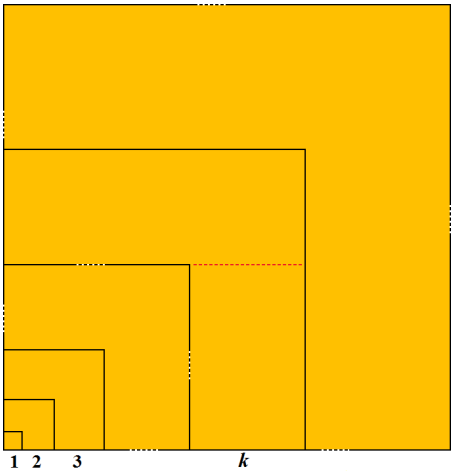
I hope you will find this a bit of fun which your students will enjoy, and at the same time increase their wonder of the many interesting patterns to be found in numbers. Unfortunately this article was not able to be completed in time for the start of the year, but it is appropriate for it to appear 25% of the way through the school year!



B2 =50-A2+SQRT(2500-99*A2)

	A	B	C	D
1	b	a1	a2	
2	0	100	0	
3	1	98	0	
4	2	95.97916214	0.020837856	
5	3	93.93612681	0.063873189	
6	4	91.86937976	0.130620235	
7	5	89.77722635	0.222773646	
8	6	87.65775991	0.342240094	
9	7	85.50882261	0.491177386	
10	8	83.32795664	0.67204336	
11	9	81.11234224	0.88765776	
12	10	78.85871846	1.141281545	
13	11	76.56327994	1.436720058	
14	12	74.22154055	1.778459447	
15	13	71.82814953	2.171850465	
16	14	69.37663854	2.623361463	
17	15	66.85906464	3.140935356	
18	16	64.2654919	3.734508099	
19	17	61.58321186	4.416788144	
20	18	58.79552201	5.204477986	
21	19	55.87971061	6.120289391	
22	20	52.8035085	7.196491498	
23	21	49.51828453	8.481715471	
24	22	45.94435844	10.05564156	
25	23	41.93318452	12.06681548	
26	24	37.13552873	14.86447127	
27	25	30	20	
28	26	#NUM!	#NUM!	

Figure 1.



Both rectangles have a width of k units.
Top rectangle: $l = 1 + 2 + 3 + \ldots (k-1) + k$
Bottom rectangle: $l = 1 + 2 + 3 + \ldots + (k-1)$
$l = (k-1) + (k-2) + \ldots 2 + 1 + 0$
Adding corresponding terms for lines 1 and 3 gives:
Total length $= 1 + (k-1) + 2 + (k-2) + \ldots + k + 0$
$= k + k + \ldots + k$ (k terms) $= k \times k$
Area $= l \times w = (k \times k) \times k = k^3$

Figure 2.

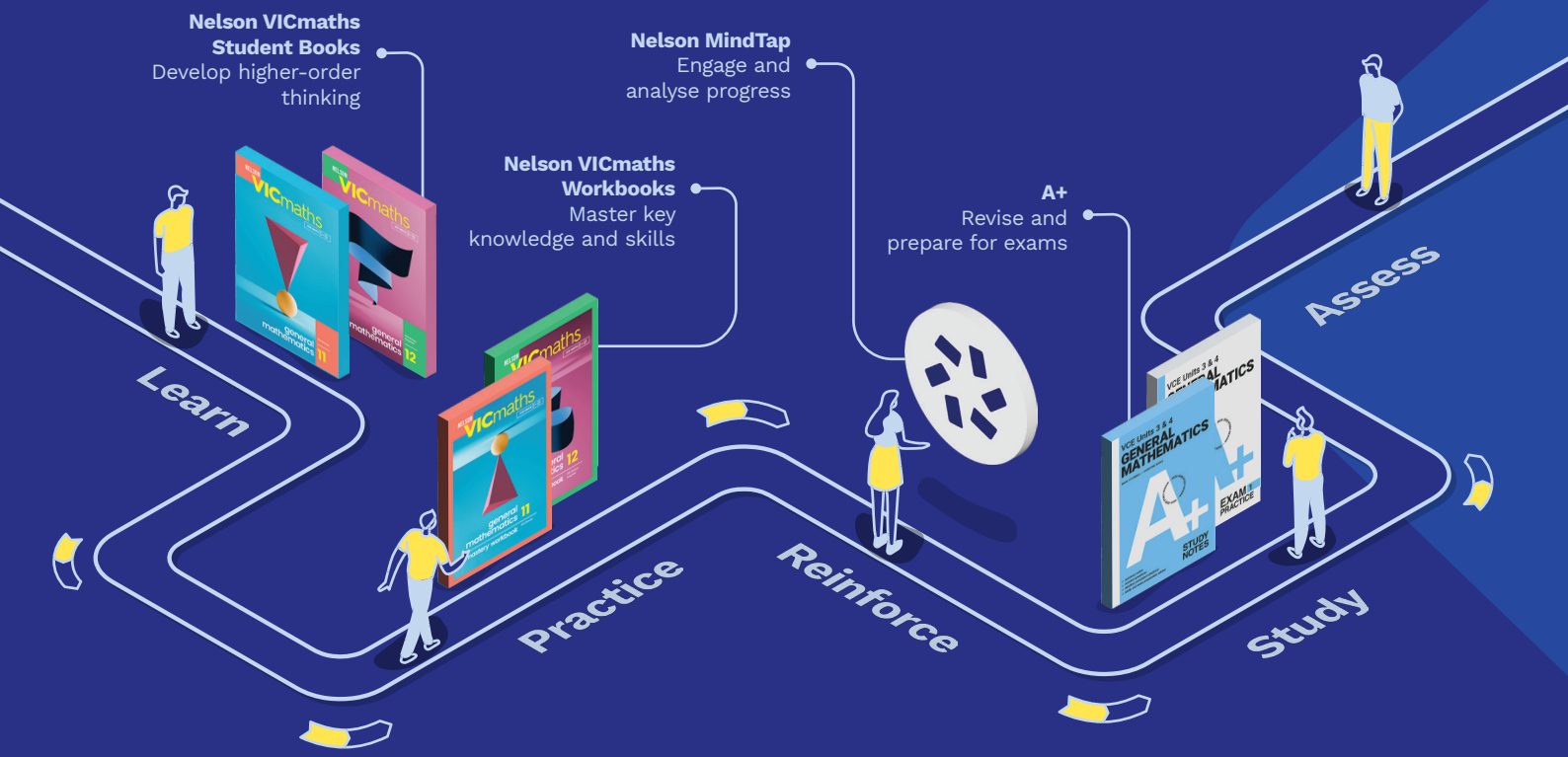
REFERENCES AND READING

Search Wikipedia for happy number, lucky number, harshad number and powerful number. I must credit Instagram for this article, as the source of most of the material. There is a lot of interesting mathematics on Instagram, although you may have to sift through some of the more well-known material.

Transform your teaching.

Nelson VICmaths: a better way to VCE Maths Mastery

Built upon research into the **science of learning** and **teacher advice**, **Nelson VICmaths** is a complete teaching and learning solution to create focused and **successful VCE mathematics** students.



Year 11-12 General + Methods + Specialist + Foundation

Dirk Strasser, Greg Neal, Sue Garner, George Dimitriadis, Toudi Kouris, Stephen Swift, Sue Thomson, Judy Binns

- Designed specifically for the 2023 Study design.
- Chapter format exposes students to exam practice in every lesson.
- Uses VCAA data to enable students to measure themselves against student performance from past VCE exams.
- Fully integrates cumulative practice and revision into students' learning.
- Explains VCE maths in a short and direct student-friendly style, including expert learning advice and 'exam hacks'.
- Provides clear worked examples and explicit CAS instructions.
- Empowers learning through Nelson MindTap interactive resources and analytics.

Want to learn more?

Contact your rep: **nelsonsecondary.com.au/contactus**
Visit: **nelsonsecondary.com.au/vce-maths**

Nelson

A WEBSITE THAT WORKS FOR YOU

Claire Embregts - Community and content manager, MAV

PERSONALISING THE MEMBER EXPERIENCE

The MAV website is a valuable hub where Victorian mathematics educators can access resources, explore professional learning opportunities and student activities and stay connected with the latest news in mathematics education. Our online community also provides a dedicated space for discussion and collaboration. Whether you've engaged in the community, found a classroom-ready resource, or attended an event, our digital platforms have played a role in supporting your teaching journey.

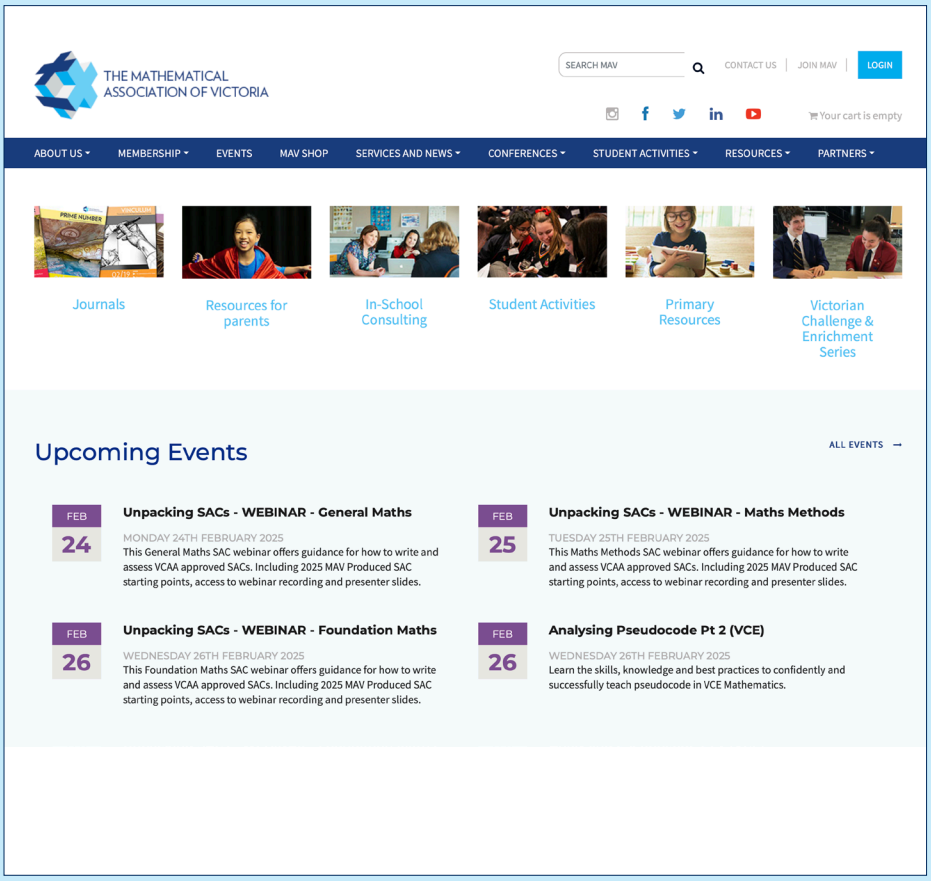
As our programs have grown over time, so has our website and the amount of content and navigation options. We recognise that finding what you need quickly may sometimes feel overwhelming, with multiple layers of menus and an abundance of information. That's why this year; we're undertaking a significant website redesign - to create a platform that better serves you and our members and makes engaging with MAV and your professional community more effortless than ever.

WHY WE'RE MAKING CHANGES

We know that every educator's journey is different. Some of you are early-career teachers looking for practical strategies to support student learning. Others are experienced leaders searching for new professional development opportunities or ways to mentor the next generation of educators and students. Some of you are researchers exploring the latest updates in mathematics education.

No matter where you are in your career, we want you to quickly find what you need and easily connect with all things MAV via our website. Our new design will focus on:

- **Easier navigation:** We will simplify the structure so that key resources, events, and information are easier to locate with minimal effort.
- **Personalised content:** A one-size-fits-all approach doesn't work. Our goal is to create an experience where the most relevant resources, discussions, and events are easy to find.



The MAV website is changing to enhance your experience. Tell us what you'd like to see.

- **Stronger connections:** As a member, you should be able to engage with colleagues, ask for advice, and collaborate on ideas seamlessly. We're working to improve how these interactions take place, ensuring a smoother and more intuitive occasion.

ENHANCING YOUR EXPERIENCE

Imagine logging into the website and immediately seeing content tailored to your needs. If you're a secondary teacher, you might find resources specific to VCE mathematics. As a primary educator, you'll have quick access to age-appropriate teaching strategies and discussions relevant to your classroom.

Professional learning opportunities, upcoming events, and community discussions will be easier to access, ensuring you never miss something that could benefit your teaching practice. Instead of navigating through multiple menus or pages, you'll have a streamlined experience with essential information front and centre.

YOUR VOICE MATTERS

We're taking a user-first approach to this redesign, which means we need your input. We are keen to find out what challenges you have with our current site, which features might you find valuable, what content would you like to see more of?

Your insights will help us create a website that better serves Victorian maths educators — making it easier to access resources, explore professional learning opportunities, and stay connected with the latest mathematics education. By sharing your thoughts, you'll go in the running to win a $250 Visa gift card. The survey is short, so please take a moment to help us with this project.

THE MISSING LINK

Taryn Volpe and Nikki D'Antonio - Limitless Maths

Figure 1. Staff participating in maths curriculum day run by Nikki and Taryn.

In 2023, we had the privilege of leading mathematics together as Learning Specialists at a public primary school in Melbourne's Northern suburbs. Although we had both been in the Learning Specialist role for several years, this was the first year that the school had a professional learning focus on mathematics.

We know the staff team well and felt that a focus on mathematics was going to provoke many different emotions and reactions, ranging from high anxiety to very strong opinions on how it 'should' be taught.

In order to get staff on board with some of the changes we were striving to make, a collaborative approach was critical. In this article, we will outline the approach we took to achieve amazing results in relation to building teacher practice and improving student learning outcomes. We will share examples of our practice in the hope that you are able to learn from, contextualise and use our strategies to enhance collaboration and in result, the professional learning environment in your school.

COLLABORATION IS KEY

Collaboration, by AITSL's definition, is 'to work with another or others on a joint project'. In order to create change in a whole-school setting, the 'others' refers to all staff and the 'joint project' refers to improving student learning outcomes based on a shared goal and vision. The key word in the definition is 'with'.

Often there can be a disconnect between staff and the shared goal and vision, leaving out the 'with'. The direction of the school, along with the priority goals, are almost always determined by the Principal Class alongside a Review Panel (based on a whole lot of school data) and written in the form of a strategic plan - which is the way the system works. The disconnect can happen when teachers don't agree with or understand the reasoning behind the goal or vision or see a purpose or practicality in it, which leads to either a half-hearted effort in implementing any changes being made or complete push back.

During our time as Learning Specialists, we've learnt that it is up to us as the Instructional Leaders to make the 'with' happen – we needed to be that missing link. We quickly realised that even the most planned professional learning session, would have minimal impact unless staff truly believed in the goal and vision and could see how it would directly benefit their specific class of students. The success we achieved in driving improvement in mathematics came down to our steadfast commitment to collaboration, balanced with strong leadership and clear direction. So, how did we make this happen? We're excited to share our top three tips!

1. BUILD YOURSELF A TEAM

Part of our role as Learning Specialists was to work with and support the Professional Learning Community (PLC) Leaders across the school. Our school had straight grades, with teams of 4-5 teachers.

The group met several times a Term, we met with individual PLC Leaders weekly and had a group email chain that was buzzing

daily with questions and ideas. Whenever we needed to make a decision related to curriculum, we always consulted with PLC leaders first. This gave us insight into how every decision may impact different year level teams across the school, and it also gave us a support person and advocate in each year level team, which is an invaluable resource.

We involved all of the PLC Leaders in professional learning and curriculum day delivery (so it wasn't just our voice that the staff were hearing) and invited them to attend external professional learning sessions with us (like the annual MAV Conference), which provided the PLC leaders with various opportunities to build their personal teaching and leadership capacity. Depending on the size of your school and the way it's structured, your team could be made up of team leaders, aspiring leaders or passionate teachers who are interested in having an input into decision making around curriculum.

2. CONSISTENCY, CONSISTENCY, CONSISTENCY

We asked staff what they believed *didn't* work in regards to professional learning in the past, and a clear theme emerged – lack of consistency! Staff commented on the lack of consistency across year levels, teams and related to the focus of professional learning, including the way it was sequenced and structured. They reported that often things started with the best of intentions, but there was rarely follow through, which meant most people just went back to doing their own thing. After hearing this feedback, we were committed to breaking the cycle.

We worked with the PLC Leaders to create consistent planning documents for teams, norms and protocols, PLC and planning agendas and a PLC timeline, so that every team would be in exactly the same phase of their PLC inquiry cycle each week.

We presented a professional learning roadmap to staff at the beginning of each Term to show how the professional learning would be sequenced and why, as well as data to show how we'd used their survey feedback to plan out the weekly focus areas.

We made sure the Termly PLC inquiry focus was linked to what our professional learning

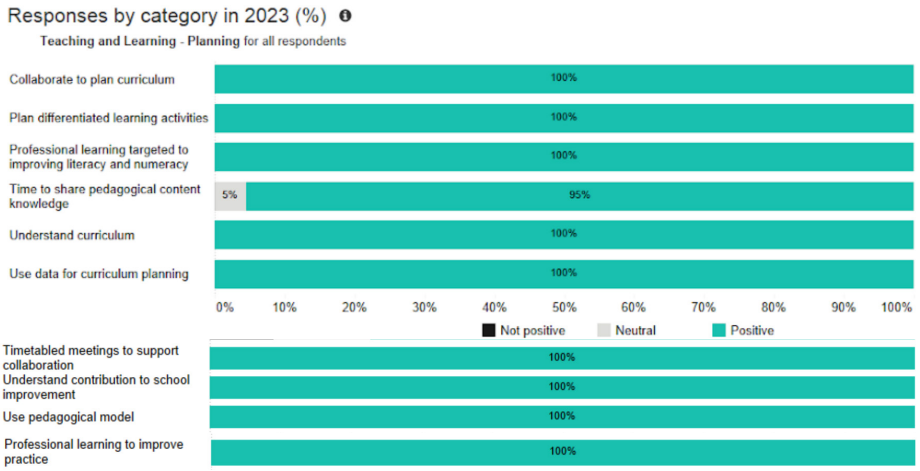


Figure 2. 2023 staff opinion survey data.

focus was, allowing individual teams to dig deeper into something of interest to them related to our whole-school professional learning. We allocated a meeting each term as a 'PLC Share session', where teams from across the school were given the opportunity to share a recount of their PLC inquiry with other teams and hear what others had been focusing on – the staff *loved* this! With all of this in place and the consistent messaging from the PLC Leaders, staff started to feel everyone was on the same page; that we were in this together as one big collaborative team of teachers!

3. VALUE STAFF INPUT (IN A TACTICAL WAY)

As well as our regular conversations and consultations with the PLC Leaders, we enabled all staff to have input and share their thinking. We attended team meetings and talked to individual teams and asked our PLC leaders to do the same. Throughout the year we set up templates and tables on Google docs, which enabled staff to access and share their ideas or input related to different things in a central place.

Termly anonymous surveys gave staff a chance to provide feedback on the professional learning, as well as have an input into future topics. Follow through is vital! It is one thing to ask for feedback and input and another to actually take it on.

Alongside any roadmaps or curriculum decisions we presented, we made sure we were transparent about the 'why'. This included sharing graphs and data from feedback surveys and collated lists of responses that we'd received from questions asked. We often had staff tell us how appreciative they were that they had a say, commenting that they felt included, heard and valued.

THE RESULTS

One of the concrete ways that we measured the impact of our work was through the staff opinion survey results. We received the best teaching and learning results that the school had seen in years, receiving 100% in some areas for the first time! Some of the highlights for us were the results related to the impact of our maths professional learning and of course, how staff felt about collaboration – solidifying that we were successfully able to make the 'with' happen!

PROBLEM STRINGS UNRAVELLED

Renee Ladner - Education consultant, MAV

A strong part of my role at MAV is supporting leaders, teachers and students in schools. A school that I have had the privilege to work alongside for some time, invited me into their classrooms to run a modelled lesson on a focus chosen by the teacher.

The Year 6 class I am reflecting on was launching into a unit on fractions and the teacher requested to see what the students knew about multiplying fractions. The teacher was an enthusiastic graduate teacher who expressed concern around the range in ability and how to cater to that without losing some of those students.

Last year MAV hosted Pam Harris from Texas, USA who provided us with hands on experience with problem strings. The beauty of problem strings lies in their capacity to guide students systematically through a sequence of interconnected problems, fostering a nuanced comprehension of relationships that ultimately guides them toward the development of efficient problem-solving strategies. Problem strings are designed to incrementally build upon students' existing understanding, instilling confidence and success in a supportive learning environment facilitated through meaningful conversations.

Given that I did not know the extent of the students' abilities, I felt this was a safe task to activate their prior knowledge, check for any misconceptions and see what connections they were making to the solutions as the problem unfolded.

This class uses a guided inquiry approach to teaching and learning in mathematics, therefore the students were confident to jump in and begin problem solving immediately. I introduced the problem simply by recording the table below on the board and asking a student to explain what I had written. Once clarity across the class was observed, we began. I started with...

Balls of wool	# of beanies
5	?
10	15

Renee: If 10 balls of wool make 15 beanies, how many beanies would 5 balls of wool make?

Student A: 10!

Renee: How did you work that out?

Student A: Because there are 5 balls of wool less, it would make 5 less beanies.

Looking around the room I saw some heads nodding in agreement, some heads shaking in disagreement and some faces looking utterly confused.

Renee: Who agrees with student A?

A handful of students raised their hands, and I asked if anyone could explain why.

Student B: I agree, you just take away 5.

Student C: I agree with student A because they're smart!

Renee: Hands up if you agree with Student A because they are confident in mathematics. Many students raised their hands. Who disagrees with student A this time? Why?

Student D: I think it is 7 and a half beanies because half of 10 is 5, therefore half of 15 is 7 and a half.

Noise filtered around the room. There were more nods in agreement this time.

Renee: If 5 balls of wool make $7\frac{1}{2}$ beanies, then how many beanies would 20 balls of wool make?

Balls of wool	# of beanies
5	$7\frac{1}{2}$
10	15
20	?

Using whiteboards, I asked students to record the number of beanies and what connections they were beginning to see between the numbers. See Figure 1.

Students began to make inverse connections between multiplication and division and were then able to generalise what other quantities could be made with other amounts of wool. See Figures 2 and 3.

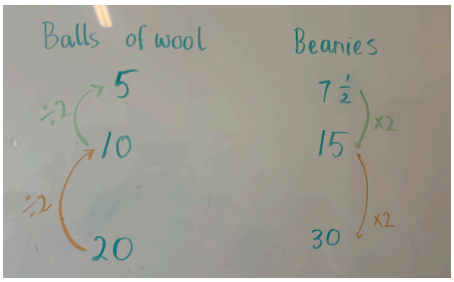


Figure 1.

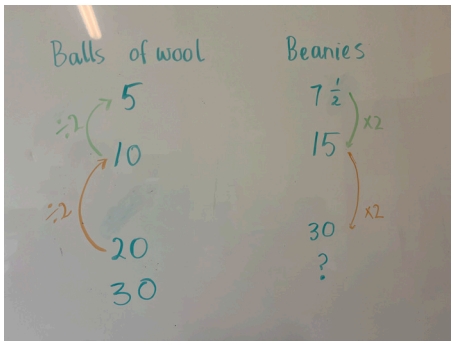


Figure 2.

I found that students who were initially reluctant in making a start or contributing were quickly trying to find an answer that someone else might not have found yet, for example, some students worked out that if:

Balls of wool	# of beanies
5	$7\frac{1}{2}$
10	15

Then, 1 ball of wool would make $1\frac{1}{2}$ beanies because they needed to solve:

$5 \div 5 = 1$, then $7\frac{1}{2} \div 5 = 1\frac{1}{2}$ beanies and they could check that because $1\frac{1}{2} \times 5 = 7\frac{1}{2}$.

Balls of wool	# of beanies
1	$1\frac{1}{2}$
5	$7\frac{1}{2}$
10	15

My next question was for students to decide the number of balls of wool and demonstrate how they solved the number of beanies. Students then showed to their partners or in small groups the information they used to solve the problem.

Students quickly went about proving their working out and some answers are detailed in Table 1.

Once students had a go at finding their own answers and sharing them, some students began to realise that the number of balls of wool produced 1.5 times the number of beanies and they began to find a 'shortcut' for a larger variety of numbers. All students felt a sense of pride and satisfaction and it was quickly evident that students of all abilities could tackle this problem and feel successful. It proved that the experience had to come before the telling for that sense of achievement to blossom. It then led quite nicely into the main part of the lesson which involved multiplying quantities for a recipe.

Within fifteen minutes of that session, I could quickly identify who:

- Was comfortable working with fractions in general
- Could multiply and divide simple fractions
- Could use information to make further generalisations, and
- Would need enabling or extending for the following task.

The teacher observing noted that they would love to engage in more of these problem strings to draw on prior knowledge, build collaboration in the classroom and further enhance students' questioning and confidence in their own thinking.

FURTHER READING

You can continue your learning by heading to Pam Harris' website, www.mathisfigureoutable.com/ps.

Stay tuned for an upcoming webinar on problem strings later in 2025. Keep an eye on MAV's website for details.

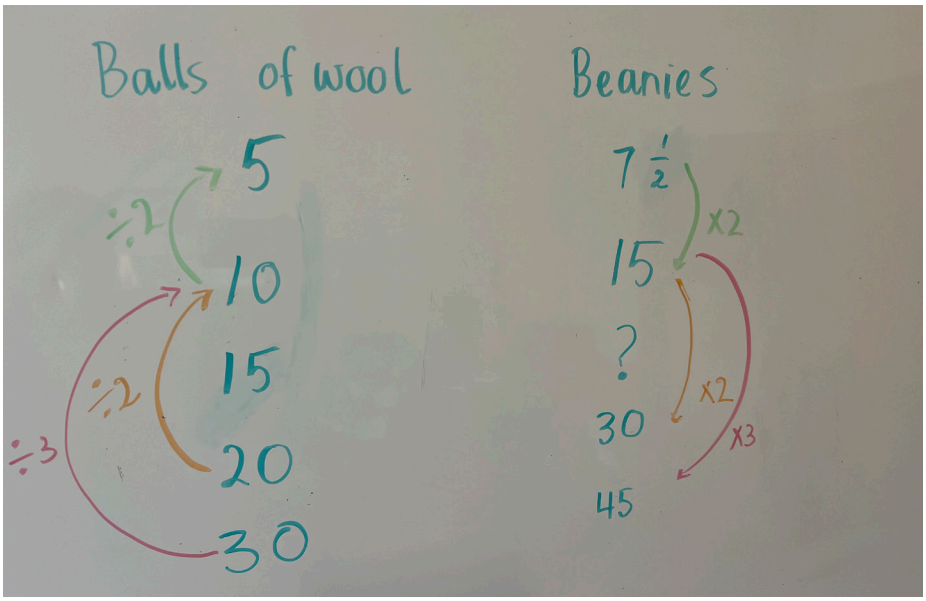


Figure 3.

Balls of wool	# of beanies	Justification
1	$1\frac{1}{2}$	
5	$7\frac{1}{2}$	
10	15	
20	30	
30	45	
60	90	I doubled the 30 balls of wool which made 45 beanies and got 90 beanies.
100	150	I multiplied 10 balls of wool by 10 and the amount of beanies (15) by 10 to get 150 beanies.
28	42	I used 20 balls of wool which makes 30 beanies, then added 5 balls of wool ($7\frac{1}{2}$ beanies) and then added 3 balls of wool ($4\frac{1}{2}$ beanies) which gave me a total of 28 balls of wool and 42 beanies. My equation would look like: $30+7\frac{1}{2}=(3\times1\frac{1}{2})=42$ beanies.

Table 1.

Reach out to at rladner@mav.vic.edu.au to share your experiences with problem strings and how you use them.

ONE MINUTE WITH: AIVA ANAGNOSTIADIS

I'M ...

Aiva and I am a professional racing driver in F1 Academy.

I GOT INTO F1....

Through my Mum. She raced when she was young and passed on the passion for motorsport to my brother and I.

F1 MAKES MATHS COME ALIVE...

Maths is in everything from measuring lap times, tyre pressures, data analysis, engineering of the car and so much more!!

WHEN I DRIVE...

I need to constantly calculate my speed, braking distances, G Forces and brake pressure.

DATA DRIVES PERFORMANCE...

It is the most important tool for helping me go faster and it never lies!

MATHS PLAYS A ROLE OFF THE TRACK TOO...

In my training, nutrition and sleep patterns. It helps me to always make sure I am performing at my best.

PROBLEM SOLVING IS A MAJOR PART OF DRIVING...

Especially when something isn't working or we need to find speed. We are always problem solving to go fast!

THE DESIGN OF THE CARS...

Is inherently mathematical, from measuring the car's weight to the downforce, to calculating the correct gearing for the car.

MOST PEOPLE WOULDN'T REALISE...

That motorsport is a sport that both males and females can compete on an even playing field.

MY PROUDEST MOMENT...

Was when I found out that I had the seat in F1 Academy!

ONE DAY I HOPE TO...

Score points in the Formula 1 Grand Prix.

I'M FINISHING MY VCE...

Via Virtual Schools Victoria over the next two years to enable me to concentrate on my racing.

I'D ENCOURAGE YOUNG PEOPLE TO...

Follow your dreams and don't let anyone tell you that you cannot do something.

Check out GOAL! Motorsport Australia lessons on The Huddle for free download: www.thehuddle.org.au/goal.

NEW PROGRAMS FOR THE

fx-CP400

DOWNLOAD NOW:

- HUNGARIAN ALGORITHM
- CREATE MATRIX (FROM RULE)
- BCD - SOLVE FOR n

Programs are available to download from Casio Education Australia, scan the QR code and follow instructions provided to download to your handheld or emulator software.
Contact edusupport@shriro.com.au with any questions.

CASIO EDUCATION

MAVSHOP

WWW.MAV.VIC.EDU.AU/MAV-SHOP

MAV MEMBERS GET A DISCOUNT ON ALL STOCK

MAV SACS SUGGESTED STARTING POINTS

2025 | ALL STUDIES

MAV SACS SUGGESTED STARTING POINTS 2025

VCE

The MAV 2025 VCE Mathematics SACs materials are an online resource that is accessed through our learning management system Thinkific.

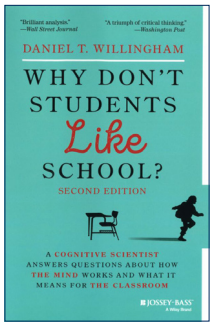
The materials are designed to provide suggested starting points for VCE Mathematics teachers for their School Assessed Coursework (SACs).

Resources include SAC starting points, alternative tasks, solution guides, marking criteria and data sets. A recording of the SAC session from the VCE MAV conference is also included to assist teachers with creating appropriate VCE SACs.

MAV SACs 2025 materials have been written by experienced VCE mathematics teachers. They are for use by teachers to aid in assessment of student School Assessed Coursework for VCE mathematics.

PLEASE NOTE: this resource is only available to current practising Victorian secondary teachers. The product is for school use only. It is not to be used by private tutoring services.

ALL STUDIES	$360 (MEMBER) $450 (NON MEMBER)
INDIVIDUAL STUDY	$120 (MEMBER) $150 (NON MEMBER)



WHY DON'T STUDENTS LIKE SCHOOL?

ALL

The book helps teachers improve their practice by explaining how they and their students think and learn and reveals the importance of story, emotion, memory, context, and routine in building knowledge and creating lasting learning experiences. This edition will be a valuable resource for both veteran and novice teachers, teachers-in-training, and for the principals, administrators, and staff development professionals who work with them.

$35.90 (MEMBER)
$44.90 (NON MEMBER)

MAV TRIAL EXAMS

2025 | ALL STUDIES

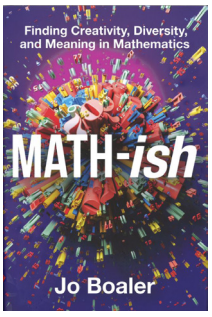
MAV 2025 TRIAL EXAMS

VCE

Prepare effectively for VCE Mathematics Examinations with the MAV Trial exams for Foundation Mathematics, Mathematical Methods, General Mathematics and Specialist Mathematics studies.

Each Trial Exam features: Original questions, highly relevant to the current course, fully worked solutions for all sections and clear marking schemes. Exam formats are similar to those used by the VCAA. Written in line with adjusted 2024 study design. Permission for the purchasing institution to reproduce copies for its students.

ALL STUDIES	$665 (MEMBER) $831.25 (NON MEMBER)
INDIVIDUAL STUDY	$255.60 (MEMBER) $319.50 (NON MEMBER)
FOUNDATION	$127.80 (MEMBER) $159.75 (NON MEMBER)



MATH-ISH

ALL

Jo Boaler shares new research on how embracing the concept of "math-ish"— a theory of mathematics as it exists in the real world — changes the way we think about mathematics, data, and ourselves. Jo guides us through seven principles that can radically reframe our relationship with maths:

- The power of mindset on learning
- Utilising a visual approach to maths
- The impact of physical movement and communication on understanding
- Understanding the value of an "ish" perspective - in mathematics and beyond
- The importance of connected and flexible knowledge
- New data on diverse teaching modes that work with different learning styles, not against them
- The value of diversity in learning mathematics — and beyond

$50.70 (MEMBER)
$63.40 (NON MEMBER)

THE MATHEMATICAL ASSOCIATION OF VICTORIA

TO ORDER
WWW.MAV.VIC.EDU.AU/MAV-SHOP
OR CALL +61 3 9380 2399

Prices are subject to change.