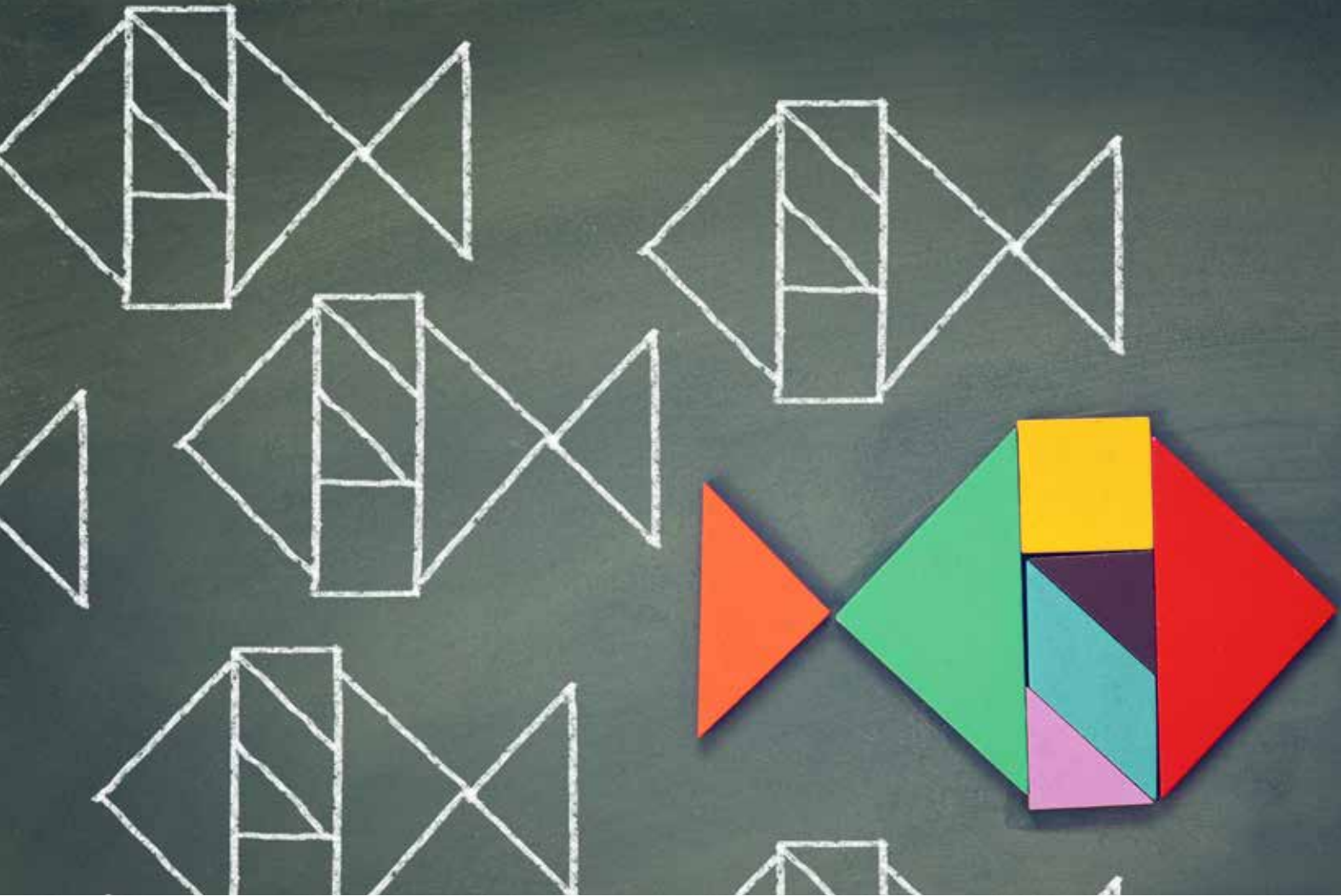


STUDENT THINKING: FRONT AND CENTRE



INSIDE

- 3 Funding boost to support Victorian maths teachers
- 11 Inquiry based learning
- 17 VCAL: being resourceful
- 23 New puzzle page: get your students thinking

'TELLING' STUDENTS WHAT TO DO IS NOT NECESSARILY THE BEST WAY

A common approach to structuring mathematics lessons, after checking homework, is for teachers to demonstrate a procedure and to present students with a set of progressively more complex exercises for them to practice what they have been shown. In such lessons, if students cannot progress, it is common for teachers to model the procedure again to individuals and small groups, perhaps even breaking the procedure down into smaller steps.

This approach is likely to foster what Richard Skemp called instrumental understanding in which students know 'how' to perform procedures but not make connections between related ideas or understand why it is done in this way. The instrumental approach runs the risk of creating the impression that doing mathematics is about remembering routines many of which apply only in a narrow range of problem types.

Continued on page 4

FROM THE PRESIDENT

Michaela Epstein

THE COMMON DENOMINATOR

The MAV's magazine published for its members.

Magazine 266, January 2018

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There is something so fantastically special about mathematics. Far more than numbers and strange symbols on a page, mathematics provides

a language for better understanding our world. And it never ceases to amaze me. At MAV17, the annual conference held last December, I had the pleasure of attending a session run by mathematician, Dr Amie Albrecht. The topic was Conway's Rational Tangles – or, in lay terms, tangled ropes. Five minutes in, and we were out of our seats holding skipping ropes and carefully following Amie's instructions. This was not at all child's play! We quickly discovered complex rules underpinning the twists and turns in our skipping ropes. Patterns, algebra and function notation were a necessary part of understanding something that seemed completely unmathematical. Amie's session was a beautiful example of how mathematics can turn up in the most unexpected of places, and be such a useful tool for making sense of novel situations.

This insight about mathematics is something that we value so highly at MAV. The association's mission is to share a deep appreciation of maths throughout the community. Excitingly, 2018 marks the start of a three-year period for a new strategic plan, to be launched at the AGM. The plan is a culmination of a year of work by Councillors, staff and members, and

sets out goals that, together, serve MAV's mission. At its heart, the goals focus on:

1. Providing benefit and value for all mathematics educators across Victoria.
2. Developing partnerships to improve of the quality of mathematics education, and to promote the importance of mathematics in society.
3. Increasing advocacy and engagement with key stakeholders around current issues in mathematics education.
4. Continuing to improve MAV's operations, management and governance.

The strategic plan represents how MAV with the support of members, will work to have a positive impact on educational outcomes. It includes a particular emphasis on ensuring that those students who typically do not take on mathematics at higher levels in secondary school and beyond have access to increased opportunities.

I encourage you to read the 2018-2020 strategic plan. If there are ways that you would like to be involved, please get in touch, office@mav.vic.edu.au.

REFERENCES

<https://amiealbrecht.com/2016/10/27/tangling-and-untangling/>

2018 CONFERENCE



At the heart of MAV's Annual Conference are teachers. Each year over 1400 mathematics educators – teachers, academics, policy makers, curriculum experts and resource developers – come together to share their collective expertise, experiences and ideas. That's what makes our conference great! Learn from each other as we share best practice, new ideas and innovative approaches around how:

- sharing action research and evidence is improving practice
- technology can be used as a valuable tool to support teaching and learning
- critical and creative thinking can be embedded into the classroom
- networks and communities of practice can support excellence and improvement.

FUNDING BOOST TO SUPPORT VICTORIAN MATHS EDUCATORS

MAV has received funding from the Victorian Department of Education and Training through the Strategic Partnerships Program (SPP). This triennial program from 2018 to 2020 will allow MAV to continue to run its Maths Camp for gifted and talented regional students and to expand online professional learning through a series of webinars, and through live broadcasts of key events.

MATHS CAMP FOR GIFTED AND TALENTED REGIONAL STUDENTS

The maths camps have been a great success for the past three years and bring together high potential rural and regional students to experience what a career in some of the most exciting organisations in the STEM industry look like. The demand for this program provided impetus for an enhanced program that gives access to a greater number of students.

Regional and rural schools nominate Year 10 students for attendance in the program who are performing above average in mathematics by documenting students' mathematical capabilities, performance and interest. The application also considers skills in leadership, teamwork and co-curricula activities. A selection process results in 24 regional students participating in a camp in Melbourne. The backbone of the camp is an industry-based, real-world mathematics project.

Students work in small groups to find a possible solution to a project problem. They receive daily mentoring by mathematicians and industry representatives. Students develop their project presentation and solution as a team, developing skills including communication, problem solving and creative and critical thinking. The open-ended projects stretch the application of mathematics past students' usual experience and challenge them to come up with innovative solutions. The week culminates in students presenting their project findings in the presence of the industry partners, invited guests and parents.

All participants visit each industry partner's facilities, and are exposed to mathematicians and STEM-based career opportunities providing motivation for future studies. In addition, they undertake



experiential activities, including Made by Maths App walks, visits to universities and presentations from professionals and academics with connections to mathematics. Following the camp, students join an online community supported by MAV.

Over the next three years MAV will make the program sustainable by seeking industry partners who can help fund the camps. In 2018 the camp is expected to run in July. Keep an eye on MAV's website for details.

MAKING PROFESSIONAL LEARNING ACCESSIBLE FOR RURAL AND REGIONAL MATHEMATICS TEACHERS ONLINE

This program will provide maths teachers across the state (especially in rural and regional settings) access to professional learning opportunities not usually available to them due to their remoteness from Melbourne. The aim is to improve teacher capacity by improving access to mathematics professional learning activities.

Funding will be used to purchase a Polycom unit and to deliver online professional learning to primary and secondary teachers.

The program will include online professional learning for teachers. Sessions will be free to all DET teachers during the first year of the funding period to make it accessible and to engage the regional audience.

MAV will begin broadcasting selected speakers including keynotes at conferences, VCE PD, and other events. This will allow wider access for teachers to MAV events never before possible. Where appropriate, sessions would be recorded and posted to the MAV website for viewing as a professional resource for teachers.

The SPP funding is a boost for MAV, allowing it to strengthen its services and impact. The funding aligns to MAV's goal to support all teachers regardless of location, and we look forward to working with teachers across the state more closely.

STUDENT THINKING: FRONT AND CENTRE

Professor Peter Sullivan - Monash University

(CONT FROM PAGE 1.)



There are now many teachers who are exploring alternative approaches which put student thinking at the centre, in which students work on challenging problems prior to teacher instruction. The argument is that this is more likely to foster what Skemp called relational understanding (meaning 'how' and 'why'). This relational approach is more likely to result in school graduates that are able to apply the mathematics they know to solve unfamiliar problems, who are willing to persevere, to think for themselves, to be confident in what they know and can use, to enjoy doing mathematics and see it as useful, and to communicate effectively using mathematical ideas.

Advice on approaches to teaching mathematics should be designed to help teachers foster relational learning. I argue that students will benefit when teachers plan lessons in which learning is the result of students working individually and together on:

- non routine challenging problems that activate their thinking about important aspects of mathematics

- for which the relevant language and concepts are introduced initially without telling the students how to solve the problem
- which are effectively differentiated for students who are experiencing difficulty and those who finish quickly while at the same time fostering a collaborative whole class community
- which are thoughtfully reviewed by the teachers
- with supplementary problems subsequently posed to consolidate learning.

Even aspects of mathematics which are commonly taught using efficient algorithms can be more productively learned using a relational approach. More or less no problem is solved in only one way and even approaches which are efficient in one situation may be less efficient in others.

For example, I would solve each of the following subtraction examples using quite different methods:

- 78 - 34
- 1002 - 998
- 473 - 308
- 135 - 37

In only one of these examples is the formal algorithm an efficient method. More important than instrumental efficiency is relational understanding.

The most important immediate and urgent goal when teaching mathematics is to enhance the experience of students and to encourage students to be more self reliant and less dependent on the teacher. While ideally outcomes will improve in the short term, the longer term goal of preparing students with the disposition and capacity to use mathematics flexibly in their later study and lives is much more important.

MAV is running a PD event toward the end of February 2018, where Peter Sullivan will present on Challenging Tasks. If you are interested, please register. See page 20 for details.

VCEPD 2018

VCE MATHEMATICS DAY OUT

This full day VCE Professional Learning event includes both Meet the Assessors and SAC workshops in all three studies - Further, Methods and Specialist Mathematics. Workshop participants will receive a copy of the solutions to the 2017 VCAA Exam and a copy of the MAV SACs relevant to the workshop attended. Morning tea and lunch are included.

Workshop fee: \$299 (members), \$380 (non-members)

WHERE

Melbourne University

Federation University, Gippsland

La Trobe University, Mildura

La Trobe University, Bendigo

WHEN

Friday 16 February, 9am – 3.30pm

Monday 19 February, 9am – 3.30pm

Friday 23 February, 9am – 3.30pm

Friday 2 March, 9am – 3.30pm

If a whole day workshop doesn't suit, you are welcome to attend our individual SAC and Meet the Assessors workshops.

MEET THE ASSESSORS

Assessors will discuss the processes for setting and marking the 2017 examinations. The presenters will provide a full analysis of the 2017 examinations highlighting student responses and key misunderstandings. Assessors will comment on some of the questions new to the Revised Study Design. There will be time for questions and discussion. Participants will be provided with a copy of fully worked VCAA exam solutions for the relevant session.

Fee: \$95 (members), \$119 (non-members)

WHERE

Wangaratta

Geelong

Williamstown

Horsham

Burwood
(Methods)

Burwood
(Further and Specialist)

Terang

WHEN

Tuesday 6 March, 5pm – 7pm

Wednesday 14 March, 5pm – 7pm

Monday 19 March, 5pm – 7pm

Thursday 22 March, 5pm – 7.15pm

Tuesday 27 March, 5pm – 7pm

Wednesday 28 March, 5pm – 7pm

Thursday 26 April, 5pm – 7pm

SACS

SAC workshops provide opportunities for teachers of VCE to be presented with and discuss possible starting points for SACs for their students. Participants will be provided with a selection of Application and Modelling and Problem Solving Tasks as suggested SAC for the study of workshop choice. The process of developing appropriate tasks, including criteria mapping and the inclusion of technology will be discussed with specific reference to the sample task provided in the sessions.

Fee: \$162 (members), \$203 (non-members)

WHERE

NE metro - Burwood
(Methods)

NE metro - Burwood
(Specialist and Further)

NW metro - Lalor

SW Vic - Terang

WHEN

Wednesday 7 March,
5pm - 7.30pm

Thursday 8 March,
5pm - 7.30pm

Wednesday 21 March,
5pm - 7.30pm

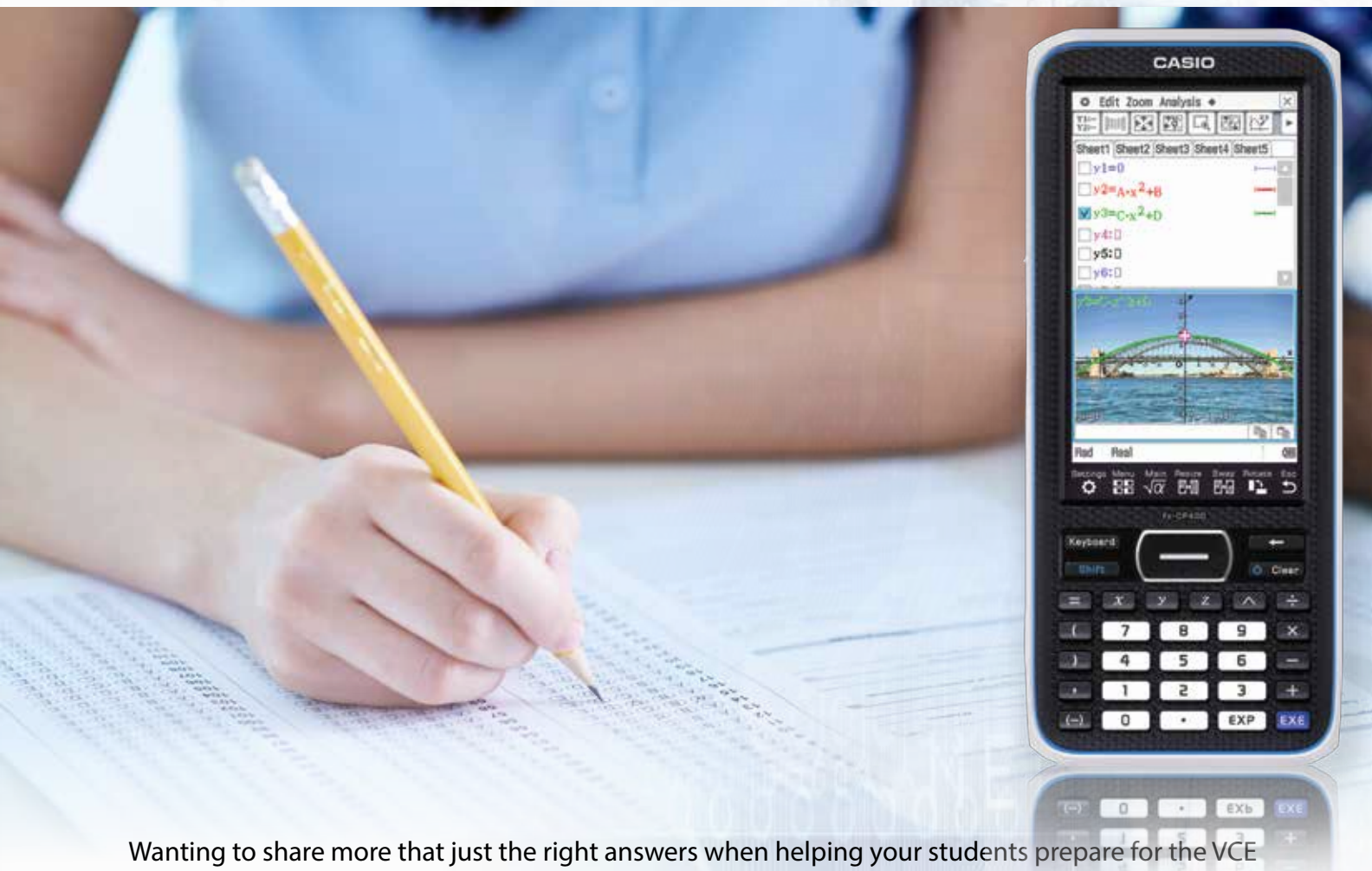
Monday 26 March,
5pm - 7.30pm



THE MATHEMATICAL
ASSOCIATION OF VICTORIA

REGISTER ONLINE AT
www.mav.vic.edu.au/pd
or call +61 3 9380 2399

NEW Classpad VCE Mathematical Methods Examination Resource Series



Wanting to share more than just the right answers when helping your students prepare for the VCE Mathematical Methods examination?

Ways of thinking? Multiple approaches? Efficient CAS use?

This 8-part video series presents worked solutions to the 2016 VCE Mathematical Methods: Written Examination 2, incorporating use of both the ClassPad and 'by hand' methods in real time, as well as a discussion about making discerning choices in this style of assessment.

This invaluable video resource can be found exclusively at <http://www.casio.edu.shriro.com.au> in the Classroom Resources section, and is available freely for all Classpad users.

**INSPIRED BY AUSTRALIAN TEACHERS
FOR AUSTRALIAN STUDENTS**

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www.casio.edu.shriro.com.au

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www.casio.edu.shriro.com.au

 **SHRIRO**

MAV MEMBERSHIP

Your Mathematical Association of Victoria membership is your gateway to the mathematics education profession. MAV is proudly 'by mathematics educators, for mathematics educators' and we are committed to advocating for and promoting the profession in Victoria.

The MAV's professional services include:

- Professional learning
- In-school consulting
- Annual conference
- Primary conference
- Student activities
- Newsletters and journals
- Publications and resources
- Advocacy, representation and professional advice

Jump online now and renew your MAV membership, it only takes a few minutes. www.mavvic.edu.au.

FREE STUDENT MEMBERSHIP



Being able to access MAV's journals, professional development and networking opportunities would really benefit me.

Having a free student membership will mean that I'll be exposed to a whole network of mathematics educators. I'm really interested in reading the journals to see what teachers are doing in their classrooms - I want to know what works and what doesn't.

I'm also keen to submit an article to MAV's journals about the experience of a pre-service teacher - and equally, I'd love to read about the experiences of other pre-service teachers.

- Rhiannon Cross, Masters of Teaching student, Monash University

In 2018, the MAV will offer free pre-service teacher, (university student) membership. This includes secondary mathematics teacher specialists and all primary and early years teachers who are required to teach mathematics. As pre-service teachers are the basis of MAV's future membership, it is critical that this important group are provided support and services to ensure they are highly prepared for a future in the classroom.

Free membership will provide an opportunity for pre-service teachers to access member benefits and services from the MAV. MAV provides membership benefits to a growing network of over 13,500 mathematics educators.

Students looking to start their education career through professional learning, support resources, and industry connections should apply for free membership.

Student members will receive access to digital versions of MAV journals and magazines - all other benefits will be the same as a full member. The MAV plans to host a few special events just for pre-service teachers, targeting their needs and helping them prepare for the future.

To qualify for free student membership, pre-service teachers must be studying an accredited or recognised Victorian course in education. Postgraduate students studying full-time and not teaching in a paid role, may be eligible for student membership.

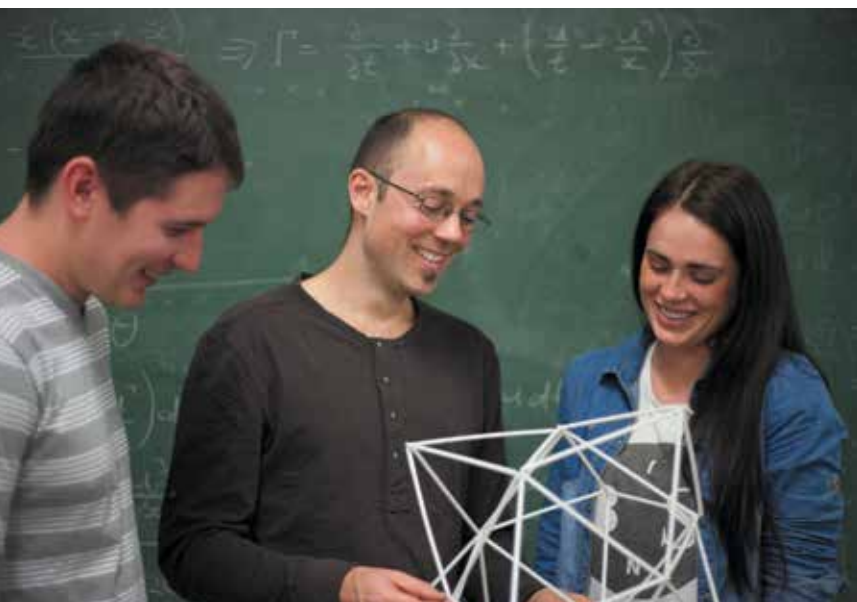
The MAV will contact all university education departments to send some materials to display and hand out, and to ask for their support in letting pre-service teachers know about this fantastic initiative. If you are working with pre-service teachers, you can help by spreading the word!

More information can be found on the membership section of MAV's website, www.mavvic.edu.au. To join, pre-service teachers can contact MAV's Membership Officer, Michael Green: mgreen@mavvic.edu.au



Mathematics

Outreach at La Trobe: explore algorithms, logic and the mysteries of mathematics



High school students

Our workshops offer insight into the university environment. Programs are developed by teachers and academics and designed to inspire students while offering experiences not available at school. We provide on-campus opportunities that reinforce learning and teaching, empowering both students and teachers to raise the bar.

Workshops include 'The Beauty of Mathematics' and 'Maths and Music -What's The Link?'. Both sessions are aimed at middle years students and provide a new perspective on maths and patterns.

Maths Professional Learning Program

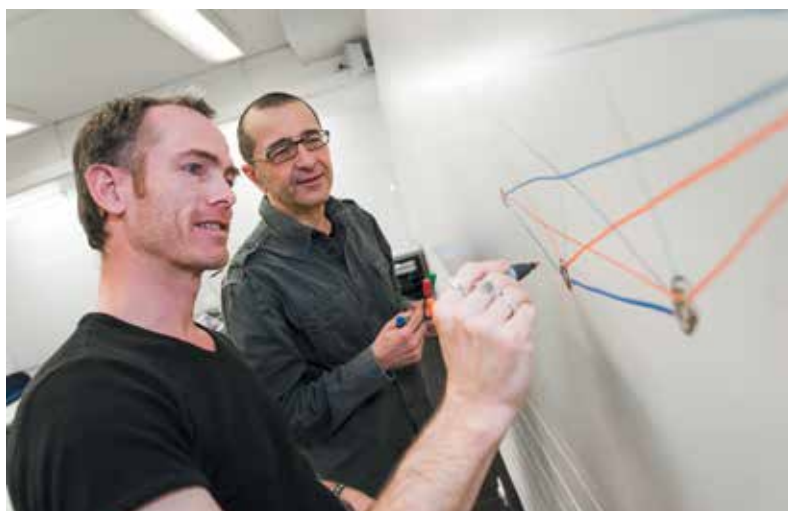
We offer a comprehensive suite of specialised Professional Learning Programs designed for teachers at all career stages. Programs reinforce content knowledge and include an introductory lecture, practical workshops and interaction with practising researchers. Designed for teachers with limited statistics training, the maths program explores technology, creativity and playfulness for teaching statistics and data analysis. It aims to make statistics simple, enjoyable and accessible to students at all levels.

Further information

E: outreach@latrobe.edu.au T: 03 9479 6516
W: [latrobe.edu.au/outreach/science](http://latrobe.edu.au/outreach/she-outreach/science)

PLP Details

Dates: 23 Feb (City), 24 Aug (Bundoora), 2 Nov (City)
Duration: Full-day (9:00 to 4:30)
Cost: \$250 (GST inclusive)
Location: La Trobe University, Melbourne campuses
Registration: www.latrobe.edu.au/outreach/she-outreach/science



A LIFETIME OF ACHIEVEMENT

Marj Horne and Elizabeth Burns were given life membership of the MAV in December 2017. Both have had a huge impact on the association over the past 30 years and are worthy recipients of the life membership award.

MARJ HORNE

Marj Horne has had a distinguished career in teacher education, including university and teaching roles. She has worked at RMIT and Australian Catholic University as well as PLC Melbourne and various government high schools. With Bruce Henry, she co-authored the Rusden Activity Mathematics Project (RAMP) – exploring innovative teaching approaches to the teaching of maths in the middle years.

Marj has won enormous respect as a Council member and as a mathematics educator at all levels. She has brought a deep understanding of and a strong commitment to the preparation of the next generation of teachers of mathematics.

Marj has made a significant impact to teacher professional learning through MAV conferences and in her university roles. For more than 30 years, Marj has given many professional learning presentations for MAV on a vast variety of topics ranging from Family Maths to the introduction of CAS Calculators. Marj has always been a sought after presenter to run PD. She has also been a regular presenter at MAVCON over many years. Her community outreach has assisted many schools to work more effectively with parents and to support children's interest in and appreciation of the relevance of mathematics.

Marj has been on MAV's council for a great many years and has held both the vice president and president role of the association.

ELIZABETH BURNS

Elizabeth Burns' dedication to her students and to the teaching of mathematics continues to inspire the next generation of teachers. She has made sustained and important contributions to both MAV and AAMT.



Over many years, Elizabeth has made invaluable contributions to the MAV as a member of Council and the MAV Executive. As President of MAV she placed the highest priority on the association's key role in supporting teachers of mathematics regardless of the school sector. She has given time, over and above the norm, in her active involvement in and support of the National Mathematics Summer School for talented senior students held in Canberra. In 2012, Elizabeth presented statewide Mathematica PD (on behalf of MAV for DET). Building on her VCAA role, she has presented Meet the Assessors workshops for VCE teachers, and VCE Revision lectures for senior students.

Elizabeth has made a significant and long-term contribution to mathematics education in Victoria, specifically through her outstanding career as a teacher and school leader; and through her contribution to senior mathematics assessment through the Victorian Curriculum and Assessment Authority where she has been Mathematical Methods: Deputy Chief Assessor and a Member of Examination Review panels.

She has held a wide range of important positions of leadership in schools and universities including at Dean of Students at St Mary's College, University of Melbourne; Deputy Principal at Loreto Mandeville Hall and Head of Mathematics at Melbourne Girl's Grammar School. In all of her senior leadership roles, Elizabeth has been an advocate promoting the importance of mathematics for all students, especially its importance in the education of young women.

On the community front, Elizabeth volunteers weekly as a VCE tutor at The Huddle (based at North Melbourne Football Club). The Huddle is a homework club for senior students living in the North Melbourne area. A large percentage of its students come from Somali refugee families; and, due to prior disrupted schooling in their countries of origin, frequently experience difficulties in transitioning to mathematics in high school and the VCE.

CRITICAL AND CREATIVE THINKING

MAV in collaboration with the Melbourne Graduate School of Education's Mathematics Education Group will present a conference focusing on primary school mathematics education in June 2018.

The Victorian Curriculum states that 'The Critical and Creative Thinking capability focuses on the development of increasingly complex and sophisticated processes of thinking'. The knowledge and skills required for critical and creative thinking must be explicitly taught if students are to develop and apply the skills and learning dispositions that support logical, strategic, flexible and adventurous thinking in mathematics.

Join us to investigate critical and creative thinking, focusing on:

- questions and questioning for deep learning
- rich tasks, challenging tasks and inquiry based learning
- reasoning and metacognition
- digital technologies

Develop your professional ability and confidence as a primary mathematics teacher.

This truly collaborative event is hosted at the Melbourne Graduate School of Education, The University of Melbourne and includes high-quality presenters and a variety of session options. Learn from leaders with practical and educational research experience.



Join us for either of these two days:

Mathematics education leaders

Friday 22 June, 2018

Mathematics leaders and those with an interest in mathematics education leadership within primary schools including Principals, Deputy Principals, Numeracy Leaders, Academics, Vic DET, VCAA and others.

Primary school teachers

Saturday 23 June, 2018

All primary teachers across Victoria are invited to attend this day focused on teaching and learning mathematics in the primary classroom.

NGV TRIENNIAL

The National Gallery of Victoria are showing the Triennial exhibition until 15 April 2018. Featuring the work of over 100 artists and designers from 32 countries, the NGV Triennial surveys the world of art and design, across cultures, scales, geographies and perspectives.

This is a free exhibition and visitors have an opportunity to look at the world and its past, present and future through the eyes

of some of the most creative minds working today.

There is an education program available on the NGV website and students will be amazed to see how the common kitchen sponge can be repurposed to create the artwork pictured here. There are also thousands of tangrams available for visitors to create their own carpet design. The exploration of patterns is fascinating.



INQUIRY-BASED LEARNING

Lee-Ann Pyke - Mathematics consultant



How were the Pyramids built? How tall are they? What's inside them? How many are left?

Inquiry-based learning is a leading pedagogical approach allowing students to be actively involved in their learning and to take responsibility for their learning. The objective in an inquiry classroom is activating student's curiosity rather than than the objective of simple information delivery through transmission, a model familiar to most adults.

Inquiry is about learning something new, and learning something new generates its own enthusiasm, even if it's something new about the content we've covered for years but are revisiting.

Let's say you're clicking through your Twitter or Facebook feed and you stumble on a link in your interest area. You realise it's a new fact or a new perspective on an age-old topic. Maybe it's a new TEDTalk or graph with statistics, something that makes a concept more concrete. Maybe it's an infographic or a photo, something that startles you to furrow your brow and say, 'Whaaat?!'

In an inquiry classroom teachers need to ignite the love of 'whaaat?!' The teacher needs to model his or her own curiosity quotient. Our curiosity quotient is a hunger to learn that defines how we advance our knowledge of the world. According to the

Harvard Business Review, a higher curiosity quotient can indicate more flexibility and help build a greater ability to handle complexity.

In inquiry-based learning there are many models, however, once curiosity is aroused four basic steps follow: developing questions, researching, presenting or representing what has been learned and reflecting on the relevance of new understanding, deciding what comes next. Lessons on literacy, mathematics, researching or information technology, for example, are all embedded into each of these steps. Students work individually in pairs or in groups developing collaborative work skills.

Inquiry allows each child to develop their understanding of the world in a way and at a rate that is unique for each individual.

It allows students to construct meaning by drawing on their prior knowledge, by provoking curiosity through new experiences and by providing opportunities for research, reflection and consolidation.

Teachers who use inquiry-based learning can generate such excitement in students that neurons begin to fire, curiosity is triggered, and students can't wait to

become experts in answering their own questions. It transfers some responsibilities from teachers to students, it puts students in charge of their learning and by releasing authority engages students. It engages students actively in their own learning.

Inquiry-based learning requires students to develop the strategies to investigate questions and solve problems. The teacher's role is to facilitate their inquiry and the students develop their own skills as experts in authentic learning situations. These skills include basic numeracy and literacy, the tools essential for inquiry as well as the skills relevant to specific disciplines.

In terms of student achievement, the power of their question should help drive the research, the writing, and the presentation. It should help motivate them to become experts in their self-described field.

The more often a student gets a taste of what it feels like to be an expert, in however small a concept, the more they will want that feeling later on in life. Resulting in life-long learners able to problem solve collaboratively in the 21st century.

MAKING IT MORE CONCRETE...

Students develop questions

Identifying what needs to be known and asking compelling and relevant questions that can be researched.

Research the topic

It's crucial for students to have some access to the head researcher in the room - the teacher. Teachers aren't going to do the work for them, but are going to guide them and model methods of researching reliably.

Students present what they've learned

Students create and present a culminating artifact. After all, many people can understand content, but can they communicate it? For example, students could develop a website using Weebly, or perhaps a slideshow using Google Slides.

Students reflect on the process

Reflection is key. It's about reflecting on the process itself. Thinking about thinking: metacognition. Thinking about how they learned not just what they learned.



REGIONAL SCIENCE EXCHANGE PROGRAM

Hosted by John Monash Science School, the Regional Science Exchange Program offers talented Year 10 students from regional and rural areas an opportunity to experience three weeks of hands-on learning at Victoria's first specialist school for science, mathematics and associated technologies.

Open to Year 10 students who display talent, interest, curiosity or passion for science, mathematics or technology, the Regional Science Exchange provides an opportunity for regional and rural students to attend John Monash Science School for a one-of-a-kind educational experience.

Designed to fit comfortably with regular Year 10 studies, exchanges are all-inclusive and take place in immersive three-week blocks at the beginning of both Terms 2 and 3.

Visiting students will experience the unique learning environment at John Monash Science School, including:

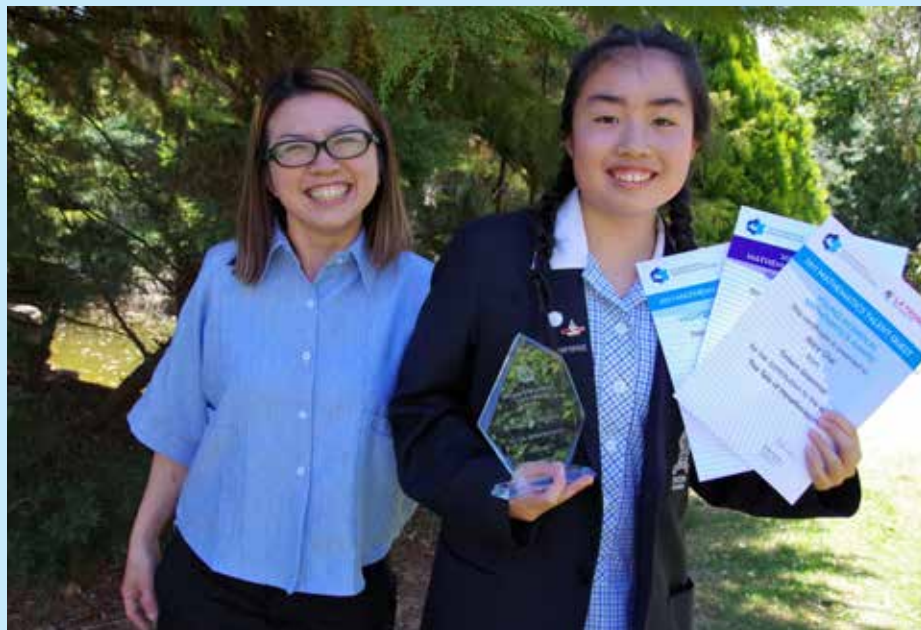
- Participating in Emerging Science electives developed in partnership with Monash University;
- Engaging in hands-on scientific enquiry through field trips, site visits and extra-curricular activities; and
- Exploring Melbourne's diverse cultural and sporting landscape through homestay accommodation and curated excursions.

APPLICATIONS FOR 2018 NOW OPEN



YOUNG WOMEN IN MATHEMATICS

Jen Bowden - Mathematics education consultant, MAV



Abby Chai (right) was a recipient of the Young Women in Mathematics award at MAV's Maths Talent Quest 2017.

Emily Choung from Annunciation and Abby Chai from Tintern Grammar School were the 2017 recipients of the Young Women in Mathematics Award.

Abby submitted a Mathematics Talent Quest investigation titled *The Tale of Hexaflexagons* where she explored the relationship between crafting and mathematics. 'I discovered these really intriguing origami figures online called hexaflexagons. These paper shapes look just like ordinary, flat hexagons at first, but when flipped, reveal many different hidden faces. For my investigation, I found out how hexaflexagons work and worked out a formulae comparing the number of faces, triangles and flexes. I then compiled everything into a storybook.'

'The most fascinating thing I found about was how something that looks so simple can be so complicated. When you first look at a hexaflexagon, your first impression is that it is just a boring, flat, hexagon-shaped piece of paper. But really, when you take the time to look at it carefully, it really is quite amazing.'

'The stand out mathematics ideas in my investigation were probably the algebraic formulas that I came up with. I found it really interesting how just about anything can be turned into an equation.'

'I hope to go to university and continue to pursue a career that involves mathematics.'

Emily's investigation, *Different Maths Systems*, focused on different maths systems from ancient civilisations, Roman, Mayan and Hindu Arabic numerals.

'I thought it would be cool to learn about how other civilisations used numerals to figure out equations and how they worked with numbers in their everyday lives. I was surprised at how different the Roman and Mayan numerals were compared to the Hindu-Arabic numerals. Mayan numerals and Roman numerals don't use digits. The Mayan system uses dots and lines and the Roman system uses letters from the alphabet.'

Emily is keen to pursue her dream of becoming an accountant and part of that desire stems from her love of mathematics. 'Maths is a part of everyone's life and it can be used for anything - architecture, cooking, fashion and so much more. I am honoured and grateful for the opportunity to participate in the Maths Talent Quest and then to be chosen for the Young Women in Maths award. I loved seeing all the investigations that everyone else had completed and am glad that mine was amongst such great work.'

Details regarding the 2018 Maths Talent Quest are available at <https://www.mav.vic.edu.au/student-activities/maths-talent-quest.html>.

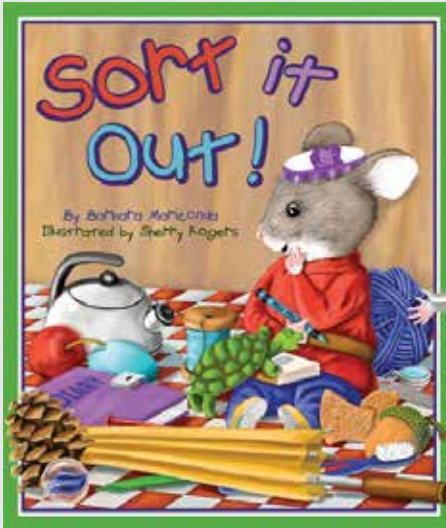
All Victorian and Tasmanian students from early years through to VCE are able to enter. The best of these entries will be entered into the National Mathematics Talent Quest.

Registration opens on Wednesday 18 April and closes on Monday 23 July. If you are interested, refer to the website for specific information, dates and other details.

The MTQ is a terrific way to capture imaginations, promote mathematics, go on a mathematical exploration and give students an accessible, fun way to approach mathematics.

SORT IT OUT: RESOURCE REVIEW

Alica Clark - Foundation teacher, St Mary's Whittlesea



Mathematics is made up of skills and concepts that can sometimes seem difficult for small children to relate to. Placing these skills and concepts into a context that they can understand and engage with is vital during the early years. Picture storybooks have become well known amongst mathematics educators as a highly effective way to achieve this relatable context and engagement.

Sort It Out! is a colourful picture story book written by Barbara Mariconda and illustrated by Sherry Rogers. It is about an inquisitive rat, Packy, whose greatest love in life is to collect all kinds of objects.

When his mother tells him to 'sort it all out' he sorts and groups his collection in various ways, such as by colour, by size, by texture and by purpose. Although this text was written with an explicit mathematical objective in mind, children will love listening to the rhyming text and studying the detailed illustrations, and will enjoy the mysterious nature of the ending where Packy must discover where all of his collections are disappearing to!

Here is an outline of a session undertaken with a group of Foundation students on sorting and classifying, using this picture storybook as a springboard. At the Foundation level, students are expected to: 'Sort and classify familiar objects and explain the basis for these classifications' (Victorian Curriculum: <http://victoriancurriculum.vcaa.vic.edu.au>).



Sorting objects just like Packy the Rat. In this example students have sorted by colour.



Students also sorted in more creative ways such as 'hard objects and soft objects' and 'smooth objects and rough objects'.

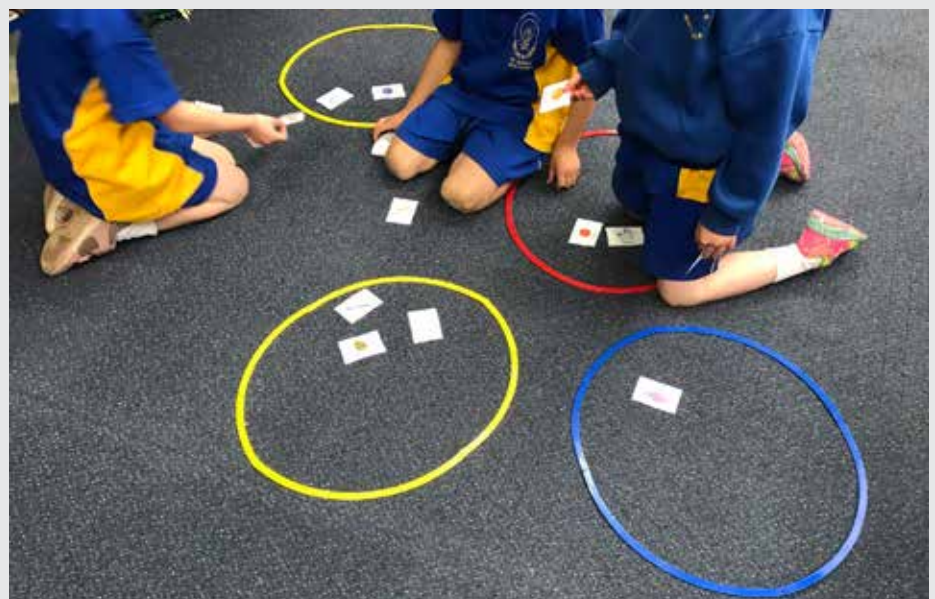
The session was one of the first in a unit on sorting, classifying and pattern, and it is important to note that the activities that follow were completed over two lessons.

We read the story, spent time looking at the illustrations, and studied what Packy the Rat sorted into each group. For each group that Packy made, we looked around our classroom and found other things that would fit into that group, for example, when Packy sorted all things that were green, we found a green crayon, a green texta, a green counter and a green unifix cube. The students were very engaged – they had a character that they could relate to, and they were taking an active part in the story by ‘helping’ Packy with the sorting of his collections.

Then we used ‘Packy’s Sorting Cards’ (a very useful, photocopiable resource provided at the back of the book) to practise sorting as a whole class. Students sorted the cards according to various criteria, such as long objects and short objects, things you can eat and things you can’t and so on. I encouraged students to verbalise why they were grouping objects and justifying why objects didn’t fit belong.

Following this, students were placed into small (mixed ability) groups and were told to ‘be like Packy.’ They spent a few minutes moving around the classroom space to collect different objects. Each group was then given sorting hoops and asked to sort the objects they had collected. It was interesting to see the creative ways the Foundation students were able to do this. Again, students were encouraged to verbalise and justify their classifications. At the end of the session each group was asked to share one way they grouped their objects.

Sort It Out! provided an amazing beginning to our sorting and classifying topic. This is just one way that this story can be used as a mathematical springboard. There is a helpful section for teachers at the back of the book, with other suggestions about its use in the classroom. It has ideas to extend students such as creating graphs about each group Packy made, as well as some links to literacy.



Above: Packy’s Sorting cards. Below: Students using the cards to sort, classify and justify.

REFLECTIONS OF A CONFERENCE

Roger Walter - Editor of MAV's secondary journal, *Vinculum*

With literally hundreds of options on a wide variety of topics, the MAV annual conference is, for me, a must-do activity each year. It is also a good opportunity to exchange ideas with other educators over coffee, lunch, or during happy hour, and to see what the different commercial organisations have on offer. Perhaps the best reason to attend these kinds of events could be summed up by Vicky Kennard, as 'seeing maths in different ways to what you're used to', (*Seeing maths*, session H11).

This short piece will contain my reflections on some of the things I experienced at the 2017 MAV annual conference.

There were keynote sessions for every interest, but how could you go past David Butler's *Playful and joyful mathematics*? What a way to begin a conference! I already know that mathematics is intrinsically a playful and joyful activity, but this seems to have escaped many of our students, we must help them to discover this, even in such mundane things as textbook exercises. Joy is a happiness you know that can't be taken away, and occurs when I work something out by myself, or find something that fits together in an amazing way.

Play is trying out ideas inspired by your own curiosity – and being absorbed in the activity. While playing you forget about being wrong, or not knowing the answer, or what others might think, the big three fears in mathematics! We learnt ways to put joy and play into our lessons. His favourite questions are, 'What do you notice?' and 'What do you wonder?' Keep watching this space, as we hope to have more from David (pictured) in a future issue of *Common Denominator*.

The other keynote session I attended (and enjoyed) was by Norman Do, himself a very playful and joyful man, a self-confessed maths freak and one of the most entertaining and engaging speakers I have ever heard.

His favourite question, after looking at some mathematics, is, 'What's going on here?' In one of my favourites, he used the delegates as human dice to produce the following sequence.

1 5 3 6 3 2 5 3 5 5 5 5 4 2 ...



Have you seen this sequence before? Of course not! So we make a new sequence from this by writing under each number 1 if it's the first time it appears in the sequence, 2 if it's the second time it appears and so on.

1 1 1 1 2 1 2 3 2 3 4 5 1 2 ...

Have you seen this sequence before? No, so repeat the process.

1 2 3 4 1 5 2 1 3 2 1 1 6 4 ...

Have you seen this sequence before? No, so repeat the process.

1 1 1 1 2 1 2 3 2 3 4 5 1 2 ...

Have you seen this sequence before? A few people, myself included, said no, but most recognised that it was the same as the second sequence. We don't need to do this process again, because the two sequences will continue to oscillate. What's going on?

I won't say any more, and I don't want to steal anyone's thunder, but watch future editions of *Vinculum* for articles by Norman.

MATHEMATICAL NETWORKING

In an organisation like MAV, there are many ways of making mathematical connections. As an example, during Hanlon's handy hints, I was chuffed to hear that the presenter had found one activity in *Vinculum*. We hope to publish some of Hanlon's hints in the future.

This year I presented a (repeated) session involving Desmos, a fairly new (free) online graphing calculator. I appreciated the overall participation of the audience, and find it can enrich the overall experience.

One participant mentioned how he had used Desmos to great advantage in his class, and after my session he was thinking of presenting what he did at the next annual conference. I suggested he also write about what he had done for *Vinculum*, but like many people he felt he didn't know how to write for a journal. If that is you, or you feel it would be too hard to write for any of our three teacher publications, please reconsider.

All you need are good ideas, or anything worth sharing. If MAV is about anything, it's about working together and sharing what we do. I would like to encourage anyone who has something to share, to do so via a professional organisation, either through a magazine or journal, the annual conference, or even, if you're game enough, by running a professional learning activity.

Finally, I will finish with some quotations.

I teach high school maths. I sell a product to a market that doesn't want it but is forced by law to buy it.
Dan Meyer. (2011)

I don't worry about machines thinking like humans. I worry about people thinking like machines.
Apple CEO Tim Cook.

Our job is not to make mathematics interesting. Mathematics is intrinsically interesting. Our job is to help our students to realise that mathematics is interesting.
Roger Walter. (2017).

If Jim Hacker can quote himself, then so can I.

VCAL: BEING RESOURCEFUL

Jamie Gray - Peter Lalor Vocational College

As VCAL Numeracy teachers begin the annual tradition of planning for the following year, we take a look at the books and resources that are available to VCAL Numeracy teachers through MAV. As we explore these resources, I will provide a brief description of how the resource may be used in a VCAL classroom and also suggest how they may be mapped and evidenced to VCAL outcomes at the different levels.



One of my perennial favorites is *Having fun with maths* by Dave Tout. As the name suggests the book is about using games and activities to have fun while exploring mathematical

ideas. VCAL students have not always had the smoothest maths journey before they arrive in our classrooms, so the notion of having fun is indeed a refreshing outlook for both students and the VCAL numeracy teacher. The book provides many different ideas on how to engage students, particularly offering activities that can break up your lesson and rejuvenate the students, such as, the section on dice games.

The section on co-operative logic problems offers VCAL teachers two distinct advantages. The first being that the activities are co-operative in nature and thus builds upon the notion of teamwork and sharing ideas, that are cornerstone fundamentals of the VCAL mantra. Secondly, the activities are easily adaptable to VCAL students for a number of reasons. The tasks themselves increase in difficulty and therefore reflect the differentiation experienced inside the VCAL classroom.

As well, the topics lend themselves nicely to the VCAL outcomes. For example, the shape tasks map to the elements of the intermediate design outcome and the location problems map neatly with the intermediate location outcome. Once again, depending upon factors, such as, teacher assistance, student autonomy and difficulty of problem the activities can easily be mapped to design, location and problem solving outcomes at senior level.

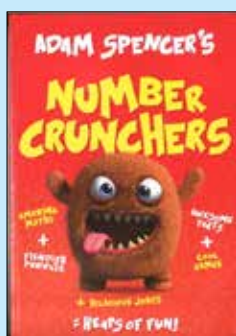
The activities would be best evidenced through photos or videos, or some activities have a student template.



Straight off the MAV press, we have *21 Games for Maths Games Days*. Einstein tells me that this book comprises 21 hands-on activities that can be easily used in a VCAL classroom. Tasks

are fairly short and are specifically made for two players. Rules are provided for each game and the rules are simply stated and clearly set out. These activities could be mapped to the senior problem solving outcome, particularly looking at the element that looks at oral language to discuss strategies around solving mathematical problems. These tasks could be evidenced through photos or student reflections of their personal strategies in tackling the problems.

Adam Spencer has long been a favorite mathematician of mine. His ability to find maths in the world around and then apply it in fun and engaging manners, makes for great reading. Any of Adam's books provides many ideas for the VCAL teacher to start a conversation and hook the students into a numeracy activity.



Adam's book *Number Crunchers* once again provides many facts, games and puzzles to engage the VCAL student. One problem from the book, looks at the fact that there is fifty

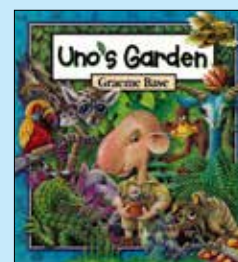
ways to give one dollar in change. This not only creates conversation but also provides the foundation students with a money and time outcome activity that explores all the different ways that this can happen. Students could experiment this using real coins (yes, the coins do come back!) and record their findings in a table. This could be evidenced by photos, student reflections or as a record of conversation.



The *24 Game* is a card based activity that requires the student to use computational and problem-solving skills. This series of 24 Games is particularly useful if you are running a VCAL class with students at the three VCAL levels. Tasks can be differentiated in a number of ways.

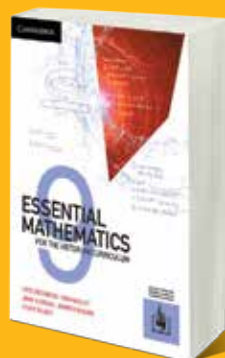
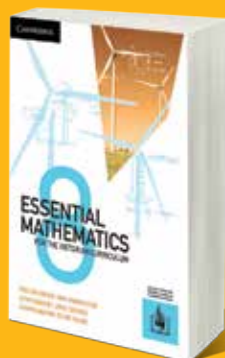
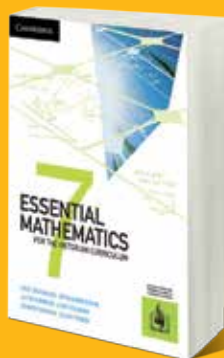
Firstly, the variety of cards can be presented in a graduated manner, whereby students can progress through single digits problems to double digit problems and then to fractions and decimals. Secondly, the cards are also marked with a dot system, signifying three levels of difficulty. One dot means that it is a simpler problem than the two dot and three dots being more difficult than two. Thirdly, the teacher can use a mixture of working groups, perhaps starting with groups of two or three as the students get the hang of the cards and then individually to reflect where the student is at on their personal learning journey. In this way, students can strategise together, for instance, looking at the multiples of 24. These cards could evidence elements of the numerical information outcome at the foundation, intermediate and senior levels and could also meet elements of the problem solving and formulae outcomes at a senior level. Records of student attempts, photos and videos could all be ways to record student evidence.

Graeme Base is one of world's leading picture book creators. Very few Australian children (and adults) would not have come across his amazing story-telling and artistry through much loved books like *Animalia*, *Enigma* and *The Eleventh Hour*.



Our current generation of VCAL students are very familiar with the Graeme Base and thus engagement can be fostered upon the student's

fondness and knowledge of the books. *Uno's Garden* engages the reader by looking at the delicate balance between population growth and its effect upon the environment.



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VCAL: BEING RESOURCEFUL (CONT.)

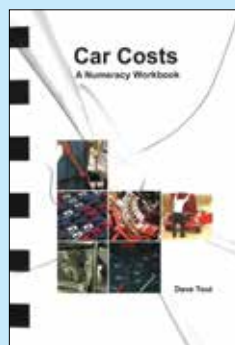


Buying a car is of interest to many VCAL students.

Throughout the story the author uses mathematical concepts, such as, squares, doubling and primes to explore concepts around environmental impact. In terms of VCAL outcomes, this book could be used in a variety of ways.

VCAL teachers could look to integrate some of the concepts across other VCAL strands like literacy and personal development. population growth, infrastructure and environmental effect are all big issues right now in Victoria so the comparisons to the book could certainly be investigated in an integrated approach.

Extending these issues for intermediate and senior students, by studying demographics in your local area would address many elements of the data and numerical information outcomes. These could be evidenced through print-outs of student presentations, peer assessments of presentations and records of participation in classroom activities.



One of the few books that comes already mapped to the VCAL outcomes is *Car Costs* by Dave Tout. Although primarily produced for intermediate and senior VCAL students, some tasks could be used for foundation students with a bit of extra assistance. The manual looks at many of the aspects that VCAL students are currently interested in. Choosing a car, paying for it and running costs are examples of some of the areas covered. This could be evidenced by submission of the manual and photos of activities, such as, measuring objects with fingernails and hand spans.

I would especially like to thank Helen Haralambous and Darinka Rob for their work in helping me get this article together.

Hopefully I have shed some light of VCAL resources that are available from MAV's online shop and some ideas about how they can be used in a VCAL classroom.

Good luck with your 2018 VCAL planning and remember that VCAL Numeracy teachers are doing an amazing job in providing young people with the mathematical skills that they will use in their future endeavors.

PD 2018



CHALLENGING TASKS

The potential of challenging mathematics tasks for engaging all students

This session will present examples of cumulative sequences of challenging mathematics experiences that are designed to engage students in building understanding about concepts, while making active decisions about and taking responsibility for their own learning.

Presenter: Peter Sullivan is an Emeritus Professor at Monash University. Peter has extensive experience in research and teaching in teacher education. He was an editor of the Journal of Mathematics Teacher Education for eight years, and is now the editor of the Mathematics Education Research Journal. He is a past President of AAMT and was the author of the Shape Paper and lead writer of the Australian Curriculum: Mathematics.

WHEN	Friday 23 February, 8.45am – 3pm
WHERE	Sunshine College, Sunshine
WHO	F - 9 teachers
FEE	\$200 (member) \$250 (non-member),
REGISTER	www.mav.vic.edu.au/pd

PROFICIENCIES

Incorporating the proficiencies

This workshop will explore a planning tool to help you embed the most up to date approaches to learning in your classroom. You will learn how to incorporate the proficiencies, provide multiple opportunities to revisit key ideas and strategies for targeted teaching. Inquiry-based approaches to the teaching and learning of mathematics will be explored, while ensuring an unrelenting focus on the big ideas that make a difference.

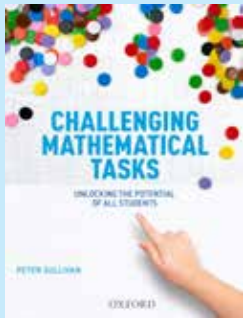
Presenter: Di Siemon is a Professor of Mathematics Education at RMIT University. Di is the Director of the Reframing Mathematical Futures project, working with secondary schools to develop an evidenced based teaching and learning framework for mathematical reasoning in the middle years. She is actively involved in the professional development of practicing teachers, particularly in relation to the development of the 'big ideas' in number, the teaching and learning of mathematics in the middle years, and the use of rich assessment tasks to inform teaching. Di is a past President of AAMT and a life member of MAV.

WHEN	Tuesday 15 May, 12.45pm – 4.30pm Repeat session: Tuesday 22 May, 12.45pm – 4.30pm
WHERE	Session 1: St Francis Xavier Montmorency Session 2: MacKellar Primary School, Delahey
WHO	F - 9 teachers
FEE	\$100 (member) \$120 (non-member),
REGISTER	Registrations will open in 2018

Dates are subject to change. Check www.mav.vic.edu.au for the most up-to-date schedule.

CHALLENGING MATHS TASKS: RESOURCE REVIEW

Lee-Ann Pyke - Mathematics consultant



Great news for those for whom Peter Sullivan and Pat Lilburn's *Open-Ended Maths Activities* (1997) has been a staple resource for many years - Peter Sullivan has done it again! Another

essential resource to support teachers in differentiating their maths teaching for all learners, while stimulating high level thinking and developing problem solving.

This new book is the result of collaborations with academic and teacher colleagues in diverse classrooms in Australia and overseas. The book builds on the ideas in *Open-Ended Maths Activities* and connects Peter's well-crafted questions with a model for teaching. This model includes launching the lesson, time for exploring the problem, reviewing the students' insights through class discussion and a teacher summary clarifying the key ideas.

Aligned to the Australian Curriculum, the book is organised by topic, with tasks exploring additive thinking, multiplicative thinking, fractions, decimals, measurement and geometry. The learning tasks are linked to the AC year level content descriptors assisting teachers with planning. Possible solutions to each learning task are included. Of course well-crafted questions will have several possible answers; fostering high level thinking and developing problem solving expertise while students acquire mathematical skills.

The tasks are intended to be challenging. They require concentration and effort over an extended time. With support and encouragement students develop the necessary persistence required for sustained thinking, decision making and risk taking. Enabling prompts and extending prompts are suggested to help teachers differentiate the lessons. Enabling prompts support students who cannot make progress with the initial task. The intention is for them to be able to restart and solve the original problem.

Extending prompts are provided for those who finish the task quickly and are aimed at expanding the student's thinking.

After the students have listened during discussion to successful strategies, supplementary tasks build on the initial task and support students' consolidation of the concept.

One particular authentic task that connects to student's real life experience is *Time Differences* (p124). The students are asked to find two ways to work out the difference between two times. Students are required to find their own strategies and to explain them. 'The hidden purpose (which you don't need to explain to students) is to illustrate the 'difference' form of subtraction.' Finding time difference is a useful real life skill.

Challenging Mathematical Tasks is available from MAV's online shop, <http://shop.mavvic.edu.au>.

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PUZZLES

Michael Nelson - Teaching and learning coordinator, Portarlington Primary School

LOWER PRIMARY



I went to the zoo and saw a small tree and a large tree with seven monkeys in them. How many monkeys did I see in the large tree?

Connect number names, numerals and quantities, including zero, initially up to ten and then beyond (VCMNA070)

Represent and solve simple addition and subtraction problems using a range of strategies including counting on, partitioning and rearranging parts (VCMNA089)



I saw a shape on a piece of paper. It had four sides, all of which were the same length. How many different ways can I name this shape?

Describe and draw two-dimensional shapes, with and without digital technologies (VCMMG120)

MIDDLE PRIMARY



I have three dogs of different ages. When I add the ages together I get 15. When I multiply the ages I get 45. What ages are my dogs?

Recall addition facts for single-digit numbers and related subtraction facts to develop increasingly efficient mental strategies for computation (VCMNA133)

Represent and solve problems involving multiplication using efficient mental and written strategies and appropriate digital technologies (VCMNA135)



Read what Mary and Michelle say about the green triangle.

Michelle: The green triangle represents $\frac{1}{3}$ of the pieces.

Mary: The green triangle represents $\frac{1}{6}$ of the hexagon.

Can you explain why each of them is right?

Model and represent unit fractions including $\frac{1}{2}, \frac{1}{4}, \frac{1}{3}, \frac{1}{5}$ and their multiples to a complete whole (VCMNA136)

UPPER PRIMARY



My backyard has a paved section. The landscaper does not charge by square meter, but rather than the number of tiles. He cuts every tile the same for a job. If my paved section is 24m x 15m, what is the size of the square paver that I need the landscaper to cut to have the least amount of tiles?

Identify and describe factors and multiples of whole numbers and use them to solve problems (VCMNA181)

Design algorithms involving branching and iteration to solve specific classes of mathematical problems (VCMNA221)

2	3	8	13	17
27	36	39	49	51
56	64	91	119	121
125	136	143		

How many different numbers with at least four members can you find in the number families box?

Identify and describe factors and multiples of whole numbers and use them to solve problems (VCMNA181)

Investigate and use the properties of odd and even numbers (VCMNA151)

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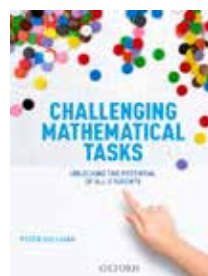
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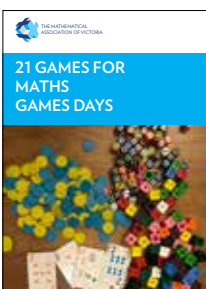


CHALLENGING MATHEMATICAL TASKS

K-6

Challenging Mathematical Tasks supports the idea that students learn best when they work on problems that they do not yet know how to solve. Peter Sullivan's research shows that many students do not fear challenges in mathematics, but welcome them. And rather than having teachers instruct them, these students prefer to work out solutions for themselves. This book includes activities that allow for sustained thinking, decision-making and risk-taking by the student. It features a learning focus, key mathematical language, pedagogical considerations, enabling and extending prompts for each task, plus supplementary tasks and possible solutions. The book follows a set structure to help students approach and work through the tasks.

\$69.63 (MEMBER)
\$87.04 (NON MEMBER)



21 GAMES FOR GAMES DAYS

5-10

The Mathematical Association of Victoria (MAV) Games Days are very popular and a great way of engaging students through competing with like-minded individuals. The MAV often gets enquiries from schools either wishing to run smaller scale games days at a local or school level or requesting games days resources.

MAV has compiled a selection of favourite maths games some used in games days. Whether for games days or for general classroom use, the games are a useful tool in engaging all students.

The resource has been designed with one game per page, so teachers can print the desired page as is. Each game has the same format, listing materials required, the rules and the aim of the game.

\$20 (MEMBER)
\$25 (NON MEMBER)



ASSESSMENT FOR TEACHING

F-
VCAL

Grounded in contemporary, evidence-based research, this book provides a comprehensive introduction to assessment and teaching in primary and secondary school settings. Taking a practical approach to assessment and the collaborative use of data in the classroom, this text advances a developmental model of assessment which aims to improve student outcomes through targeted teaching interventions. Thoroughly revised and updated to include the latest research, this edition features expanded content on collaborative teaching, competence assessment, learning and assessment and self-regulated teaching and learning.

\$74.66 (MEMBER)
\$93.32 (NON MEMBER)



A PLACE FOR ZERO

F-3

Having nothing to bring to the game of Addemup, Zero cannot play with the rest of the players in Digitaria and so must come up with a clever plan that will let him play despite his numeric shortcomings.

\$11.82 (MEMBER)
\$14.78 (NON MEMBER)