THE MATHEMATICAL ASSOCIATION OF VICTORIA

THE COMMON DENOMINATOR 2/21

TEACHING IN BIDYADANGA

INSIDE

Daniel Steele. Image: part of the fishing experiences lessons involved students following directions and landmarks on maps to locate and save pretend turtle eggs.

Being hit in the face, figuratively and literally, by the humidity of Broome during the wet season is something that stays with you. Having moved from inner-city Melbourne to remote Australia with my wife, also a primary teacher, we were both struck by the orange-crimson dirt, beautifully unique boab trees, and the lack of people around the streets.

Neither of us had even been to Western Australia before. So, the levels of excitement, nervousness, and uncertainty as we drove two hours south of Broome to our new home, community, and school in Bidyadanga, didn't really drop below 'extremely high'. I'll never forget the moment we stepped out of the school's minibus onto Teacher Street (yes, that was its name) spotted our house, the metre-high grass, and the school oval and buildings just on the other side of our back fence. Excellent commute time to work, I'll have you know!

Continued on page 6

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

Magazine 279, April 2021

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Print Post Approved
Publication No: PP100002988

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FROM THE PRESIDENT

Michael O'Connor

This year will see changes made to both the Australian Curriculum P to 10 and the VCE. As always there will be disagreements about what should be 'in' the curriculum and what shouldn't; how much, or how little, technology should be used; and whether or not the changes are useful in real life. In a career spanning over thirty years these topics are as regular as clockwork. They are also a distraction from the teaching our students to the best of our ability.

Mathematics, as a field of human endeavor, is ever growing. No one set of concepts and skills definitively sets up students for success or failure. Rather, it is how well connected the ideas and skills are to one another that gives a picture of the whole. Eddie Woo likens it to how well we, as teachers, tell the story. The printed curriculum, is merely a set of directions like the voice on Google maps telling us when to turn left or right. To take these directions and turn them into something vibrant, interesting and relatable means we need to pay attention to the geography, the landmarks and the history.

Recently I took a Year 7 class for an extra. The lesson was to be on Lowest Common Multiples and Highest Common Factors. I took advantage of the opportunity to find firstly, find out about the different ways that the students knew how to factorise whole numbers. They were actually quite adept, with solid fundamentals. I next went on to showing them what is known as the Korean Method for HCF and LCM. After the lesson I wrote up my notes and passed them on to the teacher whose class it was. She had not seen it done that way before and was quite interested in the technique.

At the same time I was working on factorising quadratics with my Year 10s and on Diophantine Equations with Year 11 Specialist students. In both cases I referred back to HCF and LCM and the Korean Method. Serendipitously I had encountered three different learning situations separated by five years in schooling all connected by the same concept, and being able to usefully employ the same technique.

The curriculum does not mandate the Korean Method for factorising. It is one of many enlightenments that I have picked up over a lifetime of practice. I like that it has a mnemonic device that aids in remembering what to do and in turn, helps the students to learn. In his book, *What Expert Teachers Do*, John Loughran talks about the 'need to communicate and share our knowledge of practice in ways that extend beyond tips and tricks as the sole measure or expectation of classroom expertise' (preface).

Factorisation and multiplication are, and always will be, bedrock mathematical experiences for our students, no matter how that is expressed in the current written curriculum. What we as teachers need is to share our experiences with each other and in so doing find the stories that give meaning to the practices. Loughran describes this as a move from professional development, where teachers are told what to do, to professional learning, which supports us in increasing our knowledge.

THE KOREAN METHOD

1. Place the two numbers side by side, and then systematically extract common prime factors row by row.
2. When all the common factors have been exhausted, draw up the H.

Common Prime Factors	24	36
2	12	18
2	6	9
3	2	3

3. The Highest Common Factor is found by multiplying the prime factors along the left vertical of the H.

Common Prime Factors	24	36
2	12	18
2	6	9
3	2	3

4. The Lowest Common Multiple is found by following the L down the left side and along the bottom of the diagram.

Common Prime Factors	24	36
2	12	18
2	6	9
3	2	3

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OAM: PETER MAHER

Jennifer Bowden

MAV congratulates Peter Maher, of Penleigh and Essendon Grammar School on being awarded the Order of Australia in 2021. Peter has been a long time supporter of MAV, and his OAM is well deserved recognition of his dedication to mathematics education and should be celebrated widely.

In the Australia Day Honours 2021 Peter Maher was awarded the Order of Australia for his contribution to education, particularly mathematics. Since 1976, Peter has taught at Penleigh and Essendon Grammar School and has been the Mathematics co-ordinator at the Boys' Junior School Campus since 1981. Over that time, Peter has guided the learning of thousands of students and has led professional development for hundreds of teachers.

Peter is a very active member of The Mathematical Association of Victoria, conducting Year 5 MAV Games Days for over a decade as well as judging the Maths Talent Quest for many years. Penleigh and Essendon Grammar School was one of the first schools to be granted Maths Active Schools status by the MAV in recognition of its dynamic and highly successful developmental program for both students and teachers.

In recent years, Peter has been recognised by the MAV for outstanding contributions to mathematics education, and by the Australasian Problem Solving Mathematical Olympiad Committee for his contribution to the teaching of problem solving.

Peter is the author of over 30 maths books designed to improve the teaching of the subject in areas such as mental arithmetic, maths games, engaging homework tasks, problem solving and the use of calculators.

Peter's passion for teaching mathematics centers upon his belief in the need to engage students through the presentation of meaningful 'life worthy' activities, the need to develop creative and original problem solvers and the desire to demonstrate the inherent beauty that lies within the mathematics as a subject.

Congratulations to Peter on this well deserved recognition of his service to mathematics education.

Peter has been a longstanding and active supporter of MAV. He has made a stellar contribution to the Maths Talent Quest and MAV Games Days over many years. Penleigh and Esssendon Grammar School are a MAV accredited Mathematics Active School.

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MAV STRATEGIC PLAN

MAV 's Board approved a new *MAV Strategic Plan 2021 to 2023* in November 2020. The strategic plan has been developed via a process of consultation and analysis of the context in which the MAV operates, taking over a year of ongoing work to finalise.

The four goals in the strategic plan identify key areas of focus where MAV will work to create a positive impact on educational outcomes in support of mathematics educators. This includes in teaching and learning in mathematics education and in support of students from various backgrounds from early childhood to the senior secondary years.

The MAV Board is proud to launch this plan and looks forward to progress being made over the coming three years. A summary of the plan is detailed below. It is anticipated that during this time members and maths educators across Victoria will be able to access new services and opportunities, alongside MAV's already established programs, and that the plan will allow MAV to stay current and at the forefront of your support at this important time in education.

If you want to find out more or have questions, please contact Peter Saffin, CEO, psaffin@mav.vic.edu.au.

VISION
Valuing mathematics in society

MISSION
MAV provides a voice, leadership and professional support for mathematics education.

CONTEXT
Education is changing, and MAV must lead the way in supporting mathematics educators to have the best impact possible.

The mathematics curriculum needs to respond to these changes: from VCE and VCAL to the early years of school, and early childhood education.

	Community engagement	Collaboration
Objective	**To provide increased value for all mathematics educators in MAV's community.**	**To strategically develop and embed high profile collaborations that support MAV in delivering products and services that amplify the impact of the association's work.**
Strategic intent	To expand MAV's reach, grow MAV's community of educators through community building approaches, backed by improved and more targeted communications and engagement opportunities.	To enhance benefits to educators and society by collaborating with partners aligned to MAV's vision and mission. Collaboration allows MAV to expand influence and impact in delivering programs.
Strategies	1.1 Review and strengthen the foundations required to build a stronger mathematics educator community, ensuring MAV provides tangible and compelling value. 1.2 Build a strong, engaged and sustainable community of mathematics educators and evolve membership models for the future. 1.3 Focus on expanding MAV's services in early childhood. 1.4 Investigate opportunities for recognition of experienced and accomplished mathematics educators.	2.1. Develop new and ongoing partnerships with key stakeholders to provide sustainability, enhancement and expansion of MAV's vision, programs and services. 2.2 Develop deeper relationships with AAMT and affiliates to create new opportunities for the mathematics community in Victoria, nationally and for international events within Australia. 2.3. Engage with industry-related educational providers to bridge the gap between mathematics education and the wider workplace and society.
Measures	• Increased membership • Increased engagement with mathematics educator community. • New systems for community interaction are implemented. • Approaches to membership and engagement evolving to include new models.	• MAV's voice and reputation is strengthened by expanded programs and active collaboration with key partners and stakeholders including: AAMT and state-based affiliates, AMSI and AMT, Industry, Universities and Principals across sectors.

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Teachers require professional support and resources to develop in students the numeracy capabilities needed in their personal, professional and civic lives.

It is critical that students are prepared for life after school, progression to further study and for career pathways in a world that is data and information rich and technologically advanced.

MAV must grow, evolve and become a sustainable organisation in a changing not-for-profit sector.

	Advocacy	Operations and culture
Objective	**To strengthen MAV's position as a key stakeholder in mathematics education through strategic advocacy and engagement with key stakeholders.**	**To refine operations and resources to maximise efficiency, enhance workplace culture and improve organisational capacity.**
Strategic intent	To ensure MAV is the prominent voice in mathematics education in Victoria, and nationally where appropriate. MAV's view must be heard and sought out on matters of importance related to its mission and vision.	To maximise efficiency and prepare MAV's skills, systems and culture for future opportunities in a changing not-for-profit sector.
Strategies	3.1 Seek input and data from members to better represent their views and put forward a voice for educators. 3.2 Strategically develop discussion and position papers to articulate and communicate MAV views to stakeholders. 3.3. Actively engage with government and government authorities to represent the interests of mathematics educators, and seek funding for mathematics education initiatives on priority areas. 3.4 Increase support to out of field teachers.	4.1 Align resources to strategic plan and programs to ensure success. 4.2 Diversify MAV's programs and services to reduce dependence on face-to-face approaches. 4.3 Develop values and behaviours, and use these to build and strengthen MAV's culture.
Measures	• Increased advocacy is evident. • Partners and stakeholder engagement around issues increases. • Members and educator views are accurately represented to stakeholders. • Out of field teachers are better supported.	• Initiatives are delivered on time, to budget, and with appropriate skilled staff and experts. • Delivery models evolve and respond to mathematics educator needs. • MAV culture is strong and based on agreed values and behaviours.

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TEACHING IN BIDYADANGA

Daniel Steele - Assistant principal, Aldercourt Primary School

CONT. FROM PAGE 1.

Figure 1. The red landscape as we flew toward Bidyadanga.

That first big moment of opening our squeaky back gate, cautiously stepping over two snakeskins that seemed just a bit too big, and strolling around the school grounds feels like it happened just yesterday. I can still vividly see the faces of the first bunch of kids from the community who came running up to suss out the new teachers.

No one piece of writing could cover the insights and lessons from those two life changing years in Bidyadanga, but I'd like to share one key lesson that has shaped how I've taught, planned, and led mathematics learning since those days.

REAL WORLD LEARNING CAN BE SIMPLE AND POWERFUL

Within Bidyadanga, maintaining student attendance was a critical focus. If kids are not at school - or in our rooms but completely disengaged - it's hard to learn. In Bidgy, we faced a dilemma with student attendance dropping significantly each Friday. This led us to ask the question, 'How could we make school more enticing for kids on Fridays?'.

The simple answer? Making learning real, applicable, engaging, and connected to their lives. We all use those buzz words 'authentic' and 'real world' often when talking about learning, but what can it really look like?

For us, it looked like teachers coming together to share their collective knowledge of our kids, their families, and their lives. We brainstormed and named students' and community interests, hobbies, and events: football, drumming, fishing, painting, drawing, singing, camping. From there we started connecting these to bigger maths concepts and ideas. We wanted to bring learning to life through our students' worlds and experiences.

A love of fishing and tides could be used to channel deeper understandings of negative and positive numbers for our older students. Graphing the tides, and types of fish within the waters over the course of a year supported students to interpret data and see a stronger purpose for collecting and graphing data, besides asking someone their favourite sport or colour.

A classic activity that came about from this was students using magnetic fishing rods to try and catch fish. Before making a cast, they had to name the fish they were after and how likely they were to get it. Within the learning experience we had younger students building and exploring the language of chance, while our older students went further, describing, writing and/or drawing successful and unsuccessful attempts as fractions and, where able, as percentages.

A more famous series of sessions involved Super Soakers. Yes, Super Soakers. Giving students time to explore and test out the best techniques to pump and shoot out the water, the kids had an epic battle to spray water the furthest. Estimating length, measuring accurately, converting units, comparing lengths, and sorting data ruled supreme . . . amongst the laughter, smiles, and slight chaos of learning. Plus, a cheeky water fight may have happened once or twice. I cannot confirm or deny!

Collaboration was critical with this work. With teachers seeking to teach a series of

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Figure 2. Dot arrays are great, but pearl shells collected over the weekend work well too. They are also a terrific, hands-on way to explore number facts, fact families and factors.

lessons to students spanning K – Year 7, we had to be able to tweak our ideas for students' needs and points of learning. Tapping into our collective knowledge of both our students and the curriculum made this possible.

When we see our curriculum beyond simply dot points to be ticked off, and we remember it's a developmental or conceptual progression to support our teaching and learning, we are better able to make learning real and connected to our students.

This requires teachers to fight the temptation to always zoom in on those content descriptors that unpack each skill, knowledge, or understanding. It's important to zoom out to see how our students are progressing in their proficiency of big ideas – such as number patterns, additive strategies, or fractions. The relatively new numeracy learning progressions can assist leaders and teachers in making this shift. (This is also why you might have noticed states' curricula moving from year levels to 'stages' or 'levels', alongside a lot more talk about personalised or point of need learning).

While content descriptors help us unpack the various skills, knowledge and understandings across the three strands of mathematics, they aren't three separate checklists to run through day-in day-out. If teachers see our curriculum like this, it can lead to us missing the authentic links across strands, other learning areas, and our unique community of learners. Instead, let's focus on more immersive learning, where we combine our individual and collective knowledge of our students and community, alongside that piece of paper with the curriculum on it. When we do, the stage is set for some amazing opportunities and discoveries.

This was our approach in Bidyadanga. When we explicitly linked our students' lives to the curriculum, connections and relationships were strengthened. Student engagement and attendance increased, and, importantly, kids discovered and learned more - which is at the heart of this whole teaching caper, right?

FURTHER INFORMATION

La Grange Remote Community School is situated in the Bidyadanga Aboriginal Community in the Kimberley region on Karajarri (Gurri-jurri) country, approximately 200km south of Broome. Bidyadanga is the Karajarri language word for Emu. It means a place where an emu was killed.

The first European thought to have been seen by local Aboriginal people was the French explorer/navigator Baudin who sailed into what is now called La Grange Bay in 1802.

When people from the Nyangumarta (Nung-a-marda), Mangala (mung-a-lah), Juwaliny (ju-wah-li) and Yulparija (yew-l-pah-jah) country moved from the desert into Bidyadanga, the Karajarri people accommodated these people into their country. Community members today still identify as being from one or more of the language groups.

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MIDDLE YEARS MATHS CHALLENGE

Ellen Corovic - Mathematics education consultant, The Mathematical Association of Victoria

The Middle Years Maths Challenge (MYMC) is a Victorian Department of Education and Training funded project proudly delivered by The Mathematical Association of Victoria (MAV).

The purpose of MYMC is to provide proficiency-based student-interest activities for inclusion in the Mathematics Curriculum Companion. To start the project, surveys of teachers and students were undertaken, along with data obtained from MAV's Maths Talent Quest to outline key areas of interest of students from Years 5 – 9. A great range of interests were identified that have been linked to topics in the mathematics curriculum, in order to ensure that the activities produced are engaging and of high interest when used in the classroom. As part of this process the curriculum was analysed and key connections to Koorie culture were also established. Altogether 70 activities will be trialled in classrooms, with a selection of these tasks focused on Koorie culture.

MAV will trial these new tasks in Term 2. To express your interest in being involved in trials, please contact Peter Saffin, psaffin@mav.vic.edu.au to learn more.

RECONCILIATION IN ACTION

As part of the MYMC selected writers spent time with Matt Lillyst to gain deeper insight into Aboriginal and Torres Strait Islander culture. Matt worked closely with the writers to ensure that each Koorie based lesson stayed true to the cultural intent outlined. Read about Matt's experience on page 9.

Here are some brief reflections and learnings from MYMC writers who assisted in developing the Koorie focused mathematics tasks.

Informal and curious

What I loved about working on the Indigenous Tasks was being able to take time to appreciate the genius of our first nations people. While some Aboriginal cultures may not have had formal number systems, the way they approached problem solving was very mathematical. Taking time to observe and notice the world around them, then building things and refining them over time to solve problems. It's incredible to think that three-thousand years before the Pyramids were made an aquaculture system to breed and trap eels at Budj Bim was created using just grass and stones!

In our current climate it's easy to get bogged down in memorising formulas and rote learning facts that we miss moments where maths can be developed naturally. By taking time to be curious, using informal measurements and experimenting we can offer students genuine opportunities to work as mathematicians and develop their own tools for problem solving.
— Andrew Lorimer-Derham

Length of history

I really enjoyed investigating some of the ongoing archaeological evidence of ancient Aboriginal and Torres Strait Islander civilisations in Australia that continues to be discovered and researched, showing their impressive and unparalleled length of history.
— Mabel Chen

The journey of cloaks

I learned something specific about their culture. For example, I learned that the Gunditjmara and Yorta Yorta communities in Victoria made cloaks out of possum skins to keep warm, protecting them from the rain and cold. They have been doing this for thousands of years. Each person had their own unique cloak right from birth. These cloaks told the journey of the wearer. As the person grew older, more possum pelts were hunted and added to these cloaks. Artwork was added to represent the individual's life and community. Some possum cloaks incorporated images of country, so these could be read like topographic maps. They were usually created as an aerial (bird's eye) view.
—Judy Gregg

Language of identity

One of the first questions I wondered in the beginning of the project was which words to use to identify Aboriginal and Torres Strait Islander's as I was confused as to which terms to use; Indigenous, Koorie, Koori, Aboriginal, First Nation or Aboriginal and Torres Strait Islander.

Matt provided his perspective and highlighted that in Australia there are many terms and they can be used interchangeably according to the community you are talking to or about. Each community holds many words to identify their person/culture/community. Therefore, Matt's very practical advice was to use the terminology the individual or community uses. Or if comes from references or written documentation, use the same terminology in the source. Each individual may identify differently therefore take the precedent that has been set. I am now more aware of the language of Aboriginal and Torres Strait Islander identity and more comfortable to use the language appropriately.
—Ellen Corovic

The MAV would love to hear how you are incorporating Australian and Torres Strait Islander culture in your mathematics classroom. Email your story to Jen Bowden, jbowden@mav.vic.edu.au.

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ABORIGINAL PERSPECTIVES

Mathew Lillyst - Professional practice leader Koorie literacy and numeracy, Victorian Department of Education and Training

The Aboriginal and Torres Strait Islander histories and cultures cross-curriculum priority is as equally exciting as it is daunting, much like the journey towards reconciliation in Australia. As stated by Reconciliation Australia, 'We all have a role to play when it comes to reconciliation, and in playing our part we collectively build relationships and communities that value Aboriginal and Torres Strait Islander peoples, histories, cultures, and futures.' Much like reconciliation, embedding perspectives in the classroom is not the sole work or teachers or Aboriginal and Torres Strait Islander communities – it is a collaborative effort.

As a Gunditjmara man, I have been privileged and fortunate to grow up immersed in my culture. In my work as an English teacher, the connections between my cultural knowledge and the curriculum came easily, even where a perspective was not explicitly referenced in the syllabus. For teachers who are new to or unfamiliar with the space, without this knowledge base to draw on, it can be quite overwhelming.

In subjects such as English, the Humanities or the Arts, a general knowledge of Aboriginal and Torres Strait Islander histories and cultures is often enough for finding logical opportunities to embed perspectives. For subjects such as Science and Mathematics, the connections may seem a little obscure. However, working collaboratively makes the problem-solving process exciting and authentic, as well as embodying genuine reconciliation in action.

This was very much the case for a joint venture between the Mathematical Association of Victoria and the Department of Education and Training. In developing the MYMC, there was a commitment to develop a range of lessons that embedded Aboriginal perspectives. To begin the process, I brainstormed a list of cultural concepts where I (in my limited mathematical expertise) could identify potential connections to mathematics. A group of mathematics teachers were able to look over the list and identify a variety of connections between the concepts and the curriculum. These ideas were presented to the MAV writers who designed lessons around these concepts.

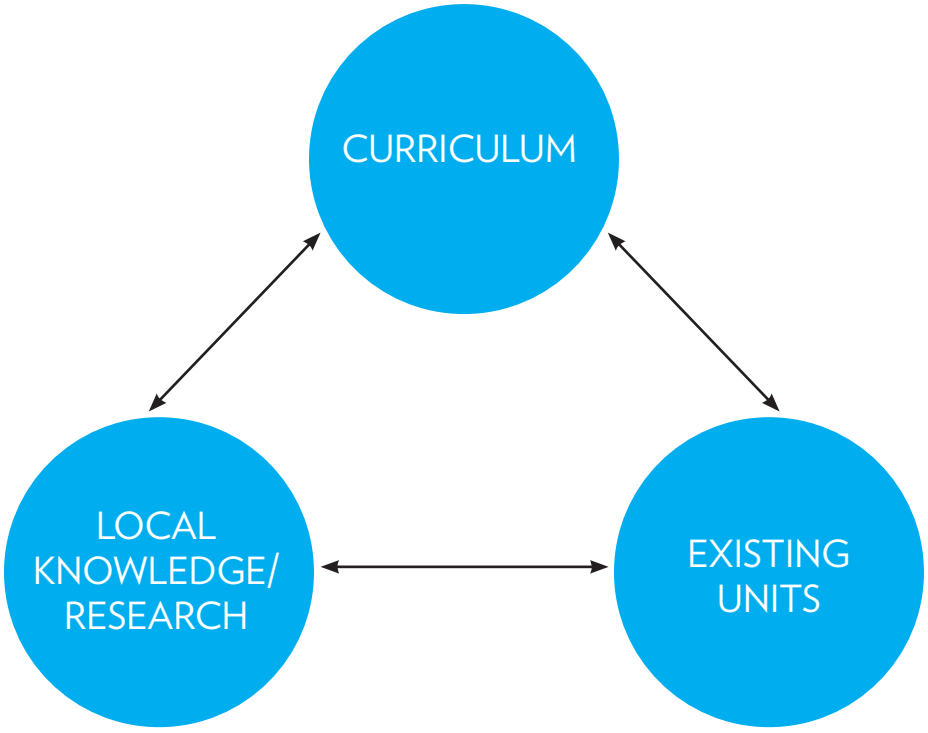

Figure 1.

There is a growing base of research exploring mathematics and Aboriginal knowledge systems, such as the work of Dr Chris Matthews and the Aboriginal and Torres Strait Islander Mathematics Alliance. For the MYMC initiative, the lessons used cultural knowledge as a launching pad for understanding abstract mathematical concepts.

For example, the Budj Bim cultural landscape was added to the UNESCO World Heritage list in 2019 for its cultural significance and elaborate aquaculture system. One aspect of the cultural aspects of the aquaculture system were eel traps (Figure 2) designed specifically to only catch mature eels, allowing younger eels to swim through so the population could replenish. In Aboriginal culture, it is our responsibility to look after Country. When it comes to things like food and hunting, you could only take what you need, at the right time of season. This would ensure that the food source, and the wider ecosystem affected by this food source, was looked after for future generations to use.

Figure 2.

The MYMC lesson used this perspective as a real-world context for investigating measurement and averages. Students were provided with a range of figures, including average sizes for different eels, and then directed to work out the required measurements for the traps. The lesson allowed students to meaningfully engage with an abstract mathematical idea, while simultaneously providing a deeper understanding of Aboriginal and Torres Strait Islander histories and cultures. For teachers beginning the journey, Figure 1 may help navigate embedding perspectives in the curriculum. There is no right or wrong place to start, as each part of the process links back to another.

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ABORIGINAL PERSPECTIVES (CONT.)

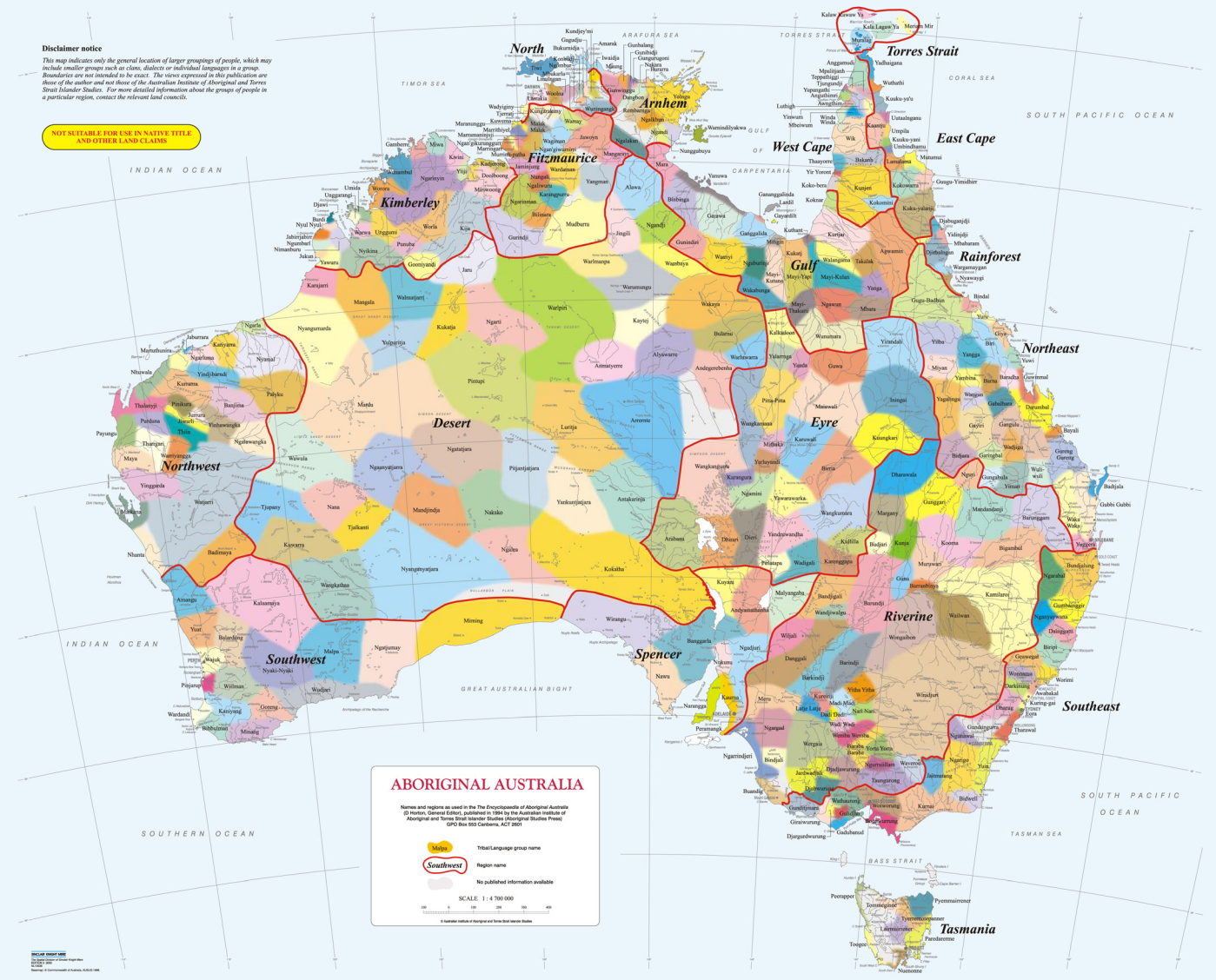

Figure 3. Aboriginal language map (image from https://mgnsw.org.au)

Curriculum: Review existing curriculum descriptors that explicitly mention that Aboriginal and Torres Strait Islander histories and cultures. This is a logical starting point for anyone new to the space.

Local knowledge/research: If you have a thorough understanding of the curriculum, researching the local community may provide insight into different cultural concepts. These can then be aligned to a range of curriculum descriptors focusing on the skill, rather than the Aboriginal concept.

Existing units: Once you have developed a richer understanding of Aboriginal and Torres Strait Islander perspectives, review existing course plans and outlines to identify opportunities to showcase those perspectives.

Other potential opportunities for embedding perspectives in mathematics include:

- Comparing the different seasonal calendars used by Aboriginal communities (visit the Bureau of Meteorology website)
- Collating the archaeological data for sites such as Moyjil (Point Ritchie), or midden sites in Victoria
- Researching the astronomy of cultural sites such as Wurdi Youang
- Exploring the shapes and dimensions of traditional tools/weapons
- Investigating the work and inventions of Aboriginal inventor David Unaipon.

IMPORTANT WEBSITES TO VISIT

- The Victorian Aboriginal Education Association Incorporated (VAEAI) website. VAEAI have a range of curriculum resources and Protocols documents to support you with working with the community. www.vaeai.org.au/documents
- The Victorian Curriculum and Assessment Authority (VCAA) website. The VCAA developed presentations to support teachers with embedding Aboriginal perspectives across different domains. https://victoriancurriculum.vcaa.vic.edu.au

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- The Aboriginal and Torres Strait Islander Mathematics Alliance (ATSIMA) website. ATSIMA facilitate professional learning opportunities to understand mathematics in Aboriginal knowledge systems, as well as working to improve outcomes for students. https://atsimanational.ning.com/about

From the beginning of the project, it was crucial to create a space for two-way learning between myself and the writers. There are many complexities when it comes to things such as respectful terminology and cultural appropriation, which often cannot be solved in a quick conversation. The writers were very kind, open and generous throughout the process, which allowed us to have ongoing conversations where we could collaboratively navigate these complexities.

For example, one of our initial conversations focused on appropriate terminology, which is a complex discussion because of the diversity of the communities. First Nations or Indigenous are collective terms to refer to both Aboriginal and Torres Strait Islander peoples, but they are not universally accepted across Australia. The term Koorie/Koori is used to collectively refer to the groups of Aboriginal communities in Victoria, while other regions use different collective terms. Ultimately, a conversation with the community you're working with will help you navigate what is appropriate for that area.

To the credit of the writers, their willingness to be vulnerable and ask potentially embarrassing questions allowed us to have honest and frank discussions. Although this may have been challenging, the open and safe space allowed the two-way conversation to develop a shared understanding based on mutual respect and empathy. The process was very much a practical example of reconciliation – where the two cultures came together to learn from each other, listen openly to each other, and work together to find a way forward.

To the general teaching population, the cultural concepts such as the eel traps mentioned above may not be common knowledge, mainly because these learning opportunities were not available to teachers through their schooling.

The richest way to develop a deeper understanding of Aboriginal and Torres Strait Islander histories and cultures to learn directly from the local community. Inviting guest speakers, or organising excursions to local cultural tours are meaningful learning opportunities. The community may not be available to visit the school, in which case there are several resources available online that provide some insight into the 500+ Aboriginal and Torres Strait Islander communities across Australia. Resources where the local community is sharing the cultural knowledge themselves are more powerful and authentic.

A huge thank you to Kerryn Sandford and Kelli Dodman for championing the idea to embed Aboriginal perspectives in the MYMC. Thank you to MAV for being incredibly supportive in endorsing the project and allowing it to happen. Finally, a very special thank you to the writers! Their humility and respect allowed us to generate some amazing mathematics lessons for students. As an Aboriginal man, I am confident that reconciliation will become an easier process if we continue to share our stories and experiences – learning from each other to enrich the learning experience for students.

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
MAV AGM	25/5/21 Melbourne	All	Guest speaker: Associate Professor Stephen Davis
'The Big Ideas' to support learning intervention: tips for tutors and teachers	30/6/21-27/7/21 Virtual	F-6	Dr Paul Swan, Angela Rogers and Dr Catherine Pearn
What's the glue that binds our mathematics curriculum together? Proficiencies, dispositions, content	12/7/21 Wangaratta	F-12	Various, including Dr Paul Swan, Andrew Lorimer-Derham and Helen Haralambous
Building articulate mathematical thinkers with the proficiencies.	23/7/21 Horsham	F-12	Various, including Dr Sharyn Livy, Ellen Corovic and Thomas Moore
MAV Primary and early childhood conference: day for leaders	10/6/21 Virtual	EY-6	Various
MAV Primary and early childhood conference: day for teachers	11/6/21 Virtual	EY-6	Various
MAV Annual conference	2/12/21 and 3/12/21	EY - VCE	Various

STIMULATING THINKING

Jennifer Bowden – Education consultant, 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.

FOUNDATION - YEAR 2

- Estimate how many blocks are in this picture. Without counting, share a strategy you could use to check your estimate.
- Name at least four different 2D shapes you can see in the picture.
- There are 6 different colours/shades in the picture. Classify the blocks by colour? Display this representation on a graph?
- The centre circle is made up of two hemispheres, one is yellow one is white. Find a square that is made up of two other shapes.
- What other quadrilateral is made up of two other shapes? Name all of the shapes?
- Who am I? Choose a 2D shape in the picture. Describe it's features to a classmate without mentioning its colour or name.
- Choose one of the 2D shapes in the picture and identify some objects in the real world that represent this shape.
- The shapes create an image like a jigsaw. Using 2D shapes can you draw a similar picture that fits perfectly into a large square.
- Play a game of *I Shape Spy* with a family member without describe the shape you want but where the shape. For example, 'I spy a shape that is above an arch, next to a triangle, to the left of a long rectangle and below a square'.
- Brainstorm twelve mathematical words that relate to the image. Share your brainstorm with your friends. Which words did you have in common?

YEARS 3 AND 4

- There are two types of triangles in the picture. What are their specific names?
- Explain how the two types of triangles are similar and different. You may like to use a T-chart or Venn Diagram.
- In this picture you can only see one face of the block. Draw and name at least 5 of the 3D shapes to show all of their faces.
- What fraction of the total image of shapes has **not** been painted and shows a wooden face? How can you prove this?
- Classify the shapes as regular or irregular polygons. Draw an addition three regular and irregular polygons that are not in the image.
- Estimate how many right angles are in this picture. Without counting, share a strategy you could use to check your estimate.
- Who am I? Choose a 2D shape in the picture and imagine what it may be as a 3D block. Describe the features of the block to a classmate without mentioning its colour or name.
- Choose one of the 2D shapes in the picture and imagine it as part of a 3D shape, identify some objects in the real world that represent the 3D shape.
- Brainstorm twenty mathematical words that relate to the image. Share your brainstorm with your friends. Which words did you have in common?

YEARS 5 AND BEYOND

- Most angles in the picture are right angles, what other angles can you identify? Describe and measure them with a protractor.
- Choose one of the block faces in the image. The block can make at least two different 3D shapes (for example a 2D equilateral triangle can be the face of a triangular prism and a triangular pyramid). Name the two different 3D shapes it could be and then draw the nets for each shape.
- Create a pentagon using some the 2D shapes in the picture. What other polygons can you create by combining the shapes in the picture.
- The pink square is half of the yellow rectangle. What fraction is the red rectangle of the white rectangle? How can you prove this? What other relationships between the 2D shapes can be described using fractions?
- What is the formula for the area of a rectangle? If the longest side of the yellow rectangle is 5 cm what could its area be?
- What is the formula for the volume of a rectangle? If the longest side of the yellow rectangle is 5 cm what could its volume be?
- What could the area and volume of the unpainted rectangle with a semicircle removed be? Write a formula for both are area and the volume.
- Brainstorm twenty mathematical words that relate to the image. Create a Venn diagram with a friend that displays the vocabulary you have chosen.

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NOBLE PARK IS MATHS ACTIVE

Melissa Fraser - Maths learning specialist , Noble Park Secondary College

Noble Park Secondary College is a co-educational school with 450 students. The diverse community includes international students, refugees and approximately 80% of students with a language other than English. In 2020, despite COVID-19, the maths faculty enthusiastically set about gaining MAV accreditation as a Mathematics Active School.

Noble Park Secondary College (NPSC) aims to cater for all learners, challenge high achievers and extend those that need support. The school recently introduced the Galileo Program which enables students to explore mathematical concepts in greater depth and emphasises investigative and problem solving skills. Students participate in activities such as robotics in collaboration with CS in Schools, a free, industry-supported digital technology program in conjunction with RMIT University to integrate digital technology into the curriculum to enable students to learn to code.

NPSC delivers a comprehensive Numeracy Intervention Program providing intensive support to students identified as below standard. The intervention program was developed by the maths team within an enquiry framework – to explore the underlying reasons for poor achievement in mathematics and develop strategies to improve student outcomes. A support model based on the Response to Intervention (RTI) Model was developed (see Figure 1). This involves support being provided via a three-tier model where students in Tier 1 (at or above the expected level) are supported through teacher differentiation, those in Tier 2 (below expected level) are supported in class and in small groups by a numeracy specialist teacher and students in Tier 3 (significantly below the expected level) are assisted by the intervention specialist teacher both in and out of class.

IDENTIFICATION OF STUDENTS AND THEIR LEARNING NEEDS

Resources such as Key Maths, On Demand testing, NAPLAN and PAT testing are used to determine where students have misunderstanding of mathematical concepts and programs are designed to target these areas.

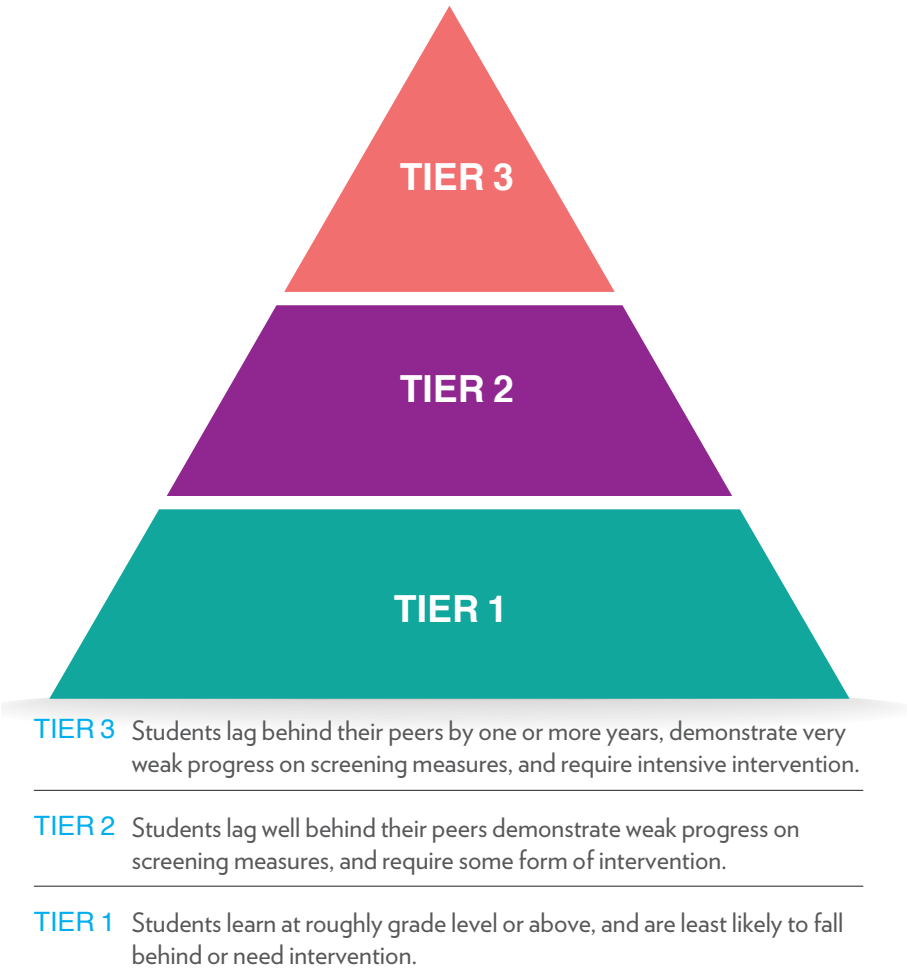

Figure 1.

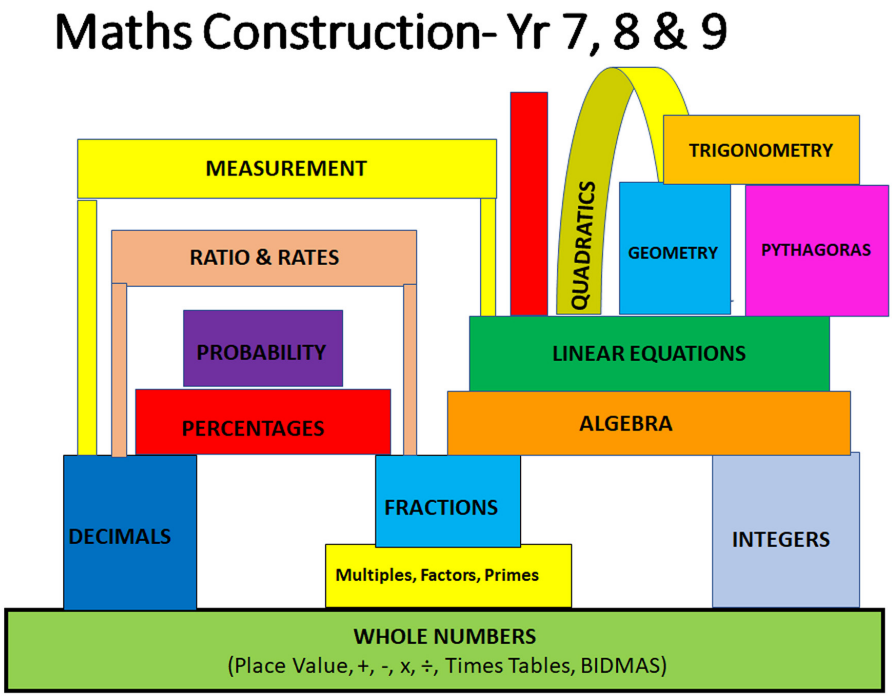

Figure 2.

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Students are provided with individual work plans which often involve developing number sense, understanding of place value and multiplicative thinking. Determining the student's point of need (no matter the level of the starting point) and working from this helps the student build the mathematical foundations required for further progress.

Students often work one-on-one with the intervention teacher in the tailor made program and staff have found working with students in frequent, focused short sessions very effective. Student progress is monitored regularly and the program is adjusted according to their learning needs so that each student moves at their own pace. This sense of achievement helps to maintain enthusiasm and commitment to the program. NPSC has developed an interactive maths website with customised videos which students can access to practise and reinforce their number skills.

Figure 2 was developed by Noble Park Secondary College and identifies the foundational concepts required to build further learning.

OUTCOMES

Feedback from students involved in the Numeracy Intervention Program show that they feel empowered following their involvement in the program:

'I like how we have a quick revision at the beginning of each session', 'there are games involved and they teach techniques for each topic', 'I'm more confident because there's no pressure and you feel that you can do it'.

When asked the question, 'do you think you have improved in maths?', a Year 7 student responded with this great feedback:

The latest NAPLAN data shows the growth achieved (see Figure 3).

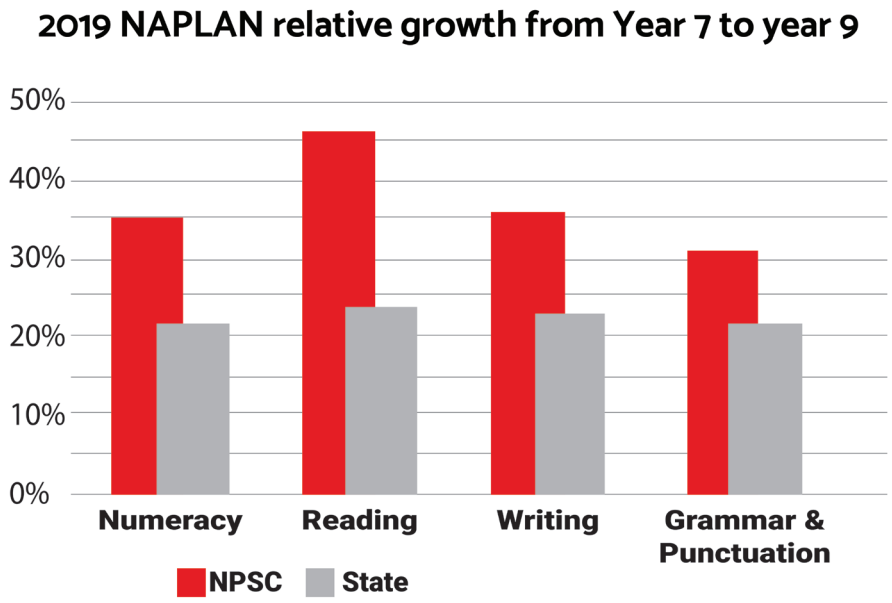

Figure 3.

TARGET NUMBER GAME

Throughout the year all students are encouraged to participate in various maths challenges such as the Target Number Game to promote mental maths skills. Students have to use the numbers provided and the four standard operations to generate the specified target number.

FAMILY MATHS CHALLENGE

The maths team connected with the school community during remote learning and with the introduction of the Family Maths Challenge. A problem was presented each fortnight and students were encouraged to work with members of their household to produce a solution. The problems varied from designing a fair method for deciding the overall winner of a heptathlon, constructing a boat from household items (according to given specifications) and investigating the weight the boat could support before capsizing to surveying members of their households to gain responses to statements such as: *100 is big, infinity is really big, people who are 100 hit their heads on the ceiling.*

This certainly started some great mathematics conversations!

Noble Park Secondary College has a passionate maths team whose enthusiastic approach motivates students and engages them in the learning process. Our results show significant growth in the percentage of students in Tier 1 over a year. This positive change occurred through collaboration between teachers and the intervention team. We look forward to continuing the maths conversations to engage students both in and out of the classroom and improve student outcomes further.

Noble Park Secondary College is a Mathematics Active School. To learn more about Maths Active Accreditation, visit www.mav.vic.edu.au/Membership/Maths-Active-Schools.

The website outlines the process of accreditation and shares criteria about what a Maths Active School looks like and attributes of maths active teachers, students and the community.

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VCE SACS: LINEAR GRAPHS

Andrew Stewart

The good aspect of SACs is that there is not only more time available to test student understanding of key topics, but also time to explore activities that are not included in examinations due to time constraints. These activities are presented as written for the Trial Exam, but with a little careful modification, could form the basis of challenging tasks.

LINEAR PROGRAMMING

In most examinations, the linear programming graph is provided with the feasible region indicated. Given that student abilities in drawing graphs need improving, why not combine them in a SAC task?

Modified from **2016, Exam 2 Question 4**

The motel on the island tropical resort that Amy stays at have worked out the ideal conditions for the motel to operate based on the numbers of cleaning staff (x) and desk staff (y) working at the motel. These can be described by the four constraint inequations shown below:

$$\text{Constraint } 1 : 30 \leq x + y$$
$$\text{Constraint } 2 : 60 \geq x + y$$
$$\text{Constraint } 3 : \frac{x}{4} \leq y$$
$$\text{Constraint } 4 : \frac{x}{2} \geq y$$

Activities

1. Construct the graph based on these constraints.
2. Identify the feasible region by shading the appropriate region on their graph.
3. Identify and label the coordinates of the corner points.

The completed graph with feasible region shaded, is given (Figure 1). The corner points are:

(20, 10), (40, 20), (48, 12), (24, 6).

4. Determine the solution to either (or both) a minimum cost (most likely business situation) or maximum cost (coping with a crisis) with appropriate objective function(s). These could be framed in terms of management looking at the costs of proposed union requests for pay rises (desk staff wanting more than cleaners, cleaners wanting more than desk staff or staying at current rates where both are paid the same wage).

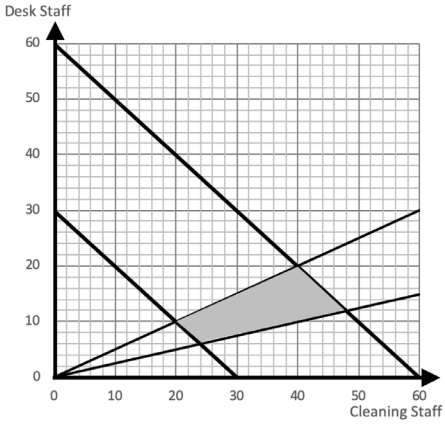

Figure 1.

Notes

1. The situation where both cleaners and desk staff earn the same hourly wage (for example, $C = 10x + 10y$) means that the objective function has the same gradient as the two negatively sloped lines (– 1).

Minimum cost would be any point on the line $x + y = 30$ between $x = 20$ and $x = 24$. Maximum cost would be any point on the line $x + y = 60$ between $x = 40$ and $x = 48$.

In both these situations, students would have to supply a number of whole number values for the numbers of staff required that lie within the feasible region.

2. In a situation where the desk staff are paid more than the cleaning staff, the gradient of the objective function will lie between –1 and 0. This means that the minimum cost situation will occur at (20,10) and the maximum cost will occur at (48,12). The green graphs shown in Figure 2 use $C = 5x + 10y$ and in this case have a gradient of –1/2.

3. In a situation where the desk staff are paid less than the cleaning staff, the gradient of the objective function will be less than –1. This means that the minimum cost situation will occur at (24,6) and the maximum cost will occur at (40,20). The red graphs shown (Figure 3) use $C = 10x + 5y$ and in this case have a gradient of –2.

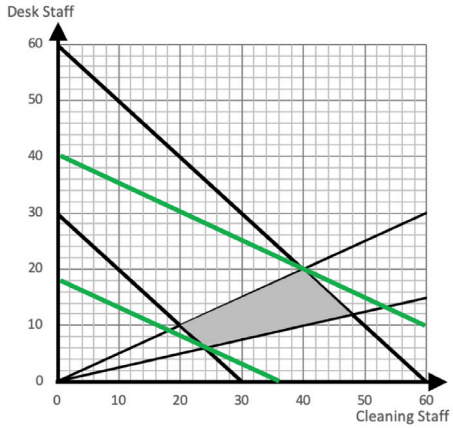

Figure 2.

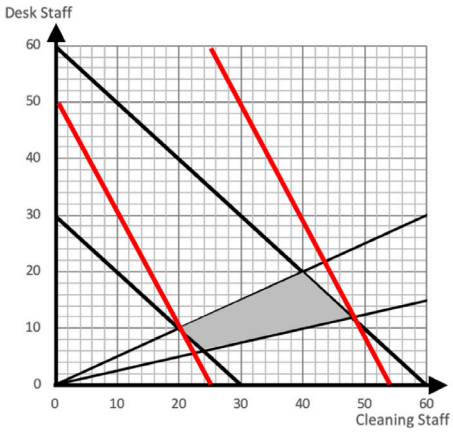

Figure 3.

This activity offers great potential in a number of areas. Changing the constraints offers a great opportunity to reshape the feasible region to make it smaller or larger. Changing the limits on the smallest and greatest number of staff, together with changing the ratio limits on the number of staff will make this happen. Using a mail merge document, each student could have their own unique situation to explore and resolve.

GRAPHING AND BREAK-EVEN ANALYSIS

2016, Exam 2 Question 2

Amy plans to stay in a motel in Noumea that charges Australian dollars for her accommodation. The motel charges a cheaper rate per day when customers stay after a certain number of days. A graph showing the cost to stay at this motel over a period of days is given (Figure 4). It is plotted as a series of points because only whole days are charged:

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The points can be joined using two straight lines that would have the relationship between cost ($\$C$) and number of days ($n$):

$$C = \begin{cases} 150n & 0 < n \leq a \\ b + dn & a < n \leq 20 \end{cases}$$

Activities

1. Determine the values of a, b and d, showing all working.
2. Another motel that Amy considers for her holiday charges an upfront cost of $1500, but then only charges $30 per day for stays up to 20 days long. The equation that models this relationship is $C = 30n + 1500, 0 \leq n \leq 20$. Add the line for this equation to the graph in Figure 4.
3. How long would Amy need to stay for the price to be cheaper at the second motel?

Answers

1. $a = 10, b = 700, d = 80$
2. See Figure 5.
3. Break-even (same cost) is 16 days, so it cheaper at 17 or more days.

This activity offers great potential in a number of areas. A new set of values for a, b and d would change the starting graph, and students could then explore, within given limits of the upfront cost and daily charge for the second motel, where the breakeven situation occurs.

As an alternative, ask students to find an upfront cost and daily charge that would lead to a particular breakeven point. There could be a fractional answer for the breakeven situation, requiring rounding decisions to be made. The setting could be relocated to an Australian resort town (rural Victoria or Gold Coast or Kimberleys for example), or some upmarket hotels in a state capital city!

Again,using a mail merge document, each student could have their own unique situation to explore and resolve.

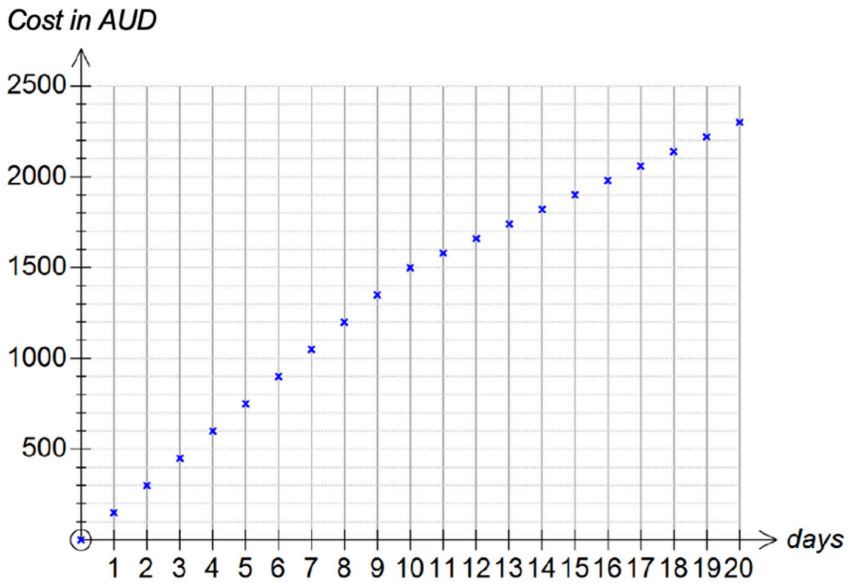

Figure 4.

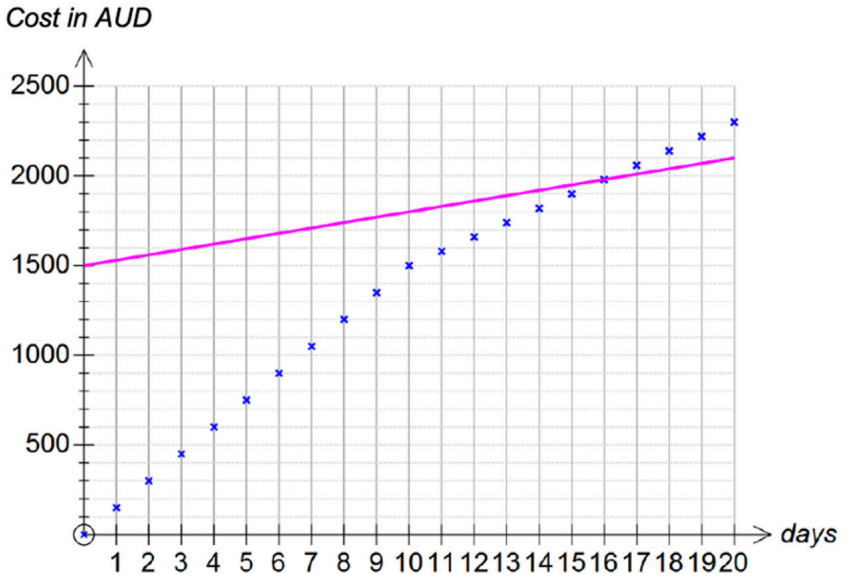

Figure 5.

MAV produces VCE Trial Exams which you can find online at:
www.mav.vic.edu.au/mav-shop

ONE MINUTE WITH DIANNE SIEMON

I'M..

Dianne Siemon, an Emeritus Professor of Mathematics Education at RMIT University. I've technically retired, but continue to pursue my research interests in the development of multiplicative thinking and mathematical reasoning. I enjoy supporting PhD students and providing professional learning sessions on the big ideas in number and the use of formative assessment.

BEST PLACE I'VE EVER BEEN...

For sheer 'out of this world wonder', it would be Yellowstone National Park in the depth of winter. For a deep sense of connection with people, place and culture, it would be Elcho Island in the Northern Territory.

2020 TAUGHT ME...

To be patient – we can find ways to make virtual learning viable, engage meaningfully with colleagues, and 'carry on' with a little more kindness and consideration of others. However, 2020 has also made me appreciate something I realise I took for granted and it is the value of working with colleagues in a shared physical place where unplanned, incidental, but often serendipitous conversations can lead to a breakthrough or a new way of thinking about something that you couldn't possibly have imagined and certainly not achieved in a planned 'zoom'.

MY HOPES FOR 2021 ARE...

Apart from global action on climate change and a world free of wars, pandemics and other catastrophes, I hope teachers, schools, and educational systems can take some time to take stock of what is really important in education – building and sustaining meaningful relationships that engender a love of learning and a sense of purpose. I would like to see an imaginative, evidenced-based mathematics curriculum emerge from the current review that is aimed more at building connections and understanding than isolated skill sets that have little relevance to the real world. I would like to see less summative assessment and a greatly enhanced public recognition of the incredible work that teachers do.

AN EFFECTIVE EDUCATOR CAN...

Make a really important difference to young people's lives – by building trusting, caring relationships and being passionate about their subject area. An effective educator can help students realise the seemingly impossible and bring about lasting changes in their beliefs about themselves and what they can achieve.

MATHEMATICS EDUCATION IS DEAR TO ME BECAUSE...

Mathematics helps us understand the world around us, it is a way of knowing that empowers our lives and creates opportunities. It is both beautiful and challenging and there is always more work to be done to understand how we come to learn mathematics and how the teaching and learning of mathematics can be improved to maximise access for all.

ACADEMIA...

Enables me to do what I love doing – teach, explore, research and write about mathematics education, meet and work with

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a diverse range of colleagues, visit schools, work with teachers and educational systems, and contribute in a small way to making a difference in how mathematics is taught and learnt. It has also enabled me to travel to interesting parts of the world, to get to know and talk to the 'heroes' in our field, deepen my own knowledge and question my assumptions.

THE SIMPLEST BUT MOST EFFECTIVE PIECE OF TEACHING WISDOM IS...

There is no such thing as 'best practice', there is only what we know about effective practice in a given context at a particular time, but there is something we can learn from being a reflective practitioner. This means always asking questions, accepting there are things we don't know and doing something about that, reading, researching, experimenting, engaging with student's thinking, talking to colleagues, sharing successes and failures and exploring the reasons why, interrogating our deeply held beliefs about mathematics and the teaching and learning of mathematics, and never giving up on trying to find ways to ensure meaningful mathematics learning for all.

I GET JOY FROM...

Witnessing those 'ah-ah' moments when something makes sense to someone for the first time, the pleasure someone else derives from learning mathematics or solving a challenging problem that they thought they couldn't do it, and the excitement of teachers who have made a real difference to student outcomes. I also get joy from seeing family and friends, entertaining, beautiful scenery, an outstanding play, and of course fine wine.

I'D NEVER LEAVE HOME WITHOUT...

I generally leave home with a sense of optimism and anticipation for whatever it is I'm about to do. Whether it's to provide a professional learning workshop, meet people, play golf, or do the shopping.

TEACHERS HAVE THE POWER TO...

Make students' lives utterly miserable or richly empowering and everything in-between. How we relate to students, the relationships we build and nurture, the passion and care with which we go about our work all make a difference to students' experiences of learning mathematics.

THE BIGGEST CHANGE I'D LIKE TO SEE IN EDUCATION IS...

Whatever it takes to reduce inequity, racism, and whatever else prevents students from achieving their very best for themselves and those around them. A good first step would be a courageous, visionary mathematics curriculum taught by qualified and well supported teachers.

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

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YEARS 7–10

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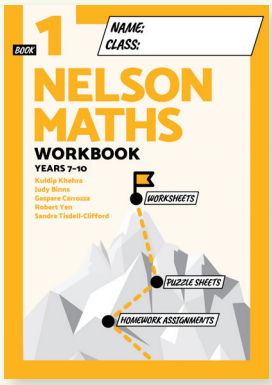

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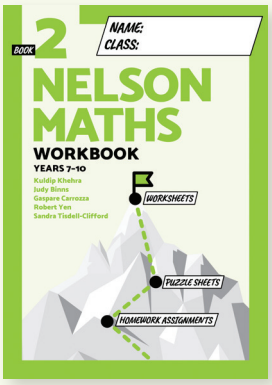

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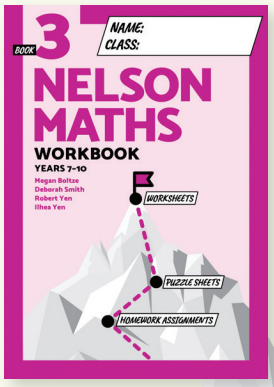

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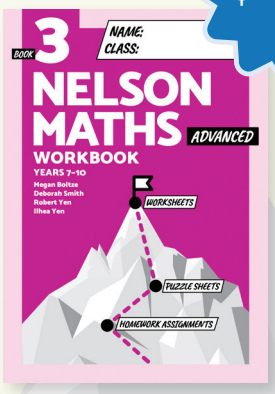

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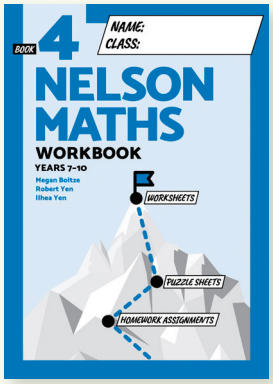

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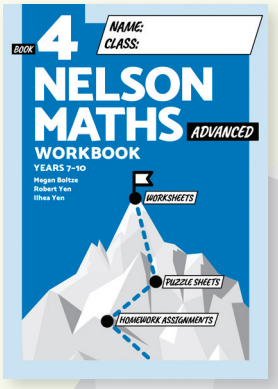

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SHAKING UP REVISION

Jessica Mount – Mathematics education consultant, The Mathematical Association of Victoria

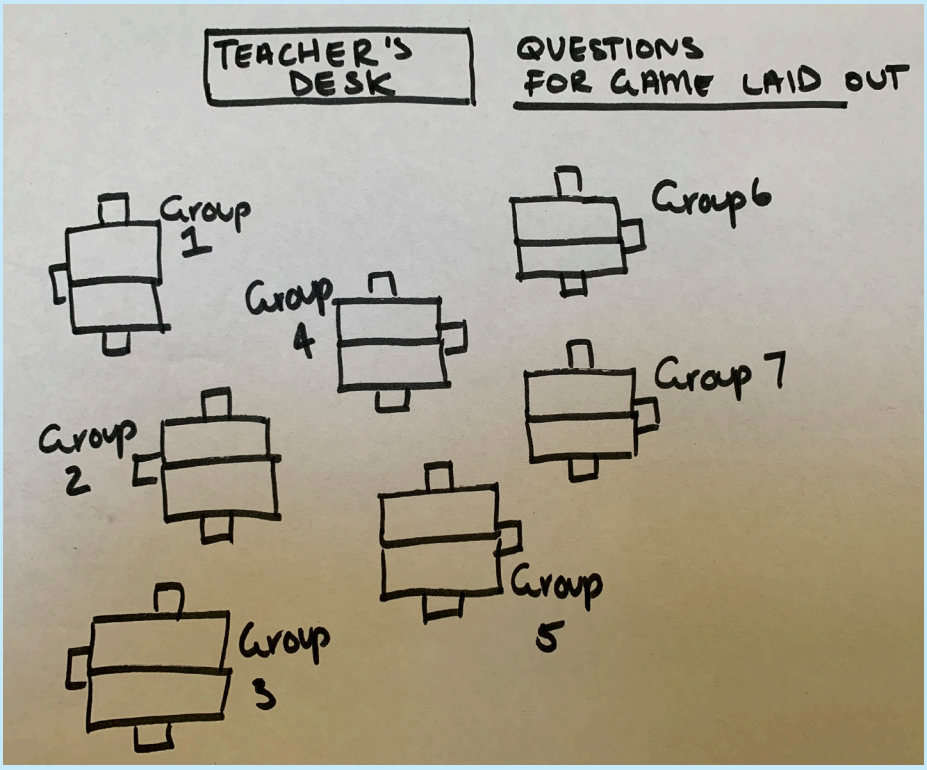
After teaching secondary mathematics for several years, I reflected on the way I ran revision lessons before classroom tests. I used to upload a previous year's test and ask the students to work through the test in class and ask for assistance as required. I would make my way around the classroom, helping as needed and occasionally doing a question on the whiteboard for the whole class to see. It was easy to set up and did not take any preparation apart from locating a suitable practise test. But it made me wonder if my students were getting enough out of it. If I was spending an entire period on revision was it worthwhile? Some students always asked a lot of questions and I could see how their results reflected a good use of the revision time. But there were always students who did not ask anything and worked independently and whilst I would aim to check-in with them, it would become difficult when other students were bombarding me with questions.

GETTING IN THE HOT SEAT

To shake up the revision lesson I devised a hot seat mathematics game using the revision test that I would usually upload. It certainly takes a little more preparation time but the enthusiasm from my students has made it worthwhile.

To set up the game you will need a series of 15-20 questions for a 45 minute revision lesson. The aim is for students to be able to answer all the questions during the lesson. The first time I trialled this idea I took the practise test, photocopied it one sided and then cut up the test so there was only one question on each slip of paper. This is because each pair (or group) of students will only receive the next question as they answer the previous question correctly.

I moved the desks around the classroom so students can work in hubs of two or three. The groups are listed on the whiteboard, so as students arrive, they find their group and sit together. I explain that the revision lesson will entail working through a series of questions in groups. As each group finishes a question they come to my desk, show their answer and I will determine if the answer is correct and provide the next question or, if the answer is incorrect, they head back to keep working on it. Make sure you have a list of answers available!



The classroom layout for hot seat revision.

I have each pile of questions laid out on the floor in numerical order so students can go and locate their next question once I have corrected the previous question.

One tip is to make sure that all the questions used in the revision game are one number (or short) answers. It makes it far easier for correcting quickly! At times I would end up with a line of students waiting to have their question corrected butcareful planning means I can quickly mark questions and keep the line moving. The classroom gets a buzz as students are keen to get their answers marked off to move onto the next question and try and be the first group to finish all the revision questions correctly. It can be a great lesson for after lunch when my students are often keen to do something different and love to move around a bit.

I have adapted the game and made revision PowerPoints with a revision question on each slide that I upload to the class portal. This obviously saves on photocopying! I use the same method – students come up, get their answer corrected before moving onto the next slide. Each group has an answer sheet with 20 spaces for their final answers so I can keep tabs if groups move ahead by looking at their answer sheet.

The first time I planned to use this game with my Year 8 class I was apprehensive about how the lesson would go. I tried to ensure I had thought of all the issues that could (and would!) go wrong but the students surprised me.

They got straight into it and loved moving around the classroom, getting their questions corrected and competing against the other groups all whilst achieving great revision for their upcoming assessment.

Student feedback has positive. Students say they enjoy working with 1-2 other students and see how they solve problems and learn from each other.

I've noticed that students who were quieter during previous revision lessons have been much more engaged and are keen to work through all the questions.

I have since used this lesson in many of my Year 7 -10 classes and it has been a hit each time. It won't be appropriate to use this game for every single revision lesson in mathematics but it's a great shake up and students often don't realise they have spent 45 minutes revising for tomorrow's test!

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INVESTIGATIONS

Ellen Corovic, Jennifer Bowden, Helen Haralambous and Danijela Draskovic – Education consultants, Mathematical Association of Victoria

FOUNDATION - YEAR 2

HOW MANY WAYS TO MAKE $1 AND 30 CENTS?

Using the collection of coins pictured, how many different ways could you make the collection $1.30?

- Enabling prompt: Can you label each of the coins?
- Extending prompt: Can you find all 5 ways?

Supporting task: www.topmarks.co.uk/money/toy-shop-money/aud

YEAR 3 - YEAR 6

PIZZA DELIVERY

Adapted from Sullivan 2017

You have ordered a pizza to be delivered and it costs $27.30. Look at the picture, these are the coins and notes you have in your wallet.

- What money could you give to the pizza seller?
- What change would you expect back if you paid with a $50 note?
- Give two different options for the combination of coins and notes you would get back from $50
- Extending prompt: What if you also ordered two more pizzas at the value of $14.25 per pizza as well as the original order. How much change from a $100 note would you get?

YEAR 7 - YEAR 9

EXPLORING LINEAR GRAPHS

Materials: Graph paper, pen, pencil ruler
Using graph paper, graph the following rules on the same set of Cartesian axes

$y = x + 2$	$y = 2x + 2$	$y = 3x + 2$	$y = \frac{1}{2}x + 2$	$y = -2x + 2$

- Which number in the rule is changing?
- What effect does changing this number in the rule have on the graph?
- Using a new sheet of graph paper, graph the following rules on the same set of Cartesian axes

$y = 2x + 1$	$y = 2x + 2$	$y = 2x$	$y = 2x - 2$	$y = 2x - \frac{1}{2}$

- Which number in the rule is changing?
- What effect does changing this number in the rule have on the graph?

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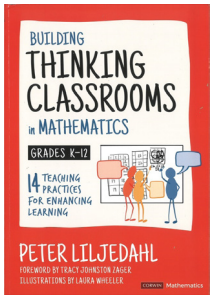

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