THE MATHEMATICAL ASSOCIATION OF VICTORIA

THE COMMON DENOMINATOR 2/18

MATHEMATICAL PROFICIENCY

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Professor Di Siemon, Director RMFII Project, RMIT University

MATHEMATICAL PROFICIENCY - YOU CAN'T HAVE ONE WITHOUT THE OTHERS

Data from our current project on mathematical reasoning, *Reframing Mathematical Futures II* (RMFII) confirm that many middle years' students are unable to apply what they know to solve unfamiliar problems and generate mathematical texts to explain their thinking even though these capacities are recognised and valued in the *Australian Curriculum: Mathematics*.

Perhaps this is not surprising when you consider how the mathematics to be taught and learnt is represented in commonly used resources at this level. That is, as a set of disconnected topics and skills to be demonstrated and practiced rather than explored, discussed and connected. As a result, the sheer magnitude of what is represented as the mathematics to be studied at any one year level is overwhelming (e.g., one Year 8 text I looked at was over 750 pages long).

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

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FROM THE PRESIDENT

Michaela Epstein

'Mathematical science shows what is. It is the language of unseen relations between things. But to use and apply that language, we must be able fully to appreciate, to feel, to seize the unseen, the unconscious.'
– Ada Lovelace

As the mathematician Ada Lovelace highlighted, mathematics is not simple. It is a complex set of relations, it can be intangible and its generalised and abstract nature means that possible applications of mathematics are not always evident.

Mathematicians the world over, like Lovelace and indeed also mathematics educators, have struggled with their craft. Part of knowing mathematics, means knowing that it won't come easily.

For students who are at school, this is no different. The subject they participate in for most – if not all – of their education, isn't one of being intrinsically 'good' or 'bad', or a subject that is 'for them' or 'not for them'. Every student can be successful in mathematics. And struggling with it is normal.

22 and 23 June marks one of those special opportunities on the calendar when different voices in mathematics education, those of teachers and researchers, will be coming together. Over two days, academics from the Mathematics Education Group at The University of Melbourne will join with the team from MAV to present a specially designed conference for primary teachers and primary school leaders.

The theme of the conference – Critical and Creative Thinking in the Mathematics Classroom – encompasses those skills that allow mathematics, of the kind Lovelace described, to come alive. Described in the Victorian Curriculum, critical and creative thinking are the skills that can be used for working with 'the familiar and unfamiliar, to break ineffective habits and build on successful ones, [and to] build a capacity to manage thinking'. Importantly, these skills facilitate the development of students as self-aware learners, with a capacity for reflection of the breadth of possibilities that mathematics can provide.

I'm thrilled that the primary conference is running for the second year now. A strong focus in MAV's work is in bringing educators from across the community together. That way, great ideas can be shared and students, the ultimate recipients, gain benefit. Whether or not you will be attending the event in June, keep an eye out for many other opportunities for students and educators alike throughout the year.

REFERENCES

Victorian Curriculum and Assessment Authority (n.d). Critical and Creative Thinking: Rationale and Aims. Accessed at: http://victoriancurriculum.vcaa.vic.edu.au/critical-and-creative-thinking/introduction/rationale-and-aims

MAV AGM

The 2018 AGM will be held on Tuesday 22 May, at the Faculty of Education, Monash University, Clayton campus. Arrive at 5.45pm for a 6pm welcome.

Following the AGM Dr Norm Do from Monash University will engage us with an interesting and fun mathematical presentation. This will be followed by drinks, nibbles and conversation with special guests of Monash University and the newly appointed Council.

All members are welcome and encouraged to attend. RSVP is essential, please email psaffin@mav.vic.edu.au by 14 May.

COUNCIL NOMINATIONS

Nominations for MAV's Council are open until 24 April 2018. The nomination form and information about roles and responsibilities of Council members can be found at www.mav.vic.edu.au. We welcome as many nominations as possible to ensure a diverse and engaged Council for the future.

TEACHERS CREATING IMPACT

CALL FOR OPTIONS NOW OPEN

At the heart of MAV's Annual Conference are teachers. Each year over 1400 mathematics educators including teachers, academics, policy makers, curriculum experts and resource developers come together to share their collective expertise, experiences and ideas.

This year the conference will focus on

- 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.

If you are interested in presenting at MAV18, and, for more information go to www.mav.vic.edu.au/conference.

EARLY BIRD REGISTRATION IS NOW AVAILABLE

MAV are again offering an early bird registration rate for both one day or two day registrations. To take advantage of the rate and benefit from priority session picks, register now.
www.mav.vic.edu.au/conference.

MAV18 KEYNOTE: DR ALAN FINKEL AO

MAV are proud to announce the first Keynote presenter for MAV18, Australia's Chief Scientist, Dr Alan Finkel.

Dr Finkel commenced as Australia's Chief Scientist on 25 January 2016. He is Australia's eighth Chief Scientist. Prior to becoming Chief Scientist, he was the eighth Chancellor of Monash University and the eighth President of the Australian Academy of Technology and Engineering (ATSE).

Since commencing as Chief Scientist, Dr Finkel has led the Review into the National Electricity Market ('Finkel Review') and the 2016 National Research Infrastructure Roadmap. He currently leads the STEM Industry Partnership Forum for the COAG Education Council and serves as the Deputy Chair of Innovation and Science Australia.

Dr Finkel has an extensive science background as an entrepreneur, engineer, neuroscientist and educator. He was awarded his PhD in electrical engineering from Monash University and worked as a postdoctoral research fellow in neuroscience at the Australian National University.

In 1983 he founded Axon Instruments, a California-based, ASX-listed company that made precision scientific instruments. After Axon was sold in 2004, Dr Finkel became a director of the acquiring company.

In 2006, he focused his career in Australia and undertook a wide range of activities including co-founding *Cosmos Magazine*. During his time at ATSE, he led the development and implementation of the STELR program for secondary school science.

Visit www.mav.vic.edu.au/conference for more information about presenting, buying an earlybird registration place and keep an eye on the website as keynote speakers are confirmed.

MATHEMATICAL PROFICIENCY

Professor Di Siemon - RMIT University

(CONT FROM PAGE 1.)

Number and Algebra	Understanding and fluency foregrounded (problem solving and mathematical resoning backgrounded)		
Measurement and Geometry	Problem solving and mathematical reasoning foregrounded (understanding and fluency backgrounded)	Understanding and fluency foregrounded (problem solving and mathematical resoning backgrounded)	
Statistics and Probability	Problem solving and mathematical reasoning foregrounded (understanding and fluency backgrounded)	Problem solving and mathematical reasoning foregrounded (understanding and fluency backgrounded)	Understanding and fluency foregrounded (problem solving and mathematical resoning backgrounded)
	Number and Algebra	**Measurement and Geometry**	**Statistics and Probability**

Content descriptors

Top-down approach to curriculum planning.

When this is considered in relation to the 7 to 8-year range in students' mathematics achievement at this level, it is easy to see why many teachers believe they 'do not have the time' to develop deep understanding, include problem solving or focus on mathematical reasoning.

Two issues need to be addressed if we are to succeed in reversing this trend. One is to address the root cause of the 7 to 8 year-range in student mathematics achievement by focusing on the big ideas in number that have been shown to make a difference in improving student learning. The other is to provide a curriculum planning framework that reassures teachers that they are 'covering the curriculum' while making time to develop all of the proficiencies and maintain an unrelenting focus on the big ideas that make a difference.

ADDRESSING THE BIG IDEAS

The big ideas are represented in the *Assessment for Common Misunderstandings* materials as trusting the count, place value, multiplicative thinking, partitioning, proportional reasoning, and generalising. Derived from the research literature and confirmed by the results of the *Scaffolding Numeracy in the Middle Years Project*, it is suggested that these are 'lines in the sand' to be achieved by key stages of schooling. That is, by the middle of Year 1 and thereafter by the end of Year 2, Year 4, Year 6, Year 8 and Year 10 respectively.

To make a difference, the big ideas need to be supported by **targeted teaching**. This is a form of differentiated teaching that responds to very specific evidence of student learning needs in relation to particular aspects of a big idea without which students' progress in mathematics will be severely impacted. Targeted teaching relies on quality formative assessment data and evidence-based advice to inform teaching. It is most effective where students work in mixed ability groups for the majority of their maths classes but participate in small groups on a weekly or fortnightly basis to focus on a specific aspect of a big idea.

A CURRICULUM PLANNING FRAMEWORK

Planning for the diverse range of learning needs while also trying to 'cover the curriculum' is one of the greatest challenges facing mathematics teachers. While there are a number of valuable planning models to support the use of rich tasks for this purpose (e.g., see Sullivan, 2011), teachers still have to decide which tasks, for what purpose, when.

Many years ago, I developed a top-down curriculum planning approach to help teachers incorporate mathematical problem solving into their programs and it has since been adapted to support the incorporation of the four proficiencies of the *Australian Mathematics Curriculum*. This approach uses a matrix that cross-references each strand of the mathematics curriculum with each other strand at a particular year level to create six cells. The content descriptors from a particular strand are listed in the cell that is cross-referenced with itself (e.g., Measurement and Geometry X Measurement and Geometry).

INCORPORATING THE PROFICIENCIES

MAV is presenting a workshop run by Di Siemon, *Incoporating the proficiencies.*

The 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.

12.45pm-4.30pm, Thursday 15 May, St Francis Xavier, Montmorency.

12.45pm-4.30pm, Thursday 22 May, Mackellar Primary School, Delahey (repeat session).

To book, visit www.mav.vic.edu.au/pd.

Four copies of the completed matrix are made, one for each school term. Teachers then work in planning teams to make decision about which content descriptors will be considered in each term with a view to maximising connections between content descriptors from different strands (e.g., place value or decimal fractions and metric measurement). Importantly, decisions are also made at this stage about which content descriptors need to be considered in more than one term (e.g., fractions in every term in Years 5 through 8). Once this is done, the planning team focuses on a particular term by considering the content descriptors from cross referenced cells (e.g., Number and Algebra X Statistics and Probability) on a mathematical, 'this goes with that' basis. The selected content descriptors are then listed in the cross-referenced cell to become the basis for an investigation, rich task and/or unit of work.

Tasks and activities still need to be chosen but the learning intentions are clearer. In self-referencing cells, conceptual understanding and procedural fluency are foregrounded to address key ideas and strategies.

Mathematical problem solving and reasoning are not ignored but they are backgrounded for the purposes of developing the necessary understanding and skills. In cross-referenced cells, mathematical problem solving and reasoning are foregrounded but provide opportunities to revisit underpinning ideas and skills in a range of different contexts. The content descriptors in these cells provide direction and focus to choose appropriate investigations and rich problem solving tasks.

The matrix organisation provides a flexible structure that allows teachers to spend time with the students who need it the most while ensuring other students are actively engaged in mixed ability groups on purposeful tasks. By providing plenty of opportunities to revisit and explore key ideas and strategies in different contexts, students are more likely to develop the knowledge and confidence they need to solve problems and explain their reasoning to others. By working in teams in a way that ensures they are 'covering the curriculum' teachers are more likely to adopt a broader range of practices and see problem solving and reasoning as an everyday practice, not a desirable 'add on'.

NOTES AND REFERENCES

See Assessment for Common Misunderstanding materials: www.education.vic.gov.au/school/teachers/teachingresources/discipline/maths/assessment/Pages/misunderstandings.aspx

See Scaffolding Numeracy in the Middle Years materials: www.education.vic.gov.au/school/teachers/teachingresources/discipline/maths/assessment/Pages/scaffoldnum.aspx

Siemon, D. (2017a). Targeting 'big ideas' in mathematics. Teacher Magazine, 27 February. www.teachermagazine.com.au/article/targeting-big-ideas-in-mathematics

Sullivan, P. (2011). *Teaching Mathematics: Using research-informed strategies*. Melbourne, ACER Press

CASIO®

Prime Schools PLUS Program

To become a Prime Schools PLUS school, it is as easy as following these 5 steps:

1. Head to: http://www.casio.edu.shriro.com.au
2. Click on the Prime Schools PLUS tab
3. Select ***"Join"***
4. Complete the form and provide a copy of your school's current book list or a letter signed by your Head of Mathematics (or equivalent), verifying that your school booklists one or more of the CASIO models listed overpage
5. We will do the rest!

CASIO®

INSPIRED BY AUSTRALIAN TEACHERS FOR AUSTRALIAN STUDENTS

MATHS SUMMER SCHOOL 2019

The National Mathematics Summer School was established under the joint educational sponsorship of the Australian National University and the Australian Association of Mathematics Teachers in 1969 by the late Professor A.L. (Larry) Blakers AM of the University of Western Australia. It is the oldest and most prestigious summer school of its type in Australia, and has been attended by over 3000 students from all states and territories around Australia.

NMSS is a two-week summer school for approximately 75 gifted mathematics students from around Australia. The program is run by the Australian National University (ANU) and the Australian Association of Mathematics Teachers (AAMT). 2019 marks the 51th Anniversary of the NMSS.

Who: Students in Years 11 - 12
When: 6- 19 January 2019

Where: Australian National University, Canberra
Cost: $1100

Applications close on 27 July 2018 and the 90-minute selection MAV Test for NMSS will be held on 3 August 2018 at the applicant's school.

Applications are now open.
Visit www.nmss.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 the thoughts and advice of 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

MAV is offering 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.mav.vic.edu.au. To join, pre-service teachers can contact MAV's Membership Officer, Michael Green: mgreen@mav.vic.edu.au

VCE MATHEMATICS

Helen Haralambous - Mathematics education consultant, MAV

As the year marches on, it is vital that all VCE teachers are well equipped to prepare their students for School Assessed Coursework, and for VCE assessment in general. MAV's VCE mathematics educational consultants highly recommend that all VCE teachers take the time to reacquaint themselves with VCAA's assessment requirements. This article captures some of the requirements and suggests links for further reading.

SACS

Preparing for School Assessed coursework (SACs) – comprises 34% of students final mark.

Ensure that both yourself and your students are fully aware of the VCAA assessment requirements.

Ensure your students are fully aware of the three outcomes for each study and that each outcome is assessed in each task.

Assessment

Further Mathematics

VCAA assessment advice requires an application task related to the Core Area of Study – Data Analysis and three modelling or problem-solving tasks, one of these to be related to the Core Area of Study Recursion and financial modelling and the other two related to the two selected modules.

› Application task (contributes 40% of the SAC mark)

The Application task is conducted in Unit 3 and is a guided investigation of a given data set with several variables. The task has three components of increasing complexity:

- the construction, description and interpretation of data plots, including smoothed plots where time series data is used
- the calculation and interpretation of summary statistics, including seasonal indices and their application where time series data is used
- the modelling of linear associations, or trends where time series data is used, including the use of data transformation as appropriate.

Time allocation: The application task is to be of 4–6 hours duration over a period of 1–2 weeks.

Marking allocation

Outcomes	Marks allocated
Outcome 1	10
Outcome 2	20
Outcome 3	10
Total task marks	40

› Modelling or problem-solving tasks (each contributes 20% of the SAC mark)

The Modelling or problem-solving task 1 is conducted in Unit 3 and relates to the Core - Recursion and financial modelling.

Time allocation: All modelling or problem-solving tasks are to be of 2–3 hours duration over a period of one week.

Marking allocation – Task 1: Core - Recursion and financial modelling.

Outcomes	Marks allocated
Outcome 1	5
Outcome 2	10
Outcome 3	5
Total task marks	20

The Modelling or problem-solving tasks 2 and 3 are conducted in Unit 4 and relate to the two selected modules studied

Marking allocation - Task 2 - 1st selected module and Task 3 - 2nd selected module

Outcomes	Marks allocated
Outcome 1	5
Outcome 2	10
Outcome 3	5
Total task marks	20

Mathematical Methods

VCAA assessment advice requires an application task and two modelling or problem-solving tasks, one of these to be related to Probability and Statistics Area of study.

› Application task (contributes 50% of the SAC mark)

The Application task is conducted in Unit 3 and comprises of a function and calculus-based mathematical investigation of a practical or theoretical context involving content from two or more areas of study, with the following three components of increasing complexity:

- introduction of the context through specific cases or examples
- consideration of general features of the context
- variation or further specification of assumption or conditions involved in the context to focus on a particular feature or aspect related to the context.

Time allocation: The application task is to be of 4–6 hours duration over a period of 1–2 weeks.

Marking allocation

Outcomes	Marks allocated
Outcome 1	15
Outcome 2	20
Outcome 3	15
Total task marks	50

› Modelling or problem-solving tasks (each contributes 25% of the SAC mark)

One of the modelling or problem-solving tasks is to be related to the Probability and statistics area of study.

Time allocation: The modelling or problem-solving tasks are to be of 2–3 hours duration over a period of one week.

Marking allocation - Task 1	
Outcomes	**Marks allocated**
Outcome 1	8
Outcome 2	10
Outcome 3	7
Total task marks	25

Marking allocation - Task 2	
Outcomes	**Marks allocated**
Outcome 1	7
Outcome 2	10
Outcome 3	8
Total task marks	25

Specialist Mathematics

VCAA assessment advice requires an application task and two modelling or problem-solving tasks, one of these to be related to Mechanics or Probability and Statistics Area of study.

› Application task (contributes 50% of the SAC mark)

The Application task is conducted in Unit 3 and comprises a mathematical investigation of a practical or theoretical context involving content from two or more areas of study, with the following three components of increasing complexity:

- introduction of the context through specific cases or examples
- consideration of general features of the context
- variation or further specification of assumption or conditions involved in the context to focus on a particular feature or aspect related to the context.

Time allocation: The application task is to be of 4–6 hours duration over a period of 1–2 weeks.

Outcomes	Marks allocated
Outcome 1	15
Outcome 2	20
Outcome 3	15
Total task marks	50

› Modelling or problem-solving tasks (each contributes 25% of the SAC mark)

One of the modelling or problem-solving tasks is to be related to the Mechanics or Probability and statistics area of study.

Marking allocation - Task 1	
Outcomes	**Marks allocated**
Outcome 1	8
Outcome 2	10
Outcome 3	7
Total task marks	25

Marking allocation - Task 2	
Outcomes	**Marks allocated**
Outcome 1	7
Outcome 2	10
Outcome 3	8
Total task marks	25

Open ended and non-routines aspects are to be incorporated in both application and problem solving or modelling tasks. The tasks should not be of an extended exam type nature. The open-ended nature of aspects of tasks should allow for multiple approaches or solutions within the one class. It is recommended that a suitable form of assessing a task of this nature is via an assessment rubric.

The VCAA website contains many resources to assist teachers in both planning and assessing the School Assessed coursework component of the study. This includes sample application task, problem solving/modelling task ideas and sample rubrics. Good references for ideas for creating your own such tasks include the daily papers, the ABS website or past Common Assessment Tasks (CATs). Another reference that has been made available can be accessed from the VCAA via the relevant study pages is the VCAA/ Cambridge School Assessed Coursework Resource (2000). With 2016 being the first year of the revised study design, following the VCAA audit of School Assessed coursework, reports for each study have been published and are available on the VCAA website. It is strongly recommended teachers read these.

RECOMMENDED READING

Further Mathematics

www.vcaa.vic.edu.au/Pages/vce/adviceforteachers/furthermaths/units_assessment_tasks.aspx

www.vcaa.vic.edu.au/Pages/vce/studies/mathematics/further/furthermathindex.aspx

Maths Methods

www.vcaa.vic.edu.au/Pages/vce/adviceforteachers/mathsmethods/units_assessment_tasks.aspx

www.vcaa.vic.edu.au/Pages/vce/studies/mathematics/cas/casindex.aspx

Specialist Mathematics

www.vcaa.vic.edu.au/Pages/vce/studies/mathematics/specialist/specialmathindex.aspx

MAV RESOURCES FOR VCE

MAV Solutions to the 2017 VCAA Exams

Each solution set features: fully worked solutions for all sections, advice on solution processes, including marking allocation and permission for the purchasing institution to reproduce copies for its students.

MAV Trial exams

MAV produces trial exams each year, each exam features: original questions, highly relevant to the current course, fully worked solutions for all sections and clear marking schemes. Exam formats are similar to those used by the VCAA. Permission for the purchasing institution to reproduce copies for its students.

Find both the 2017 solutions and 2018 tiral exams on MAV's online shop, http://shop.mav.vic.edu.au.

Student seminars

The MAV will again have a stand at the VCE Careers Expo and will offer seminars for students:

VCE Units 3 and 4 Further Maths: Exam preparation – held on Thursday 3 May and repeated Friday 4 May

VCE Units 3 and 4 Maths Methods: Exam preparation – held on Saturday 5 May and repeated Sunday 6 May.

VCE Student revision lectures

MAV will conduct revision lectures for VCE students in all three studies in both metropolitan and rural locations. These revision lectures take place in September and October. Keep an eye on the MAV's website, www.mav.vic.edu.au for details.

MATHEMATICS ACTIVE SCHOOL

Robyn Twyford - Leading teacher mathematics, Templestowe Park Primary School

Templestowe Park Primary school teachers and students being awarded their MAV Mathematics Active School accreditation by Peter Saffin, MAV CEO (back left)

At Templestowe Park Primary School we are committed to supporting the professional learning of our staff. Numeracy is a key focus of our School Strategic Plan/Annual Implementation Plan, with a focus on the development of mental strategies for students.

Recently, we had three staff members (Assistant Principal, Leading Teacher - Mathematics and Classroom Teacher) complete the Bastow: Leading Numeracy course. This course guided us as a whole staff to place a strong focus on the importance of the four proficiencies in our classroom programs. It also challenged us to pinpoint an area of need for our school, which we realised was the development of mental strategies within our students. After attending the Bastow course, our starting point was for the whole staff to work together to create a set of guiding principles that outline our beliefs and actions for all mathematics teaching and learning. They are as follows:

Because we believe:

- Students learn by exploring ... we provide concrete materials throughout our school.
- Assessment is ongoing ... we use student's knowledge to plan where we take them next and to give them feedback on the growth that has occurred.
- Every student has varied understandings in mathematics ...we differentiate activities to challenge and support each student.
- Our students should be curious, persistent and resilient ... we provide meaningful, real-world mathematical problems to solve which require them to think in different ways.
- In using correct and consistent mathematical language ... we explicitly teach it across year levels.
- Mental strategies underpin mathematical learning and everyday tasks ... we ensure students are taught and are given time to practise these skills as part of every maths session.
- Careful recording is essential ... we ensure all students are taught to set their work out accurately.
- It is important for students to explain how they reached their answer ... we provide multiple opportunities for discussion and reflection.
- Students are engaged when they can relate their learning to real-life experiences ...we ensure maths lessons make connections with their world.
- Students learn best when they know what they are aiming to achieve and the steps to get there ... we provide students with a clear learning intention and set of success criteria for every lesson.
- Maths is more than just 'sums' ... we expect students to explain their thinking to demonstrate their level of understanding.

Our next task was to carefully look at the strengths and weaknesses of our students' mental capacity and to critically look at our teaching in this area. Students who presented as 'good at maths' automatically manipulated numbers in their head. Our goal was to make it very clear, through explicit teaching to all, strategies of how to do this. Our Maths PALT team worked tirelessly to produce our TPPS Maths Mental Scope and Sequence document in line with the Victorian Curriculum. A 'parent friendly version' of this document is also available to parents.

The TPPS Maths Mental Scope and Sequence outlines the mental mathematics learning for each grade level. The skills listed are those we identify as being

important to be able to manipulate numbers mentally or 'in our head' quickly and efficiently. We know that these skills take time and practise to master. When students use mental computation efficiently, they have a true understanding of how numbers and mathematics work. Students will master these skills at different rates.

As we know, some students will grasp these concepts quickly whilst others will need more time and practise. Therefore, although we have outlined these skills in year levels, students will work at their point of need. Games are a great way of practising them in a fun context.

The 'Major Areas of Focus' is a summary of each skill, followed by a brief description of what each means. Concepts are built upon at each grade level. For instance, in Prep we work hard at learning 'Complements to 5'. This means knowing all the combinations of numbers that add together to equal 5 (eg. 5 + 0, 4 + 1, 2 + 3). In Year 1 we build on this to know all the combinations of numbers that add together to equal 10 (eg. 8 + 2, 5 + 5, 1 + 9). In other year levels, knowing doubles, then relating this to 'near doubles' is explicitly taught.

Strategies such as using the 'split strategy' for multiplying larger numbers, or the 'compensation strategy' when adding two numbers together, are also taught.

To support this document, we also created the 'TPPS Mental Maths Activities Resource'. This is a working document stored on Google Drive which we all add to. It includes the headings:

- Teaching focus
- Activity
- Equipment
- Level
- Grouping.

We have compiled a collection of quick, efficient practical activities that give students practice at mental computation in the first 5-10 minutes of each maths lesson. Each activity requires simple equipment such as dice, cards or even fingers.

Peer observations have allowed me to visit our maths classrooms in action and to witness students using the language of the strategies. They are growing in their ability to explain their thinking and as a staff, we are more focused on developing mental capabilities.

MAV's Mathematics Active Schools accreditation is open to any MAV member school who has a strong emphasis on developing maths learning and teaching.

To see the full criteria for a Mathematics Active School, visit www.mav.vic.edu.au/what-does-a-maths-active-school-look-like.html.

Maths Active accreditation is a terrific way to demonstrate excellence in maths teaching to your school community.

MAV PROFESSIONAL DEVELOPMENT

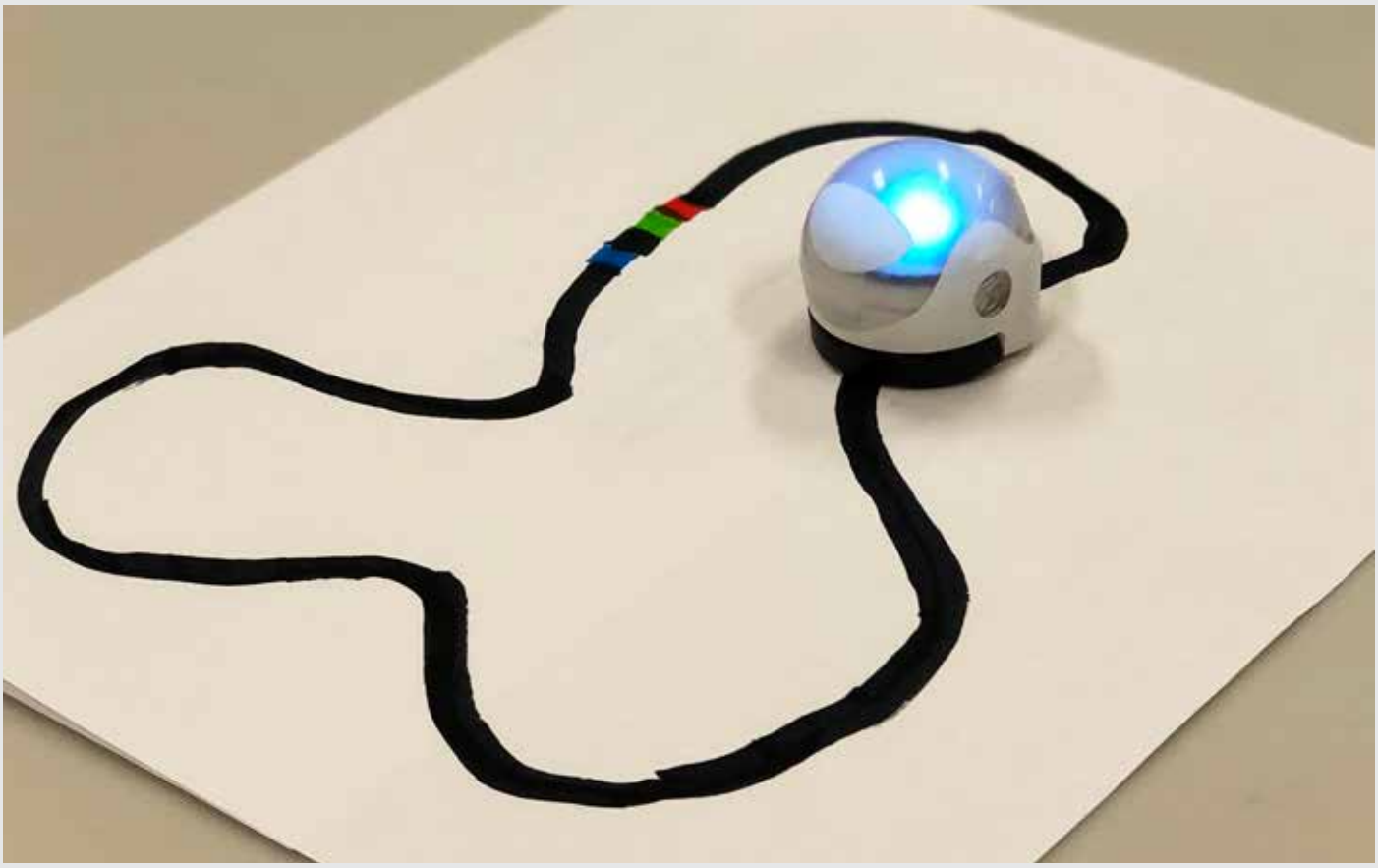
During Term 2 2018, a variety of presenters and MAV's own mathematics educational consultants will present workshops focussing on innovative teaching practice.
Make sure you reserve a place by booking online early, www.mav.vic.edu.au/pd.

TOPIC	DATE	YEARS	PRESENTER
Meet the assessors: Further Maths - Terang	26/4/18	VCE	Peter Jones
Meet the assessors: Maths Methods - Terang	26/4/18	VCE	Rod Watson
Let's get started! Using games to promote fluency and reasoning	3/5/18	F-6	Ellen Corovic and Jen Bowden
Incorporating the proficiencies	15/5/18	F-9	Di Siemon
Incorporating the proficiencies (repeat session)	22/5/18	F-9	Di Siemon
You can't learn when you're bored. A 'go to' locational/algorithmic thinking resource	29/5/18	F-6	Martin Holt
Maths games for Maths Games Days	30/5/18	7-10	Helen Haralambous
Strategies for differentiation in the mathematics classroom	5/6/18	5-9	Thomas Moore
Using picture story books to inspire mathematical thinking	7/6/18	K-4	Ellen Corovic and Jen Bowden
Teaching maths to students with special needs	TBC	F-10	Cath Pern

If you'd like tailored professional development, contact Jen Bowden, jbowden@mav.vic.edu.au.

CRITICAL AND CREATIVE THINKING

Dr Duncan Symons - Melbourne Graduate School of Education, University of Melbourne



Ozobot Evo

The Mathematics Association of Victoria and the Melbourne Graduate School of Education encourages teachers, school leaders, mathematics education consultants and others to attend our second annual primary mathematics conference in June.

The theme of the primary mathematics conference is embedding Critical and Creative thinking within mathematics. Within this greater theme, the conference will explore:

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

CODING AND CREATIVE THINKING

One example of a hands-on workshop for teachers is: Using codable robotic devices to embed learning to embed critical and creative thinking within primary mathematics, presented by Dr Max Stephens and Dr Duncan Symons.

This workshop will involve teachers' consideration of how coding and robotics can foster critical and creative thinking in primary mathematics classrooms. Teachers will explore how from the early primary years, child-friendly robotic devices such as BeeBot (below), Sphero and Ozobot (above) can be introduced to young students to develop systematic thinking to solve problems that are meaningful to them.

These codable digital systems allow students to design and test solutions to simple problems using a sequence of steps and decisions. These digital technologies fit readily with key content areas of the primary mathematics curriculum, including number, location, measurement and space, and connect directly with the capabilities of Critical and Creative Thinking in the Victorian Curriculum. Within the session, participants will engage in the following example activities:

1. Hide and seek with codable robots
2. Navigation of mazes by codable robots
3. Robot racing
4. Robot coding treasure hunt
5. Exploring the concept of 'randomness' with robots
6. Participants will 'debug' broken robot code
7. Designing a robot 'driverless' car

The session will be hands-on, interactive and will illustrate practical approaches to utilising robots in the primary classroom. A range of related resources to illustrate the key goals for mathematical thinking from Early childhood and Prep through to Year 6 with reference to the *Victorian Curriculum: Mathematics* will be presented.

THE MATHEMATICAL ASSOCIATION OF VICTORIA

MELBOURNE GRADUATE SCHOOL OF EDUCATION

PRIMARY CONFERENCE

Critical and creative thinking in the mathematics classroom

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.

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
- early childhood; 4 year old to Year 2 conference stream

Dates

Friday 22 June 2018 - for mathematics education leadership
Saturday 23 June 2018 - for primary school teachers

Venue

Melbourne Graduate School of Education, The University of Melbourne, 234 Queensberry Street, Carlton

Time

9am–4.30 pm (including networking drinks and nibbles).
Registration opens from 8.30am.

- Online booking only accepted
- Registration is not confirmed until payment is received
- Registrations will close when capacity is full, or on Friday 15 June, whichever comes first.

Special MAV membership offer

MAV Member (20% discount): $280 per day
Non member: $350 per day

To receive the member rate, you must first be a MAV member. If you are not a MAV member and wish to attend this conference, you can join the MAV with a 35% discount off a 'School membership' from only $148. Alternatively, as an individual member for 35% off - only $109.

Contact mgreen@mav.vic.edu.au to redeem this offer **prior** to completing your conference registration.

Numbers are strictly limited, so book quickly by visiting www.mav.vic.edu.au/conference/primaryconference2018 and select the day that you wish to attend.

For information about bookings email Jacqui Diamond: jdiamond@mav.vic.edu.au. For other enquiries, contact maths-ed@unimelb.edu.au.

www.mav.vic.edu.au/conference/primaryconference2018

Emerging SCIENCES VICTORIA (ESV)

An opportunity for Year 9 and 10 students to engage in specialised STEM-based studies and careers through virtual classrooms.

Facilitated by John Monash Science School (JMSS), Emerging Sciences Victoria (ESV) is a virtual interactive classroom, providing a unique opportunity for Year 9 and 10 students to study contemporary STEM subjects, regardless of their geographic location.

ESV classes run for one hour, twice a week, over 15-weeks and provide access to specialised subjects including Astrophysics, Nanotechnology, Neuroscience, Biotechnology and Earth Sciences, through web-based teaching and learning platforms.

To participate students require their own laptop, an internet connection and a headset (with microphone). Participation is arranged through a nominated liaison teacher on-staff at the students' school, and is open to all Victorian Year 9/10 students.

KEY INFORMATION

Semester Two
Begins Monday, 18 July 2018

Available Subjects

- Frontiers of Physics
- Nanotechnology
- Nature and Beauty of Mathematics
- Biotechnology
- Neuroscience
- Earth Science

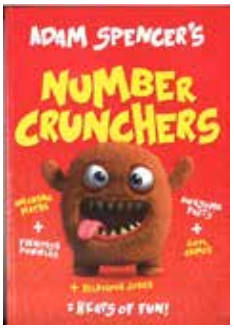
Cost
ESV fees are calculated based on school ICSEA scores, beginning at less than $5.00/student per lesson.

JOHN MONASH SCIENCE SCHOOL

FOR MORE INFORMATION AND TO REGISTER YOUR SCHOOL PLEASE VISIT
WWW.EMSCI.VIC.EDU.AU

REVIEW: NUMBER CRUNCHERS

Alicia Clark - Foundation teacher, St Mary's Whittlesea



Adam Spencer's Number Crunchers is a unique maths resource text with numerous applications for mathematics learning for children of all ages.

It is not a teacher resource book focusing on the theory behind mathematics, nor is it a picture story book aimed to act as a springboard for mathematical learning. Rather, it is an extensive collection of number facts, activities and problems providing teachers and students with numerous maths lessons and opportunities for learning. This text could be used with students from year levels F – 6 and possibly beyond. Some pages are designed for students to record their working on thinking on, and allows teachers to photocopy sections as needed as well.

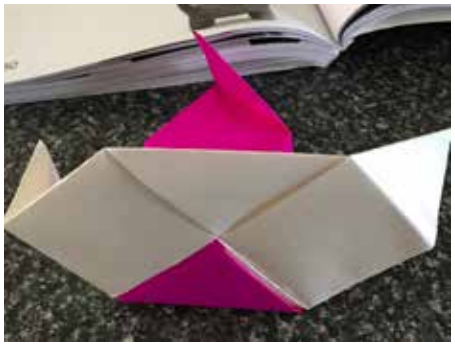
Number Crunchers contains a huge variety of activities, focusing on not just all areas of number but also touching on space and geometry. Here is a list of just some of the tasks and problems found in the text:

- tessellations
- number based jokes and riddles
- matchstick puzzles
- number based facts and problems about science, history and animals
- information, facts and questions about famous mathematicians
- spatial activities – polyhedron puzzles, transformation challenges
- tasks focusing on really big numbers – even up to one septendecillion!!
- use the grid to copy the image challenges
- problem solving tasks
- facts about the oldest living animals
- magic squares
- mazes and dot-to-dots
- challenges involving odds and ratios.

This review aims to show just a few examples of ways this text could be used in different maths settings, including whole class and small group classroom maths sessions, specialised settings such as maths extension groups and even at home with pre-school aged children.

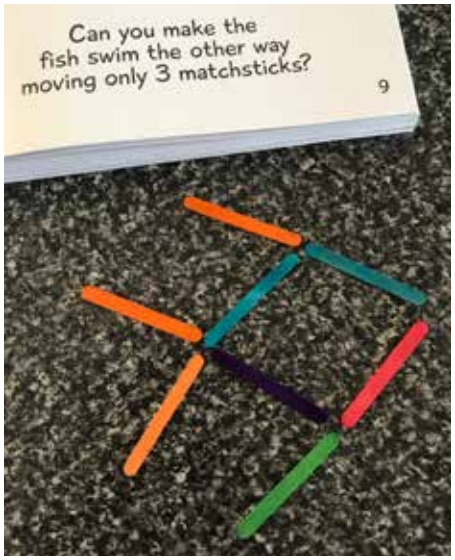
ORIGAMI SONOBE UNITS

Follow the instructions to create sonobe units! These are harder than they look, and will provide quite a challenge for middle and upper primary school children (and even some teachers!) Kinder squares are perfect for building these. Once you have created several sonobe units, they can be used to create 3D objects such as cubes and prisms. Building these objects challenges students spatial skills, and involves visualisation and transformations, areas that many students struggle with. Sonobe units provide a great hands on way to explore these areas, and once they are created sonobe units can be used over and over again!



MATCHSTICK PUZZLES

There are several of these matchstick puzzles throughout the book. I have used these in the past with middle and upper primary school students as well as with maths extension groups for Year 2 students. These provide a great spatial and visualisation challenge, and are also a great way to encourage students to work together as a team. Most of all, they are lots of fun!



SIMPLE PROBLEM SOLVING

Page 39 is a great problem to present to junior primary school children when doing addition. 'If I have two pineapples and a watermelon in one hand, and eight oranges in the other, what do I have?' Students can solve with concrete materials or by drawing before turning over the page to find the answer. (Which is 'really big hands!' This is sure to give the kids a laugh!)

DOT-TO-DOT

Number Crunchers really is for all ages. In the Foundation classroom, dot-to-dots are an excellent way to reinforce number sequences. Number Crunchers has several dot-to-dots, starting and finishing at different numbers.

AWESOMELY MATHSY PEOPLE

There are fact pages about famous mathematicians, like Einstein, Newton and Galileo. Exploring this would be a great way to kick-start a research project for older students, or for students in a maths extension group. They could do further research to find more information and present back to the class. This would be a great way to look at the history of mathematics and find some interesting mathematical facts along the way.

Adam Spencer's Number Crunchers is available from MAV's online shop, http://shop.mav.vic.edu.au.

MATHS FOR SUCCESS

Trish Jelbart - Education developer, Nicole Merlich - Mathematics support in TAFE, and Cathy Bushell - Mount St Joseph Girl's College

MOST STUDENTS NEED MATHS FOR SUCCESS AT TAFE AND UNIVERSITY

This article will discuss the 'hidden' maths required for many tertiary courses and detail the actual maths needed, which is often basic maths or particular aspects of the senior curriculum. Most students will require maths at some stage in their tertiary studies, but few students and teachers are aware of this when students make their subject choices in Years 9, 10 and 11, as maths is neither listed as a prerequisite nor assumed knowledge recommended for most courses. Some courses do have maths as a pre-requisite and these will be discussed as well.

In some cases, 50% of students are failing or withdrawing from some tertiary courses and units, because they cannot cope with the maths requirements. This leads to such disappointment when students, who have been so excited to obtain a place in the course, discover their lack of maths skills and knowledge stymies their progress.

A 'perfect storm' has evolved as Universities, TAFEs and RTOs are competing for students and often the maths required in the courses is not clearly stated, nor is maths listed as a pre-requisite. Many students then believe, or are told, they don't need maths to do Business, Science, a trade, Sports and Exercise Science, Nursing or Paramedics – however, the reality is quite different. Some elements of mathematics is certainly required for for almost all tertiary courses.

Often, students are in the midst of their tertiary course when they find there is actually significant maths involved in the course. And that's when the realisation sinks in - they should have continued with maths in Year 11 and 12. An additional problem is that many students actually 'switch off' with respect to maths in Years 9 and 10 if they assume that they don't need to continue with maths in later years.

WHAT HAPPENS IF A STUDENT FAILS AT UNIT AT UNI?

Sometimes, students can pass if they repeat the unit, but that comes at a great cost – both in terms of money and time. Repeating a unit costs quite a bit of money and it also may delay their studies by one year.

Many students drop out of their university course, simply because they can't cope with the maths components and don't have the confidence to seek the assistance provided by the University or TAFE.

MANY COURSES REQUIRE MATHS

Examples of courses that require maths

Here are some examples of courses that contain mathematics and most require maths proficiency both with and without a calculator:

- Vocational - Building, Carpentry, Electrical Engineering
- Nursing, Paramedics, Midwifery
- Sports and Exercise Science
- Education and Early Childhood Education
- Physical Sciences and Engineering
- Biological Sciences, Biomedical Science, Psychology
- Business
- Traineeship
- Pre-apprenticeship and Apprenticeships

Sometimes maths is required to gain entry to a vocational course in the form of a tests such as the following:

Attempt all calculations without using a calculator:

a. 56 + 78	i. $\frac{3}{4}\times 60$
b. 87 + 1032	j. 10% × 35
c. 2432 + 567	k. 60% × 200
d. 324 - 45	l. 75% × 400
e. 897 - 26	m. 72 ÷ 12
f. 1024 - 48	n. 39 ÷ 3
g. $\frac{1}{2}\times 27$	o. 560 ÷ 7
h. $\frac{2}{3}\times 75$	p. $\frac{300\times 30}{60}\times 60$

Jacob needs to administer medicine to a child in his care at the centre. He is due to give the medicine four hours after the last dose. If the last dose was at 9am, what time should Jacob give the medicine?

- 11am
- 12pm
- 1pm
- 12am

You have been asked by child care staff to monitor the fluid intake of a child. What is the total fluid intake if the individual consumes the following fluids throughout the day? Provide your answer in litres.

- 250ml of milk in a bowl of cereal
- 300ml drink of water
- 150ml of custard
- 150ml drink of orange juice

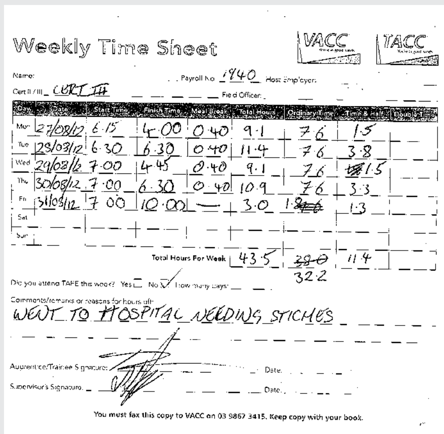
Total fluid intake (litres) = __________

Manufacturers instructions recommend this color product is mixed at a 1 : 2 mixing ratio.

The ratio is one part tint to two parts developer. A client looked at the color chart and has selected both color 5R and color 5RV. She has requested that her color be a mixture of both. That requires you to mix half of 5R and half of 5RV with the developer.

The total you need in the bowl is 150 grams. How much of each product will you need?

Apprentices will often need to complete time sheets such as the following:



Weekly Time Sheet

Name: Payroll No 1940 Host Employer:
Cert II / III CERT III Field Officer:

Day	Date	Start Time	Finish Time	Meal Break	Total Hours	Ordinary Time	Time & Half	Double Time
Mon	27/08/12	6.15	4.00	0.40	9.1	7.6	1.5	
Tue	28/08/12	6.30	6.30	0.40	11.4	7.6	3.8	
Wed	29/08/12	7.00	4.45	0.40	9.1	7.6	1.5	
Thu	30/08/12	7.00	6.30	0.40	10.9	7.6	3.3	
Fri	31/08/12	7.00	10.00	—	3.0	1.8	1.3	
Sat								
Sun								
				Total Hours For Week	43.5	~~38.0~~ 32.2	11.4	

Did you attend TAFE this week? Yes ☐ No ☑ How many days:

Comments/remarks or reasons for hours off: WENT TO HOSPITAL NEEDING STICHES

Apprentice/Trainee Signature: Date:
Supervisor's Signature: Date:

You must fax this copy to VACC on 03 9867 3415. Keep copy with your book.

MATHS KNOWLEDGE THAT IS ASSUMED IN TERTIARY COURSES

Vocational Courses (Certificates II, III or IV)

- Decimals
- Fractions
- Ratio and percentage
- Rates
- Measurement: units, area and volume
- Order of operations
- Estimation
- Times tables
- The ability to mentally calculate (maths is regularly needed without calculators, whilst driving or doing repetitive tasks or by hand calculations on the job.)

Electrical, Electronics, IT, Engineering, Plumbing Trade courses

- All maths skills listed above
- Trigonometry and Pythagoras
- Formula substitution and evaluation (Often involving Greek letters, subscripts and superscripts)
- Transposition of formulae

Here are examples of formulae used for electrical and engineering trades

$$y = \frac{Ml^2 l}{8EI} \qquad y = \frac{\lambda(x-d)}{d}$$

$$I = \frac{E-e}{R-r} \qquad A = \frac{3(F-f)}{L}$$

$$A = \frac{\pi R^2 \theta}{360} \qquad \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{2}$$

$$N = \sqrt{\frac{(a+x)}{y}} \qquad t = 2\pi\sqrt{\frac{l}{g}}$$

$$R = R_0(1+\alpha t) \qquad y = 4ab^2c^2$$

$$\frac{a^2}{x^2} + \frac{b}{y^2} = 1 \qquad Z = \sqrt{R^2 + (2\pi fL)^2}$$

Nursing, Paramedics and Midwifery

Require basic maths without and with calculators.

- Multiply and divide decimals by 10, 100 and 1000 to convert units: kg, g, mg, mcg, L, mL
- Add, subtract, multiply and divide decimals
- Using formulae
- Multiply and divide fractions
- Convert fractions to decimals
- Rates, ml/hour, mg/min, beats per min
- Rounding off and estimating
- Times tables

Paramedics need to do and demonstrate all division by long division (to comply with international conventions).

$$\text{Volume required} = \frac{\text{Strength required}}{\text{Stock strength}} \times \text{Volume of stock}$$

$$= \frac{0.24\text{mg}}{500\text{mcg}} \times 10\text{ml} \ (0.24\text{mg} = 240\text{mcg})$$

$$= \frac{240\text{mg}}{500\text{mcg}} \times 10\text{ml}$$

$$= \frac{24}{5\text{ml}}$$

$$= 4.8\text{ml}$$

Calculate the strength required for the following child:

Dosage: 0.02mg/kg, child weighs 12kg

Strength required:
= 0.02 x 12 mg = 0.24mg

Sports and Exercise Science

- Pythagoras and Trigonometry
- Simple vectors
- Force, rates, ratio and proportion
- Transposing formulae (simple)
- Statistics, fractions and decimals
- Using MS Excel

Education and Early Childhood Education

- Whole numbers
- Decimals and fractions
- Ratio, proportion and percentages
- Measurement, area and volume
- Space and shape
- Statistics and probability
- Pattern, order and algebra
- Geometry
- Time
- Times tables (without calculators)

Physical Sciences, Engineering and Building (degree)

Assumes knowledge of or mandates a pre-requisite of:

- Maths methods (Year 12)
- Physics (Year 12)
- and Specialist would also be an advantage

Mathematics and Surveying

Maths Methods (Year 12) and Specialist Maths are required.

Biological Sciences

Maths Methods are pre-requisites for some courses, but even if it is not listed as a pre-requsite, students need statistics, order of magnitude, transposing formulae measurement and rates.

Psychology

Statistics and probability are assumed knowledge.

Business and Law/Business

- Further Maths (Year 12) is a good preparation
- Statistics, probability, proportional reasoning, percentages, transposing formulae, algebra, functions and graphs are required.

IN SUMMARY

- Advise students to research the maths they need to ensure success in their chosen course.
- In general, advise students to continue with at least some mathematics in Year 11 and 12.
- Ensure students maintain basic non-calculator mats skills along with calculator skills.

Trish, Nicole and Cathy presented Success in Tertiary Education requires Mathematics at MAV's 2017 conference. To view the presentation, visit www.mav.vic.edu.au/conference-program/presentations.html.

Don't forget to register for MAV's 2018 conference.

VCAL: ON THE LEVEL

Jamie Gray - Peter Lalor Vocational College

VCAL Numeracy Skills Units addresses three levels – Foundation, Intermediate and Senior. Each different level offers students an opportunity to improve their skills and knowledge, respective to the student's entry point. In doing so, VCAL Numeracy allows the teacher to build a program, specific to the numeracy learning needs of the student. The focus of this article is to familiarise VCAL teachers with what type of hands-on activities can be offered at each of the different levels. Each of the levels will be explored through looking at a selection of elements that underpin the intentions of the learning outcomes.

Using a tape measure to find the length of wood for a toolbox project.

DESIGN

For the learning outcome of design, Foundation students must describe and compare shapes using the concepts of shape and size, however, it is at Intermediate where students have to name two dimensional and three dimensional shapes. Activities at Foundation could include setting up a Venn diagram to look at similarities and differences between two given shapes. At Intermediate, students can explore shapes through modelling, such as, simple origami constructions and using nets to make three dimensional shapes.

The constructions, videoing of the students working or photos of the constructions can all be used as evidence at VCAL quality assurance. At Senior, this can be further extended to make a polyhedron, such as a dodecahedron, and then using the language of shape to describe features of it. As well at Senior, a number of design concepts are investigated, such as, drawing and measuring angles, and applying ratio to scale drawings. This provides the opportunity for students to either draw or interpret building plans, use a compass and protractor to draw and measure the angles of everyday objects and explore the reduction or enlargement of diagrams.

MEASUREMENT

The learning outcome of measurement asks Foundation students to use a selected variety of measuring devices at a basic level. Foundation students are expected to use a number of instruments, in a correct manner, and make measurements to the nearest whole number. This could be students using a ruler to measure the dimensions of a textbook or using a thermometer to read off the temperature. At Intermediate, students are encouraged to use a range of familiar instruments, interpreting calibrations where necessary. As well, at Intermediate, students are required to measure, for example, the length of wood needed for a particular task, and then calculate the cost ($/m). This task is further extended at Senior level, with the students having to calculate areas and volumes and then working out the overall costs of the project. Activities around this could include calculating the area of a floor that needs carpeting, a wall that needs to be painted or the volume of cement required for a foundation. These tasks could be evidenced through pictures of the activity, student attendance at the activity and student calculations of the costs involved.

MONEY AND TIME

The money and time learning outcome is offered only at Foundation and Intermediate. At Foundation, students are required to make one-step money calculations. Making it relevant for the students is important and using current shopping catalogues and online buying sites adds that sense of real-life. These concepts are further extended at Intermediate, where the task may involve students having to work within a budget, while organising a school event. For Foundation students, being able to read and use time measuring devices, such as clocks, watches and calendars is critically important to their personal organisation. Once again, putting these devices into real-life scenarios enhances the learning experience. Tasks, such as, relating watches to daily routines, clocks to workplace routines and calendars to important dates all provide to the relevance of the activity. At Intermediate, students look at more complex concepts, such as, calculating elapsed time and converting between analogue and digital times. Students can incorporate these concepts into activities, such as, reading timetables, creating schedules and planning out times for an events day.

LOCATION

My favorite VCAL Numeracy learning outcome is location. Location provides so much scope for teachers to organise new experiences for the students and get the students out of the classroom and into the real world. Certainly life has changed quickly and the ways people locate themselves has evolved rapidly.

If you ask a standard teenager about Melways, you generally get a blank stare. Yet being able to read a field map and grid out an area are important skills in a lot of vocations and volunteer endeavors. Everyone still enjoys doing a grid activity, such as finding Wally!

At Foundation, students are required to locate themselves using basic instructions, such as left, right, forwards and backwards. For the Foundation students, I try and provide a graduated learning task, that has the students locate themselves around the school, then the local area, then a venue, such as a zoo (and we are lucky that Victoria has three great zoos) and then an open event, such as a tour of the local CBD.

In this way, students can build up their skills and confidence in travelling around. As well, staff can see which students need extra assistance, and then differentiate the activities to accommodate these particular requirements. At Intermediate, a lot of new concepts are explored including compass rose directions, scale indicators on maps and estimating times and distances between locations. Once again, I choose a graduated approach, however, at Intermediate I provide the students greater control over the task and that respects the VCAL mantra of providing the students with a greater amount of autonomy as they progress through the VCAL structure. At Senior, once again, the concepts are more complex and we see the inclusion of bearings, speeds and rates. I think a great activity here is that the students plan (not necessarily carry out) an 'Around Australia' activity, as teachers can incorporate a lot of the elements into the task and it provides a size of scope that is expected of a senior student.

DATA

The use of information is prevalent in today's society and students are greatly exposed to information streams through their social media platforms. The data learning outcome aims to equip the student with skills to interpret the meaning of data in terms of personal implications, social implications and make comment upon their validity and accuracy. At Foundation, students identify the key features, conventions and symbols of everyday graphs and tables.

Therefore, finding current graphs and tables in newspapers and online information services, provide a contemporary context to the work being studied. At Intermediate students are expected to collect their own data, through a survey or the like, and represent the data in an appropriate graph and then make comment upon it. Another good resource in this regard is the VCAL units, produced by the Victorian Responsible Gambling Foundation, which helps students develop healthy and informed attitudes to gambling. The resources are deliberately written against the VCAL levels and allow the students to self-differentiate on their learning by selecting a work task, after an introductory activity. At Senior, measures of central tendency are introduced and students are asked to calculate the mean, median and mode for sets of ungrouped data. Being an avid sports fan, I use sporting data to explore these concepts.

FORMULAE AND PROBLEM SOLVING

At Senior, two learning outcomes are included that do not appear at Foundation or Intermediate levels – they are formulae and problem solving. The elements of the formulae learning outcome introduces the student to basic algebraic concepts. Students are asked to solve simple equations using a variety of informal techniques, translate simple worded problems into simple equations and substitute appropriately into developed formulae. Teachers are encouraged to look for formulae that students may have already experienced, such as those around area, volume, temperature conversions or calculating interest. Problem solving has been recognised as one of the employability skills needed by the current workforce. Therefore, learning strategies and techniques around problem solving is definitely advantageous to the young worker looking for employment. The learning outcome of problem solving offers a wide scope for teachers and students to investigate a variety of problems. Mazes, tower building activities, Rubik cubes, online challenges and puzzles are examples of problem solving activities you may choose to offer.

Measuring the resistance of a circuit in an electronic control unit.

NUMERICAL INFORMATION

At the Foundation level the learning outcome of numerical information focuses upon using whole numbers and fractions in everyday situations. Teachers I speak to, often present this outcome in an integrated manner as a lot of the concepts are intrinsically embedded in tasks, encountered in other learning outcomes, or can be deliberately added. At Intermediate, use of decimals is introduced and students are asked to convert between common fractions, percentages and decimals. I find that visual aids, such as show cards or specialist dominoes, are often of assistance here, as students do have difficulty around these conversions.

Note that all of the above is current for 2018 and may be outdated in 2019 if the new VCAL Numeracy Units are accredited, during 2018. I hope that this overview provides you with some new ideas, about presenting VCAL Numeracy.

Do you teach VCAL?

MAV is keen to receive article submissions from VCAL teachers. If you have an interesting story to share, email it to Darinka Rob, drob@mav.vic.edu.au.

THE ART OF CLEAN UP:
RESOURCE REVIEW

Dr Sharyn Livy - Lecturer, Monash University, and Johnson Alagappan - Year 2 teacher, Gilson College

As teachers of mathematics, we are always keen to find a new picture story book that will engage students by making mathematical connections. But how might we engage students with only pictures and no words?

Recently we taught a lesson, using the picture book, *The Art of Clean Up* by Ursus Wehrilli.

Before looking at the book, the Year 1 children at Gilson College did not believe that the book had no words. 'That's because it is a picture book,' Sharyn said.

Together we explored the pictures including before and after photographs. In the book, Wehrili (2013) has taken a photograph, then a second photograph where everything from the first photograph has been rearranged. Imagine your fruit salad sorted into a picture graph showing 15 slices of apples to 12 slices of bananas (Figure 1).

When looking at the photographs with the children we asked them to describe what was different about each photograph. After reading the story Sharyn posed a challenge to the students: 'Now it's your turn to tidy up!'

Johnson (the classroom teacher) and Sharyn tipped out tubs of stuff they had prepared before the lesson and let the children tidy up. They didn't need our help as they worked together, engaged in the art of clean up. If only their parents knew! Many tidied up by colour, others sorted by size, or other attributes such as rough and smooth.

In Figure 2, can you work out how Bobby and Mia chose to tidy up the alphabet letters?

Bobby, told us that he tidied the letters first by colour. When describing their solution shown in Figure 2 Bobby and Mia described their sorting of letters,

'By circley, ones that go like round, ones like an x and ones with straight lines.'

Before long everything in the classroom was getting tidied up including the pencils and rulers (Figure 3).

We both really liked this lesson because it made connections to reasoning and problem solving. The children had to justify their groupings and consider how many different ways they could tidy up.

This lesson and the use of picture story books can promote a child-centred approach to learning, providing many opportunities to highlight the relevance of mathematics with quality conversations about mathematical concepts. We hope you will consider sharing stories with students as part of your mathematics lessons throughout the year.

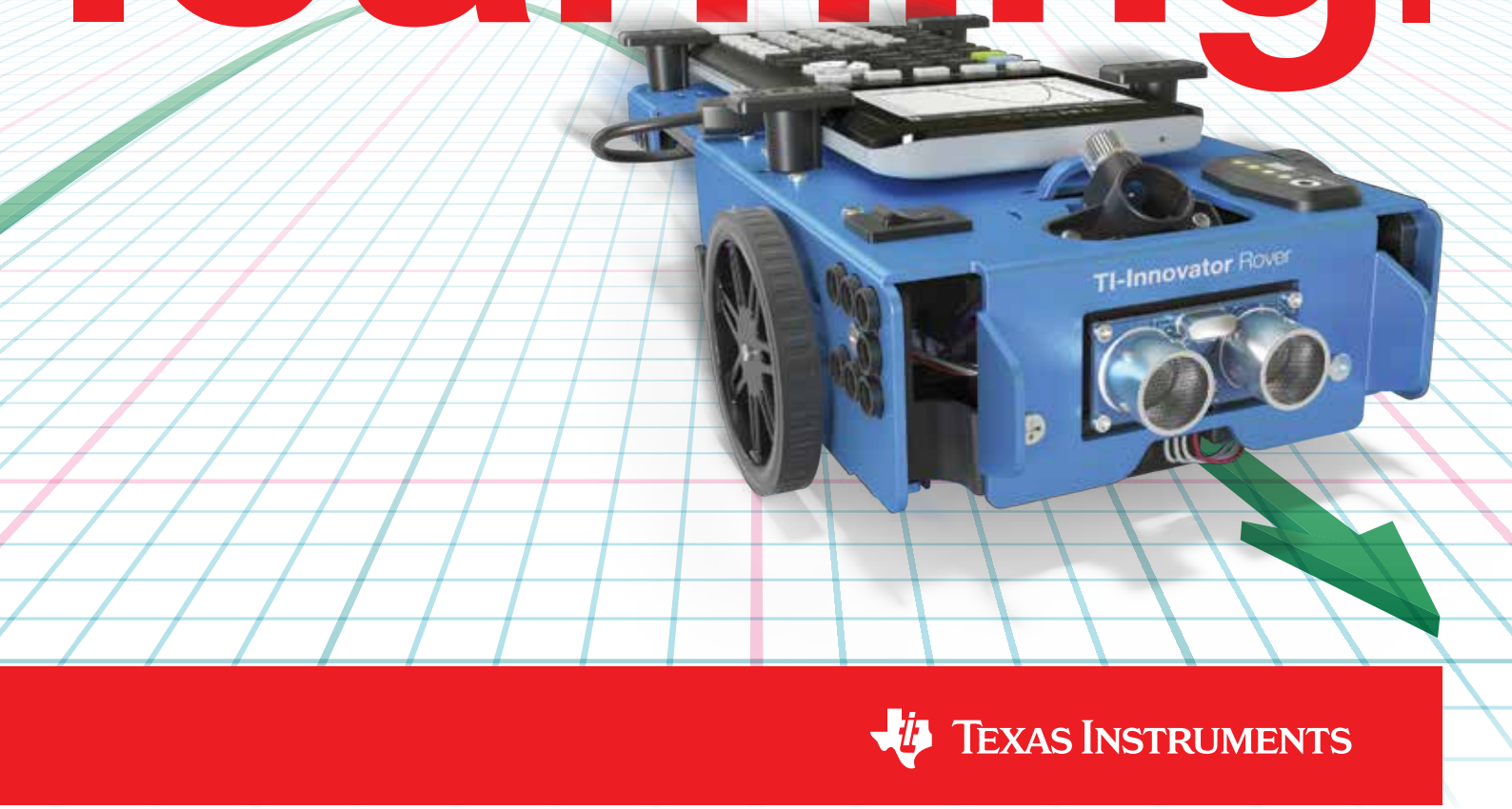
Figure 1: Sharyn sharing the book with Year 1 students, fruit salad clean up

Figure 2.

Figure 3.

The Art of Clean Up is available from the MAVshop. For more engaging lesson ideas, check out *Engaging with Mathematics Through Picture Books* which is also available from MAV's online shop, http://shop.mav.vic.edu.au.

When the wheels are turning, the students are learning.



TEXAS INSTRUMENTS

Introducing

TI-Innovator™ Rover

Put maths in motion

Learning becomes a moving experience as students program Rover to explore the maths concepts you teach.

Your ride's here. Roll with Rover, the robotic vehicle that works with TI graphing calculators and the TI-Innovator™ microcontroller.*

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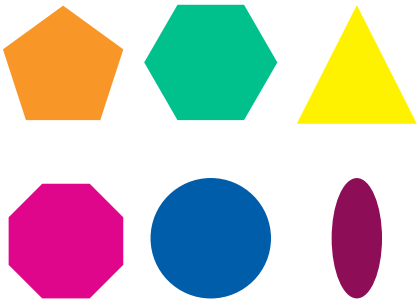
*TI-Innovator™ Rover requires a TI-Innovator™ Hub with TI LaunchPad™ Board and a TI-Nspire™ CX handheld or TI-84 Plus CE graphing calculator. Components are sold separately.

PUZZLES

Michael Nelson - Teaching and learning coordinator, Portarlington Primary School

LOWER PRIMARY



I was asked to measure the area of my table, but I don't have anything that is square or rectangular. What other shapes can I use to measure? When you have found them, what do they all have in common?

Compare and order several shapes and objects based on length, area, volume and capacity using appropriate uniform informal units (VCMMG115)

MIDDLE PRIMARY

57

39

I was asked to show how I could add 57 and 39 without using addition. How could I do this?

Recognise and explain the connection between addition and subtraction (VCMNA132)

UPPER PRIMARY

367 x

x x 28

x x

Can you solve 367 x 28 without multiplying 367 by tens?

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

Solve problems involving multiplication of large numbers by one or two-digit numbers using efficient mental, written strategies and appropriate digital technologies (VCMNA183)

I picked up a box that had three coins, none of which were the same. I can't see them and I can't feel them. How can I work out what coins are in the box?

Recognise, describe and order Australian coins according to their value (VCMNA092)

Measure and compare the lengths, masses and capacities of pairs of objects using uniform informal units (VCMMG095)

If you had this clock, how many more hours per week would you have?

Use am and pm notation and solve simple time problems (VCMMG168)

I am building a house. I have a bathroom that is 4m x 3m and was given 12 tiles to cover it. In my second bathroom, it is 6m x 2m but I was still given 12 tiles to cover it. How can this be possible if no tiles are left over?

Solve problems involving the comparison of lengths and areas using appropriate units (VCMMG224)

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MAV SACS SUGGESTED STARTING POINTS

VCE

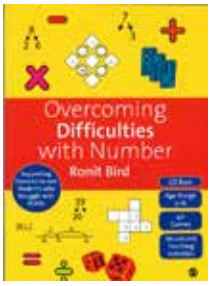
The MAV 2018 VCE Mathematics SACS materials are designed to provide suggested starting points for VCE Mathematics teachers for their School Assessed Coursework (SAC).

MAV SACS 2018 materials have been written by experienced VCE mathematics teachers. They are for use by teachers to aid in assessment of student School Assessed Coursework for Further, Methods and Specialist Mathematics.

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

INDIVIDUAL STUDY — $144.50 (MEMBER) $180.63 (NON MEMBER)

ALL STUDIES — $51.60 (MEMBER) $64.50 (NON MEMBER)



OVERCOMING DIFFICULTIES WITH NUMBER: SUPPORTING DYSCALCULIA AND STUDENTS WHO STRUGGLE WITH MATHS (WITH CD-ROM)

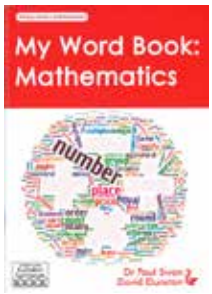
5–VCAL

Ronit Bird has drawn on her teaching and training experience to create teaching plans for key numeracy topics. She provides detailed strategies for teaching numeracy skills through a progression of practical activities and visualisation techniques which build the self-esteem of students who need extra help and give them a basic foundation in number. While the plans cover the National Numeracy Strategy, they can also be used in any setting where maths is being taught.

Topics covered include games and puzzles for learning number components, bridging, multiplication, division and reasoning strategies

This is an ideal resource for both class teachers and maths subject teachers, , and is equally useful for teaching assistants and learning support assistants

$58.30 (MEMBER) $72.88 (NON MEMBER)



MY WORD BOOK: MATHEMATICS

F–7

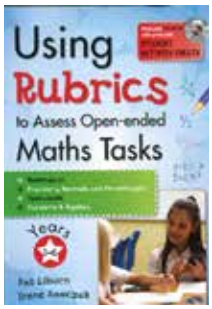
A book of lists, featuring:

- Lists for all of the Curriculum substrands, organised by year level.
- A focus on words students should know to be able to complete questions.
- Lists of essential vocabulary that has already appeared in NAPLAN (2010-17).

Guidance on:

- Word building (e.g. roots, suffixes).
- Troublesome 'sounds-alike' words (homonyms) and context.
- Words (and symbols) with specific mathematical meanings.

$12.87 (MEMBER) $16.09 (NON MEMBER)



USING RUBRICS TO ASSESS OPEN-ENDED MATHS TASKS

1–6

This book provides teachers with 36 open-ended number tasks and rubrics for numeration, fractions, decimals and percentages as well as operations, patterns and algebra. This resource provides maths teachers with a wide range of material to support assessment and learning.

With user-friendly rubrics and student work samples taken directly from the classroom, this book will help you gain a better understanding of your students and allow you to develop more relevant programs and activities to help them achieve their best.

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PENTOMINO PACK

1–VCAL

Teach number, transformation, symmetry, logic, maths terminology, area, perimeter and even spelling with this incredibly versatile pack. A set of 12 transparent pentominoes crafted to fit over two double-sided write-on-wipe-off game boards. Build skills and confidence with a range of engaging games, puzzles and activities.

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