THE MATHEMATICAL ASSOCIATION OF VICTORIA

THE COMMON DENOMINATOR 3/23

SPATIAL REASONING

INSIDE

Tracy Logan – University of Canberra

TEACHING AND LEARNING SPATIAL REASONING IN THE EARLY PRIMARY YEARS

At the Science, Technology, Engineering, and Mathematics (STEM) Education Research Centre (SERC) at the University of Canberra, our team are developing, with funding from the Federal Department of Education, a STEM program for Foundation to Year 2.

Following on from the Early Learning STEM Australia (ELSA) preschool program, also developed by SERC, the ELSA F–2 program aims to enhance STEM learning in the first three years of primary school. At the heart of the ELSA F–2 program is spatial reasoning.

Continued on page 4

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

Magazine 288, July 2023

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

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

President: Kerryn Sandford
CEO: Jennifer Bowden

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

Print Post Approved Publication No: PP100002988

Stay connected

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

FROM THE PRESIDENT

Kerryn Sandford

Change. This one word encapsulates the main challenge being faced by every one of us right now. There has been so much change in education over the past few years and it doesn't appear to be slowing anytime soon. As teachers, we have new curricula and new technologies to get our heads around, at the same time as we work to support our students and our colleagues to navigate the shifting sands around us. Leaders have new industrial agreements and changes in so many areas of the work of schools. Some of these changes, such as new technologies like ChatGPT and other AI based programs, offer exciting possibilities, albeit with a side of doubt, whilst others such as economic uncertainty and instability seem to offer little that is positive, but have huge impacts on the classroom.

Engagement is a term that has taken on a whole new meaning in many classrooms as pedagogies and content are being developed to capture the interests of this new, post COVID generation of learners.

At MAV, we are aware of the need to support teachers and students to navigate this world of change and develop new ways to teach and to learn the mathematics that, despite all the change and disruption, is still just as essential as it always was and, some would argue, more so. Our new community online platform has been developed to ensure that no matter where you teach, you can always have others to reach out to – to share and leverage ideas, and to seek support and guidance from others experiencing something similar, or just to problem solve your way through a new and novel issue that has arisen. I encourage you to investigate the platform, www.mav.vic.edu.au/membership/community.

There is a potential change on the horizon that has been a long time coming. With an impending referendum on recognising Australia's First Peoples in the constitution and establishing an Aboriginal and Torres Strait Islander Voice to parliament, there is growing interest and need to give some serious thought to how we incorporate First Nations perspectives in our teaching and learning programs. Whilst curricular are now including this, there is still a long way to go.

As we get closer to this referendum, the voices of both sides of the debate will grow louder and more insistent. We need to be aware of the potential impact that these voices will have on both our Aboriginal and non-Aboriginal students and to help them to navigate this debate and the change through curiosity – not through prejudice and stereotypes.

Mathematics educators can help our students to understand this by finding and making explicit the mathematics of First Nations history and knowledge systems. From learning probability and statistics through investigations of traditional sporting games, to developing number sense through teaching students Aboriginal and Torres Strait counting systems, from consideration of the engineering involved in the Budj Bim aquaculture structures of the Gunditjmara People of Victoria to the algebraic patterns and relationships found in the moiety systems of kinship found in many First Nations cultures, we have countless opportunities to highlight the history and knowledge of this oldest of human cultures and the first inhabitants of this land.

There are a growing array of resources and supports for teachers wanting to incorporate ATSI perspectives into the classroom. Even those with limited knowledge themselves, can learn alongside their students and walk with them on the journey. To support in this work, there are organisations such as MAV partner ATSIMA, as well as VAEAi who are leaders in this space and provide a wealth of knowledge and support.

At the All State Principal's Conference, Aunty Geraldine Atkinson spoke to delegates about the history of VAEAi and their work in supporting learning for all students of our national history and the positive contributions that Aboriginal and Torres Strait Islander peoples make to this nation. The Department of Education have also included ATSI themed activities in their Middle Years Maths Challenges.

There is a lot to learn and a lot to do. Through clear and consistent education, perhaps we can help to provide safe places for our young people to explore the details of this important and historic moment in time.

UPCOMING MAV EVENTS

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

EVENT	DATE	YEARS	PRESENTERS
Matrices in General Mathematics Units 3 and 4	24/7/23 Virtual	VCE	Fiona Latrobe
Footy Feud! A maths game masquerading as a footy game	25/7/23 Virtual	F–10	Andrew Williams
Empowering minds, crushing anxiety: PlayLunch games, Town Squared	31/7/23 Virtual	2–6	Sarah Mercer and Jen Bowden
Chat GPT in the mathematics classroom - Beginner's guide	2/8/23 Virtual	9–VCE	David Leigh-Lancaster and Antje Leigh-Lancaster
Familarisation of the Victorian Curriculum 2.0 F - 6	8/8/23 Virtual	F–6	Jen Bowden and Di Liddell
Familarisation of the Victorian Curriculum 2.0 7 - 10	15/8/23 Virtual	7–10	Danijela Draskovic and Helen Haralambous
Chat GPT in the mathematics classroom	16/8/23 Virtual	9–VCE	David Leigh-Lancaster and Antje Leigh-Lancaster
Casio ClassPad CAS - Beginner's guide to best use	22/8/23 Virtual	VCE	Kevin McMenamin
Culturally responsive mathematics education: teaching maths through Aboriginal and Torres Strait Islander histories and cultures	30/8/23 Virtual	F–10	Caty Morris

NEW BOARD MEMBERS

David Leigh-Lancaster and Dr Aylie Davidson and have joined the MAV as board directors.

Aylie's aspiration is to ensure that every child has access to a quality education and that irrespective of background, knows they can learn and succeed. She is motivated to enhance student engagement, teach for social justice and conceptual understanding. Her career spans 16 years and teaching and leadership roles in metropolitan and regional primary school settings. She has worked as a Leading Teacher (Mathematics), Numeracy Intervention Specialist, Mathematics Coach, Research Fellow and Project Manager.

In 2020, Aylie oversaw large scale reform projects in mathematics working at the Department of Education. In 2022, she stepped back into the Academy where she works as a lecturer and researcher in primary mathematics education at Deakin University.

David is an Education Consultant and partner of Leigh-Lancaster Consulting. He was the VCAA Mathematics Manager 1998 - 2021, and prior to that, taught Year 7-12 mathematics for 20 years, including half of these as a mathematics head of department.

David's career has involved leadership in mathematics education, connecting policy, research and practice, with stakeholders and other interested parties in academia, business, government, professional associations, schools, and the broader community. He has extensive experience and expertise in policy, school mathematics curriculum, assessment and pedagogy, professional learning, mathematics education research, resource development and the use of computational technology. David has long-standing interests in the nature of mathematical inquiry, connections between mathematics and mathematics education, and has worked on Victorian, national and international curriculum development projects.

Other MAV board members include:

- Kerryn Sandford, Heathmont College
- Kate Copping, The University of Melbourne
- Max Stephens, The University of Melbourne
- Patty Mete, Haileybury College
- Ann Downton, Monash University
- Justin De Lacy, Woodleigh School
- Andrea O'Connor, Catholic Education Sandhurst
- Mei Ong, Senior Finance Professional
- Ellen Richardson, South Yarra Primary School
- Louise Gray, Stephanie Alexander Kitchen Garden Foundation
- Adrienne English, Melbourne Grammar School - Grimwade House

The MAV board thanks Dan Cloney and Michael O'Connor who both served six years as directors.

SPATIAL REASONING

Tracy Logan – University of Canberra

CONT. FROM PAGE 1.

WHAT IS SPATIAL REASONING?

Although spatial reasoning is a complex phenomenon to define, it comprises skills such as 'locating, orientating, rotating, decomposing, recomposing, navigating, patterning, scaling, and recognising symmetry' (Woolcott et al., 2020, p. 246), with all these actions taking place in one's minds-eye (i.e., mentally). As examples, we can examine three spatial items from the 2016, Year 3, NAPLAN Numeracy assessment (ACARA, n.d).

Figure 1 requires the problem solver to imagine or visualise how two shapes could fit together to make a different shape. In this example, you could visualise how the triangle rotates so that the long edge fits against the side of the square.

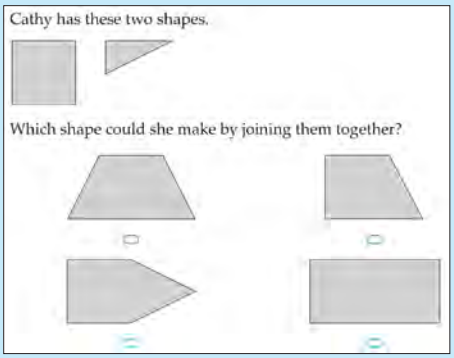


Figure 1. An example of fitting shapes together. (© ACARA, 2016)

Figure 2 requires the problem solver to mentally fold a 2D net into a 3D object. You must visualise how the faces of the net will fold to form one of the objects.

Figure 3 asks the problem solver to find the pattern by rotating the image. You must deduce from the pattern the direction of the rotation (clockwise) and the amount of rotation (90 degrees) to find the missing tile.

Each of these examples require a specific type of spatial skill to be undertaken on the provided visual images.

WHY IS TEACHING SPATIAL REASONING IMPORTANT?

Verdine et al. (2017) suggest that people with high spatial reasoning are more likely to go into STEM professions and those with lower spatial reasoning into professions such as education or law.

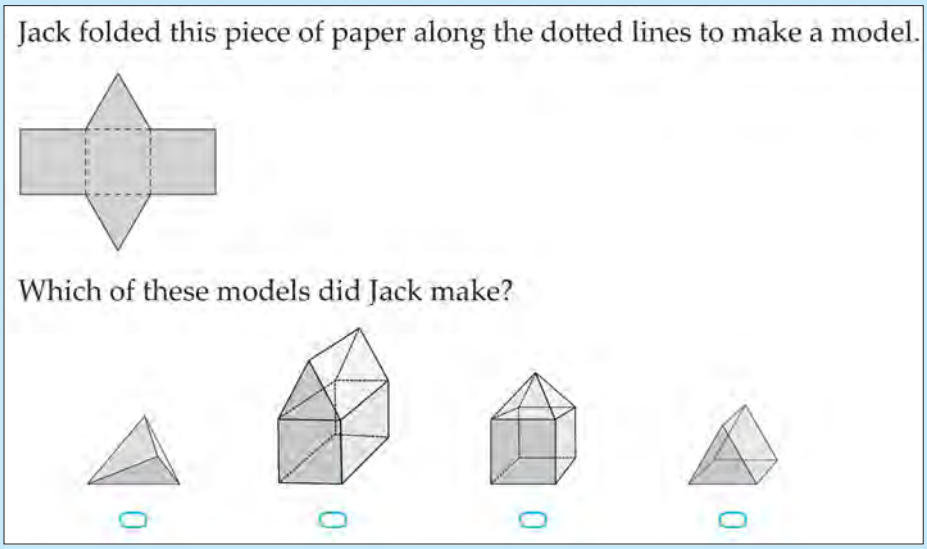


Figure 2. An example of mental folding. (© ACARA, 2016)

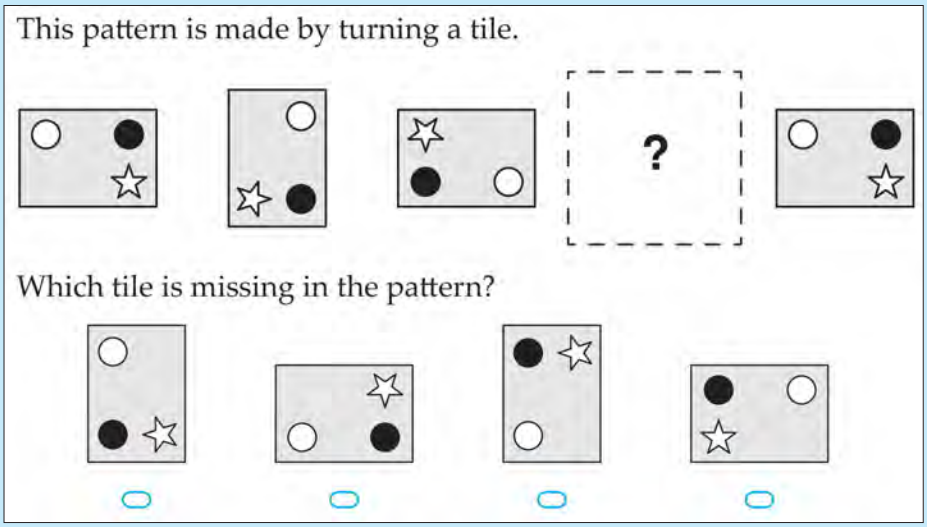


Figure 3. An example of mental rotation. (© ACARA, 2016)

This may not be surprising for many of us reading this article; as teachers we tend to think of education as a social science and therefore the need to think spatially is not as important as if we had chosen a STEM-focused career.

However, an alternative conclusion is that, if we as educators have poor spatial reasoning skills, we may be doing a disservice to the children in our mathematics classrooms.

Solid evidence exists demonstrating the strong relationship between high levels of spatial skills and achievement in mathematics, even at an early age (Resnick & Lowrie, in press) and hence, if educators themselves lack the spatial skills to effectively engage children in spatial thinking within classrooms, we may be missing a crucial element in effective mathematics instruction and engagement. However, do not despair, as research has found that spatial reasoning is malleable and can be taught, even to adults (Uttal et al., 2013).

WHAT DOES SPATIAL REASONING LOOK LIKE IN THE CLASSROOM?

Including spatial reasoning in your classroom does not mean a whole new topic. It can be as simple as focusing children's attention on the mental spatial actions that make up the spatial skills such as rotating shapes and objects, folding 2D representations to 3D objects, composing and decomposing shapes, and identifying symmetry. To promote these skills, children need practice working with concrete materials, for example pattern blocks.

An important aspect of promoting spatial skills is for children to visualise what the shapes might look like rotated or joined or presented in a pattern, before moving the blocks. One way to facilitate this is through the Visualise-Predict-Check instruction (Patahuddin et al., 2020) (see Figure 4).

After initial activities using the pattern blocks, ask the children to leave the pattern blocks to the side and try to imagine what the shapes might look like joined in a specific way, for example, a certain number of triangles joined together along any edge.

Ask the children to predict what their new shape might look like by discussing with a partner or drawing their prediction on paper. Children then use the pattern blocks to make the imagined shape and check against their prediction. This type of instruction helps children create mental models of how shapes and objects move in space, which prompts them to move away from a reliance on the concrete materials.

The same process can be followed for algebraic patterning. Having children identify the core unit of a repeating pattern, and then to continue the pattern with shapes can also use the VPC approach. For example, if we take a simple ABC pattern with shapes such as square, circle, triangle, we can ask the children to visualise what the next two units of repeat will be.

They then draw or write down what they think the continued pattern will look like, and then use the concrete materials to check. When students create their own patterns with a core unit of repeat, ask them to visualise the pattern first, describe it to a partner, and then check by having the partner complete the pattern with materials or drawing.

Does the described pattern have a repeating unit? If not, can they visualise it again?

An important goal for mathematics education is for children to develop abstract mathematical thinking, and to have a level of automaticity in their recall and thinking.

To do so we need to provide different strategies for children to use when they encounter novel or difficult tasks. Flexibility in approaches is important, and thinking

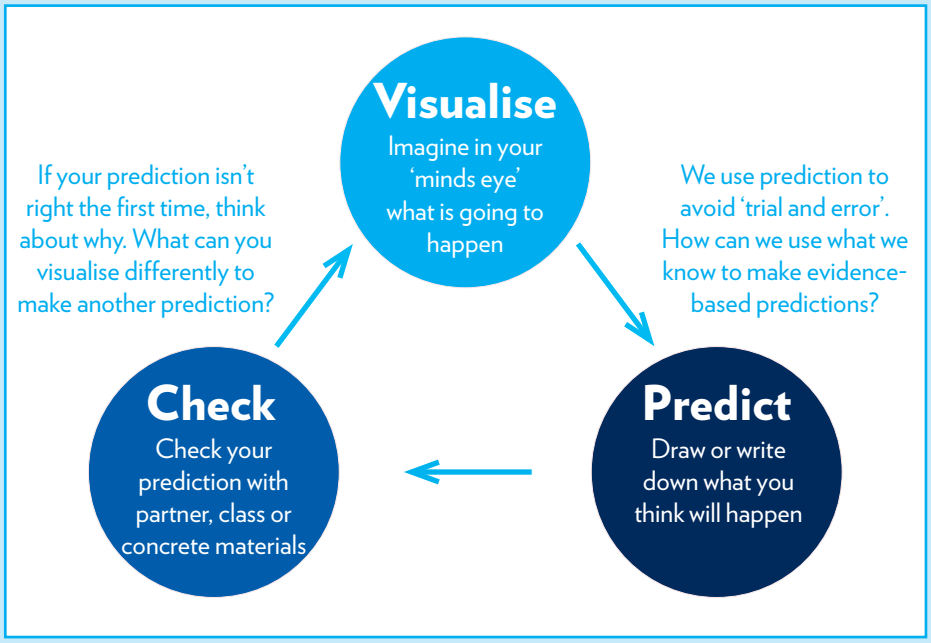


Figure 4. The Visualise-Predict-Check instruction for children to develop mental spatial models (© STEM Education Research Centre, 2019)

spatially about different tasks can provide avenues for children to engage with mathematics meaningfully, in developing abstract mathematical thinking.

REFERENCES

Australian Curriculum, Assessment and Reporting Authority (ACARA). (n.d). *NAPLAN 2012–2016 test papers and answers*. https://acara.edu.au/assessment/naplan/naplan-2012-2016-test-papers

Patahuddin, S.M., Rokhmah, S. & Ramful, A. (2020). What does teaching of spatial visualisation skills incur: an exploration through the visualise-predict-check heuristic. *Mathematics Education Research Journal, 32*, 307–329. https://doi.org/10.1007/s13394-020-00321-2

Resnick, I., & Lowrie, T. (in press). Spatial games improve spatial reasoning and numeracy in preschool: Findings from a large scale nationally representative randomized control trial. *Journal for Research in Mathematics Education*.

Uttal, D. H., Meadow, N. G., Tipton, E., Hand, L. L., Alden, A. R., Warren, C., et al. (2013). The malleability of spatial skills: A meta-analysis of training studies. *Psychological Bulletin, 139*(2), 352–402. http://doi.org/10.1037/a0028446

Verdine, B. N., Golinkoff, R. M., Hirsh-Pasek, K., & Newcombe, N. S. (2017). Spatial skills, their development, and their links to mathematics. *Monographs of the Society for Research in Child Development, 82*(1), 7-30. https://doi.org/10.1111/mono.12280

Woolcott, G., Logan, T., Marshman, M., Ramful, A., Whannell, R., & Lowrie, T. (2020). The re-emergence of spatial reasoning within primary years mathematics education. In J. Way, C. Attard, J. Anderson, J. Bobis, H. McMaster, & K. Cartwright (Eds.), *Research in Mathematics Education in Australasia 2016-2019* (pp. 245-268). Singapore: Springer.

Tracy Logan will explore spatial reasoning at the 2023 MAV conference. To register for the conference, visit www.mav.vic.edu.au/Conference/Annual-Conference.

EFFECTIVE USE OF PLANNING TIME

Aylie Davidson – Deakin University

PRODUCTIVE AND EFFECTIVE USE OF COLLABORATIVE PLANNING TIME IN MATHEMATICS

It is increasingly common practice for teachers to be allocated time to plan collaboratively. Making the most of this time improves the quality of teaching, which ultimately improves student learning and engagement.

In my work supporting mathematics teachers' planning, I am often told 'I just wish we had more time!' That is, more time to understand the concepts, reflect on assessment data, source high-quality tasks, and discuss strategies for supporting diverse learners. In reality, the time teachers have to plan is finite and planning is messy business. Here are five tips that my research (Davidson, 2017; 2018; 2019) has shown can help ensure teaching teams stay maths-focused when planning.

1. HAVE A GAME PLAN

Plan for planning. We know that meetings can easily get side-tracked. A good meeting agenda sets out a plan to ensure everyone comes prepared and follows the leader's guidelines. Some key elements of a meeting agenda include:

- Meeting objectives
- Team member roles (e.g., minute taker, facilitator, timekeeper)
- Required preparation
- Materials to be used
- Meeting schedule (time/minutes, activity, discussion, action)
- Follow up items.

2. CREATE A BLUEPRINT FOR THE LESSON SEQUENCE

One of the aims of the Australian Curriculum: Mathematics v9.0 is to help students see the bigger picture and 'make connections between areas of mathematics and ... other disciplines' (ACARA, 2023). Working together to map a progression of learning helps keep a teaching team 'on the same page' about the mathematical focus for a learning sequence. Some schools use a planning proforma to guide the coherent and connected development of mathematical ideas over a sequence of lessons. A detailed blueprint also enables teachers to spend more time preparing their classroom teaching.

3. GO STRAIGHT TO THE SOURCE

Education authorities here in Australia, and overseas, have invested heavily to develop high-quality resources for teaching and learning mathematics. These resources have been developed by mathematics education experts to reflect research insights, trialled in real classrooms, and refined for wider use. Examples available online for free include:

- reSolve: Maths by Inquiry www.resolve.edu.au
- Mathematics Hub www.mathematicshub.edu.au
- Topdrawer https://topdrawer.aamt.edu.au
- Nrich https://nrich.maths.org
- NZMaths https://nzmaths.co.nz

- Learning and Teaching with Learning Trajectories
  www.learningtrajectories.org

These resources provide teachers with helpful information about the mathematical concepts being developed, common misconceptions, and effective teaching strategies.

4. DO THE MATHS

It is well known that effective teachers are confident in their understanding of the mathematics concepts they are going to teach. That's why it's important that teachers spend time doing tasks themselves during planning meetings. Taking 5-10 minutes to share and compare strategies and solutions builds teachers' knowledge and confidence, meaning they're better prepared to make 'in-the-moment' decisions during lessons. For example, teachers can anticipate the range of student responses (including misunderstandings) and plan the prompts and scaffolds needed to support and extend students' thinking.

5. DON'T REINVENT THE WHEEL

Once teachers have curated, planned and documented a range of high-quality tasks, they are able to reflect on what happened during the sequence and refine their plans for future lessons. A well-documented blueprint helps teachers to build on their own and their students' learning from year to year.

BENEFITS FOR TEACHERS

Teachers report a range of benefits to planning in this way, including increased: *confidence* to teach mathematics, *collegiality* when planning, and *consistency* when teaching mathematics.

In my doctoral research I surveyed 123 primary educators across 24 schools about the broader issues, challenges and aspirations facing them in their mathematics planning. The survey data also led to two intensive case studies over a six-month period with a Year 1 and Year 5 teaching team, aimed at gaining a deeper understanding about the issues. This iterative research process guided and informed the development of a planning intervention to support teacher professional learning and practice. Comments from participants in my research include:

'I feel as if our planning has more direction and is more pedagogically sound after researching [tasks and concepts] through readings and discussion.'
- Year 1 teacher

'You know, I used to teach lots of these tasks that we've read about, but now I actually understand why we're teaching them.'
- Year 5 teacher

'We now share a clear vision, sequence and approach to planning and recognise the importance of collaboration.'
- Year 5 teacher

Making the most of collaborative planning and staying maths-focused is important because it improves the quality of teaching which ultimately improves student learning and engagement in mathematics.

REFERENCES AND RELATED READING

ACARA. (2023) *Australian Curriculum. Understand this learning area. Mathematics.* Australian Curriculum. https://v9.australiancurriculum.edu.au/teacher-resources/understand-this-learning-area/mathematics

Davidson, A. (2017). Exploring Ways to Improve Teachers' Mathematical Knowledge for Teaching with Effective Team Planning Practices. *Mathematics Education Research Group of Australasia*. www.researchgate.net/publication/318336943_Exploring_Ways_to_Improve_Teachers'_Mathematical_Knowledge_for_Teaching_with_Effective_Team_Planning_Practices

Davidson, A. (2018). *Investigating Primary Teachers' Mathematics Planning Processes for Student-Centred Learning and Teaching (Version 1)*. Monash University. https://doi.org/10.26180/5bdbcde4ee708

Davidson, A. (2019). Ingredients for planning student-centred learning in mathematics. *Australian Primary Mathematics Classroom*, *24*(3), 8-14. www.researchgate.net/publication/338828526_Ingredients_for_planning_student-centred_learning_in_mathematics

This article first appeared in *Teacher*, published by ACER. Reproduced with kind permission.
Visit www.teachermagazine.com for more.

LEARNING TO LOVE NETWORKS

Jess Mount – Mathematics education consultant, MAV

Teaching networks for the first time can be a daunting task. I first started teaching the networks module in 2015. I remember being overwhelmed at all the new terminology and doubting myself when answering questions that simply involved trial and error. I loved mathematics for the certainty it gave, and networks didn't seem to be as straightforward. Teaching this unit definitely had me out of my comfort zone! Now, anyone who teaches VCE General Mathematics will be covering networks.

After 8 years of teaching and presenting professional development on the topic, I absolutely love teaching networks. I have had to get my head around a lot of terminology I was unfamiliar with and build up my confidence. I spent time discovering how networks are used in everyday life so I could help my students appreciate that the edges, vertices, and faces are not just a series of jumbled mess on a page. The more you can give relatable examples, the easier it is for students to tackle networks.

One example I use to illustrate the difference between Euler trails/circuits and Hamilton paths/cycles is the rubbish truck route. When the rubbish truck needs to empty the bins of the local area it must go to every street in the neighbourhood (ideally not revisiting a street if possible). This highlights an Euler trail/circuit. Whereas a rubbish truck that visits a camping ground needs to only visit the few spots where the bins are located – it does not necessarily need to drive down every road in the camping ground. This illustrates a Hamilton path/cycle. This scenario can also be used as a great investigation task for students. Asking students to draw their own network with an Euler circuit or Hamilton path or to come up with another everyday example is a great way to test understanding.

The part of networks that tends to 'break' teachers and students, is critical path analysis. I find teachers spend the longest amount of time on this area and often report that their students still struggle with ideas. Some teachers feel that critical path analysis is the most difficult part of the module, and can rush through the other topics.

Let's look at a simple example which nicely illustrates the concept. I pose this scenario to my students 'I need to cook two things in the oven, potatoes (60 minutes) and chicken (30 minutes), and carrots on the stove (10 minutes). How long will it take to cook dinner?' If I get an answer of 100 minutes, we discuss the ability to do things at the same time, 'could I cook the potatoes, chicken and carrots at the same time? How long would it take then?' . Hopefully students will reach the answer of 60 minutes and can explain 'because the potatoes take 60 minutes whilst everything else is less time.' This is a great moment to illustrate how the longest task will determine the minimum completion time. This is important when introducing crashing, as you can refer back to this example and highlight how the activities on the critical path need to be reduced in order to reduce the minimum completion time.

Another follow up question that can help with crashing is, 'If I can cook the potatoes in 20 minutes, how long will it take to cook dinner?' Some students will say it will take 20 minutes while others will realise it will take 30 minutes as the chicken becomes the longest to cook. This highlights an important learning: when networks are crashed, students need to perform another critical analysis to see if a new critical path has been formed and determine the new minimum completion time. Too many students assume that if they have crashed activities on their critical path by 3 days (for example) that this means it will reduce the minimum completion time by 3 days. They always need to go back and check if a new critical path has been formed and therefore the new minimum completion time may not just be as simple as subtracting 3 days from the original. I find myself constantly referring to this example as I teach critical path analysis as it can be used in so many ways. I hope it helps you too!

COMMON DIFFICULTIES

- Students often have trouble drawing networks! They need constant practise.
- Crashing a critical path: use examples that show students they need to redo their critical path analysis and determine the new completion time.
- Forward/backward scanning. Be mindful that students use the larger number in forward scanning and smaller number in backward scanning.

- Difficulty in determining float times. Students can usually determine which activities have a float time greater than zero but have trouble determining the actual float times.

TIPS FOR TEACHING NETWORKS

- Take the time to read and learn the theory. For many teachers it may an entirely new topic.
- It is a great topic to have pre-prepared notes to share with students. You can have students fill in the blanks or have examples to work through with you.
- Show lots of examples of networks to illustrate the different terms that students will be introduced too (walks, trails, circuits etc).
- Build a glossary of terms and images.

MAV can provide professional development to teachers who need support teaching networks. Email jmount@mav.vic.edu.au.

THE COST OF BUYING A HOUSE

Andrew Stewart

The last few years have seen some great volatility in the housing market. Housing prices rose through 2021, fell through 2022 and are recovering in 2023. A major contributor to the fall in housing prices was the increasing cost of financing a housing loan as the Reserve Bank lifted the cash rate (11 times in the 12 months including May 2023), and the lenders followed by increasing their mortgage rates.

Combining interest rate data with house price data, we have a rich environment for School Assessed Coursework (SAC) activities in recursion and financial modelling for General Mathematics. The following suggestions could form part of a SAC activity.

QUESTION 1

a. A loan, of say $600 000, is taken out for 25 or 30 years at an interest rate of, say 3.0% p.a., with monthly repayments.

Starting with the (second/third/whatever month), each and every month thereafter, the interest rate is increased by 0.25% until it reaches 6.0%.

Construct a table showing the monthly repayment required at each interest rate level to repay the loan in 25 or 30 years from inception.

b. Assuming no further interest rate changes after it reaches 6.0% p.a., determine:

i) the total amount repaid on the loan.

ii) the total amount of interest paid.

Notes: Each student could be given a different combination of loan amount and time to repay.

Teacher answers could be prepared in advance on a spreadsheet for each combination.

Remember that for each increase the time to repay reduces by one month compared to the previous calculation! This rate increase timeline somewhat mimics what borrowers have been going through for the past year. If you want to stretch it out, make the increase occur every two or three months.

QUESTION 2

Three years ago, a loan was taken out for, say $600 000, to be repaid in 25 or 30 years with the interest rate fixed at, say 2.3% p.a., for three years.

After three years of repayments, the fixed interest rate is change to, say 6.0% p.a..

a. Calculate the monthly repayments required at each interest rate value.

b. By how much has the monthly repayment increased

i) in dollar terms?

ii) in percentage terms

c. What was the balance of the loan

i) at the end of the first three-year period?

ii) at the end of the second three-year period?

d. Mortgage repayments should be about 30% of monthly household income. How much should the monthly household

THE COST OF BUYING A HOUSE (CONT.)

Andrew Stewart

income rise by to keep the mortgage repayments at 30%?

e. The fixed interest rate of, say 6.0% p.a., applies until the end of the loan. How much extra has the borrower paid compared to the original loan had it continued at the same rate?

Notes: This is the 'edge of a cliff' moment as mentioned by many commentators on the current state of house buyers' mortgages!

There are websites that display the prevailing mortgage interest rates over the past several decades. These sites will give the current spread of interest rates.

QUESTION 3

A house buyer took out two loans to cover, say $600 000, required to purchase a house over 25 or 30 years. One loan was for, say $300 000, for three years at a fixed rate of, say 2.2% p.a. and another loan was for, say $300 000, at a variable rate of, say 3.3% p.a.

a. Calculate the monthly repayments required for each loan. After three years, the fixed rate is raised to, say 6.0% p.a., and the variable rate is now, say 6.6% p.a.

b. What was the balance of the fixed rate loan after three years? Assume that the balance of the variable interest loan after three years is $274 500 for the $300 000 loan.

c. Calculate the monthly repayments now required for each loan (assuming loans are to be repaid in the original 25 years).

d. By how much has the total monthly repayment increased

i) in dollar terms?

ii) in percentage terms?

e. Mortgage repayments should be about 30% of monthly household income. How much should the monthly household income rise by to keep the mortgage repayments at 30%?

Notes: The balance of the variable loan should be a reasonable guess based on interest rate movements over that time. If you have a good loan manager contact, they may be able to give a more accurate estimate of the balance of a variable interest loan after three years

There are websites that display the prevailing mortgage interest rates (both fixed and variable) over the past several decades if you want a selection of starting interest rates. The same sites will give the current spread of interest rates, both fixed and variable.

Tables 1 and 2 are based on an article in *The Age* on February 28 2022 and updated using resources listed at the end of this article.

These calculations assumed a principal-and-interest loan for 30 years, with the amount of the loan being 80% of the median house value for that city.

	Median house value ($)			Monthly repayments ($)		
Location	**Jan 2021**	**Jan 2022**	**Jan 2023**	**Jan 2021 (2.32%)**	**Jan 2022 (2.96%)**	**Jan 2023 (5.5%)**
Sydney	1 070 838	1 389 948	1 217 242	3305	4664	5529
Melbourne	850 988	1 002 464	904 506	2627	3364	4109
Brisbane	612 104	809 813	782 663	1889	2717	3555
Adelaide	500 277	636 853	700 000	1544	2137	3180
Perth	498 969	555 851	592 720	1540	1865	2692
Hobart	601 502	759 697	708 660	1857	2549	3219
Darwin	519 123	562 729	582 268	1602	1888	2645
Canberra	807 771	1 032 331	958 929	2493	3464	4356
National	**623 602**	**778 255**	**702 109**	**1925**	**2612**	**3189**

Table 1. Average three-year fixed rate (new loans).

	Median house value ($)			Monthly repayments ($)		
Location	**Jan 2021**	**Jan 2022**	**Jan 2023**	**Jan 2021 (3.27%)**	**Jan 2022 (3.04%)**	**Jan 2023 (5.2%)**
Sydney	1 070 838	1 389 948	1 217 242	3738	4712	5347
Melbourne	850 988	1 002 464	904 506	2970	3398	3973
Brisbane	612 104	809 813	782 663	2137	2745	3438
Adelaide	500 277	636 853	700 000	1746	2159	3075
Perth	498 969	555 851	592 720	1742	1884	2604
Hobart	601 502	759 697	708 660	2100	2575	3113
Darwin	519 123	562 729	582 268	1812	1908	2558
Canberra	807 771	1 032 331	958 929	2819	3500	4212
National	**623 602**	**778 255**	**702 109**	**2177**	**2638**	**3084**

Table 2. Average variable rate (new loans).

QUESTION 4

a. Determine the amount of the loan required in a particular (or every) city as well as the national figure for either 2021, 2022 or 2023.

b. For all cases chosen, determine whether a borrower could save money by:

i) Paying the loan fortnightly instead of monthly.

ii) Borrowing for 25 years instead of 30 years.

c. For all cases, determine the time and money that could be saved by paying half the monthly figure each fortnight (the thirteen-month option). For all cases, determine whether the money saved by taking the shorter term loan would cover

the increased monthly repayment for the duration of the loan.

d. For all cases in (b), (c) and (d), determine the family income required to support the loan, given that the repayment amount should be no more than 30% of the monthly income.

e. Which city would the student prefer to own a house in?

QUESTION 5

For a loan for a house, the interest rate is, say 3.0% p.a., for 25 or 30 years.

a. What will be the percentage increase in the monthly repayment for every city if the interest rate increases to, say 6.0%?

b. In which of these cities will the percentage change be the greatest or least?

c. Determine the increase (actual and percentage) in the family income required to support the loan, given that the repayment amount should be no more than 30% of the monthly income.

QUESTION 6

Newspapers (and other media) frequently present lists of median house prices by Melbourne suburbs and/or major country cities and areas. The Real Estate Institute of Victoria (REIV) also releases median house price data by location.

These values could be used to set up a table similar to Table 1, assuming that loans are a maximum of 80% of the median value and using the most common interest rates found. Either use these as an alternative to Ideas 1 and 2 above, or add the local suburb/country location as a further comparison for comment.

REFERENCES

Median house values and monthly repayments. *The Age*, Feb 28 2022

https://propertyupdate.com.au/the-latest-median-property-prices-in-australias-major-cities/

www.rba.gov.au/chart-pack/interest-rates.html

STIMULATING THINKING

Judy Gregg – Mathematics education consultant

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

EARLY YEARS

- How many buildings do you think there are in this picture?
- How many different colour buildings do you see?
- Which colour of buildings has the most? Which has the least?
- There are some cars in this picture too. How many do you see?
- What is the weather like in this picture? How do you know?
- What shapes do you see in this picture?
- What time of the day do you think this photo was taken? How do you know?
- Which building is the tallest? Which one is the shortest?
- Which of these buildings would you like to live in? Draw a picture of it and write a house number of your choice on it.

FOUNDATION - YEAR 3

- How many buildings are there of each colour? Make a graph to show this.
- Usually, the houses/apartments on one side of a street have odd numbers and the other side have even numbers. What could be some possible house/apartment numbers for each side of one of these streets?
- If you lived in one of these apartments what would your bedroom look like? Draw a picture of it, including windows, bed, desk, cupboards etc.
- How long do you think it would take you to walk from one end of the road in the middle of this picture to the other end of the road?
- Draw some apartment buildings in a row making a repeating pattern using some of the colours that you see.
- There are 30 people living on one floor in one of these buildings. There are five people who live in one apartment. They move out and a new family of seven move in. How many people are living on the floor now? How did you work it out?
- There are four apartments on one floor of one of these buildings. The total number of people living in each apartment is as follows:

Apartment A	Father, mother, 3 children
Apartment B	Mother, 6 children
Apartment C	Father, Mother, Grandfather, 1 child
Apartment D	Father, Grandmother, 4 children

- Order the apartments from the one that has the highest number of people to the one that has the lowest number of people.
- Make a graph showing how many different family members are in the four apartments above. For example, the number of fathers, the number of children etc.
- What season do you think it is in this picture? What could the possible month be?

YEARS 3 - 6

- If one of the buildings has 48 apartments, how many floors might it have and how many apartments on each floor?
- What fraction of each colour of buildings are there? For example, what fraction of the buildings are orange?
- Draw a bird's eye view of these buildings.
- If you lived in the yellow building at the bottom right of this picture and your friend lives in the orange building on the far left, give instructions on how you would get to their place.
- Estimate the total number of people who might live in all the buildings that you see. How did you work out your estimate? Explain your thinking.
- What are some angles that you observe in this picture? Estimate the size of these angles.
- You live in one apartment building and your friend lives in another building. You want to go to your friend's apartment to catch up for an hour. It takes you 20 mins to walk there and 20 mins to walk back home. Your parents say you are allowed to visit your friend if you are back before dark. It gets dark at 5.40 pm. What are some possible times that you could leave your house to ensure that you are back before it gets dark? What is the latest time that you could leave?
- In one of these buildings there are a total of 345 people living there. There is a mixture of young and old. This is the breakdown by age range:

55 – 65 years of age	44
35 – 55 years of age	98
25 – 35 years of age	43
18 – 25 years of age	10
Under 18 years of age	150

- What percentage of each age group lives in the building?
- Two of the apartments have a total of four children living in the apartments. What is the probability that one of the apartments has only one child?

YEAR 7 AND BEYOND

- Use grid paper to draw where each of these buildings would be.
- How many people can fit in one of the lifts in these buildings? They are designed to carry a maximum of 700kg. Could it be any other number? Explain your thinking.
- If the cost of rent to live in one of these apartments is $620 a week, and you move in January knowing that the rent will increase by 5% in July, what would be the total amount that you would pay for the year?

- In one of the buildings, each apartment is 80 square metres. You have been asked to design the layout. Draw this apartment with each of the rooms in place. Include the dimensions of each room.
- You have just moved into one of these apartments. You would like to make some new curtains for your bedroom window. You need three metres of material. You find the material you like. It costs $12 per metre, but if you buy a minimum of four metres you can get a 25% discount per metre. Are you better off buying five metres or just the three metres that you need?
- What fraction of the buildings are the colour yellow? Orange? Green?
- One of the apartment buildings has a pool that is 11 metres long and five metres wide. The depth at one end is three metres and the depth at the other end is one metre. What would be the volume of the pool?
- In one of the buildings there are 48 apartments. If each apartment is allotted two car spaces, what size area would you need to accommodate all these cars? Explain your thinking.
- Design a Cartesian plane that can be overlayed on this picture. Assign a scaled length/distance between coordinate points and use these to find the distance between two objects or buildings in this picture.

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

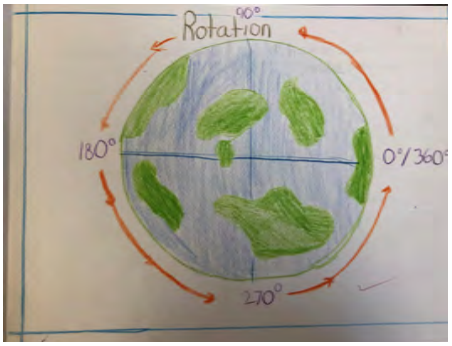
If you have an idea for a stimulus image in future editions of Common Denominator, we'd love to hear from you. Email office@mav.vic.edu.au with your suggestions.

IMAGINING ANGLES: STEINER PEDAGOGY

Tanja Boxelaar – East Bentleigh Primary School

I am passionate about maths and want every child in my class to find it exciting. East Bentleigh Primary School supports a hybrid model of a mainstream and Steiner stream working in parallel. Each year level has at least one mainstream class and one Steiner class, and teachers collaborate. I believe that every child can do maths, according to their own abilities and interests. As a Steiner teacher, I have the opportunity to harness the power of curiosity, imagination and engagement through our philosophy of teaching the whole before the parts. Here, I share how modern concepts of maths are explored in the Steiner philosophy by explaining a class 4 Geometry lesson, *Freehand Geometry*. The lesson begins with drawing forms and circles using string and sticks, our bodies and the world around us. We draw tangents and ellipses and other 2D shapes. We use a blackboard and chalk, string and stick – no rulers yet – it is freehand with no technology.

Next, we tell a story about how it seems that fixed stars move in great circles around us. They make a circle once every 24 hours, but they also move forward a tiny distance from one night to the next. They will get to that position each night four minutes earlier. These movements can be measured by the width of an outstretched thumb - this represents one degree. Each night they move forward by four minutes, and it takes a year to get back to the same place at the same time. So, in ancient times the circle was divided in the same way as the stars move in the heavens.



One day is about four minutes in the cycle of a year: 1 day = 24 hours, 1 hour = 60 minutes, 24 x 60 = 1440 minutes in a full day. Divide 1440 by 4 = 360.

So, the circle is like the movement of a star over one year: 1 day = 1 degree and 1 year = 360 degrees.

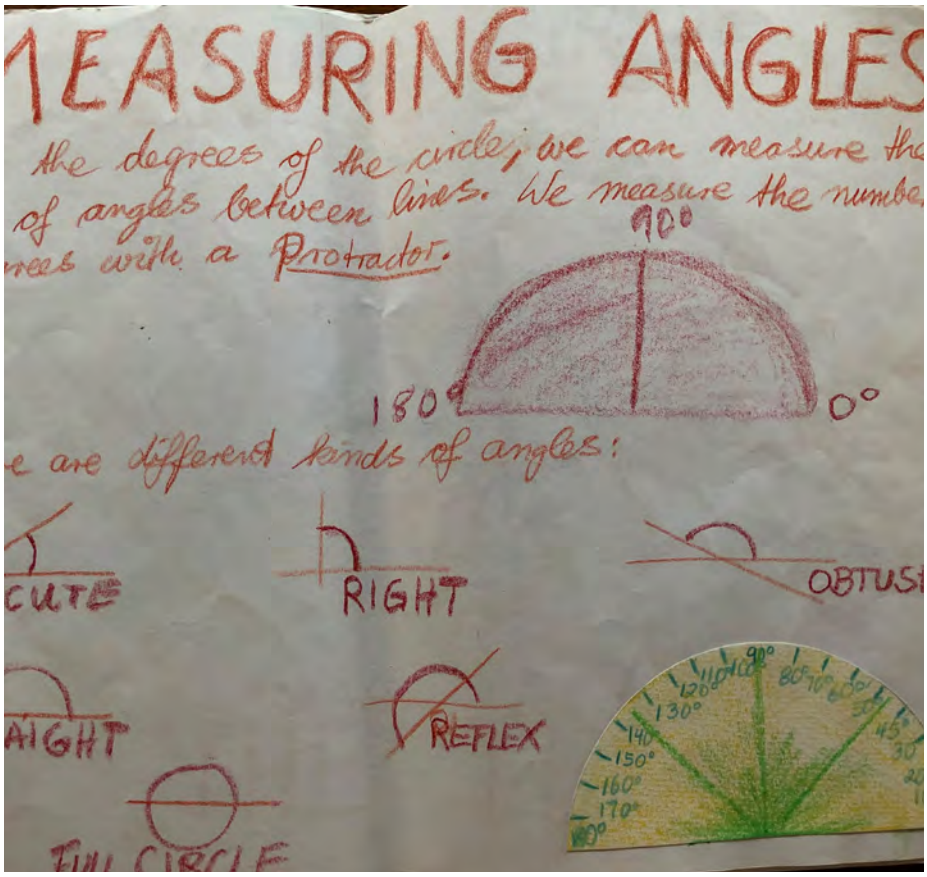


Figure 1.

This information is shared with students over a period of three days. We ask the students to pick a star and measure the distance each night (hopefully there is a clear sky!). We make beautiful drawings of stars in the sky over Earth and then do the calculations. We explore the concept of 360°, circles, the angles inside the circle and teach the children different angles and how to use a protractor. See Figure 1.

The way this lesson taps into the child's imagination, curiosity and engagement is astounding. Students connect with the concept of angles through a deep learning experience. All this is done using a black board with daily new drawings, as we don't use technology until class 5. Engagement occurs through storytelling, as students become participants in their community and culture, which encourages collaborative learning. Knowledge through narrative rather than mere transmission is constructed afresh by the student. The imaginative concepts have the capacity to grow with the child's changing understanding of the world. After the age of 10, the children progress from an imaginative, picture consciousness to more abstract, intellectual thought processes. The child's curiosity is developed through a focus on exploring the 'why' questions of new concepts, which is supported through teaching the whole concept before breaking this into parts and through their active participation during these lessons. We tap into their imagination by creating a sense of wonder, and we draw our observations. We explain why a circle is 360° through an active exploration, and asking which are angles 90°, 45° and so on.

According to Rudolph Steiner, learning in the primary years seeks to engage the feelings of the child so that a strong personal identification with the subject matter can occur. Learning is essentially experiential. Imagination is the key quality and pictorial imagery is vital. Acquiring new skills and practising them until are different processes requiring different rhythms.

So, even though our approach differs from a mainstream approach, Steiner teachers teach the same concepts, making collaboration and comparisons of learning outcomes achievable.

ONE MINUTE WITH PAUL SWAN

I'M…

Paul Swan. I support schools and teachers do the best they can to help children reach their potential in mathematics.

I CHOSE A CAREER IN MATHS EDUCATION….

Partly by fluke. I lived in a low socio-economic area and went to low socio-economic schools and was offered the opportunity to attend teachers' college before completing my final exams. When I got there, the maths lecturers like Dr Jack Bana (a life member of the Mathematical Association of WA) demystified maths for me, and I decided that I wanted to do the same for others.

THE BEST RESOURCES FOR TEACHERS HAVE …

Clear direction and practical suggestions, based on a well-reasoned, research informed base. Now and again teachers need a 'pick-me-up' so children's books can inspire. Look at Dr Seuss' *Hooray for Diffendoofer Day*.

WORD OF ADVICE TO NEW TEACHERS …

You can always spend more time preparing. At some point you need to decide how much is enough. Remember students see the person in front of them. Try to find a balance between preparation and performance in front of the children.

I WRITE MY BOOKS…

So that I can share ideas with a wider audience. I love the process of laying out the page, so I publish my own materials.

STUDENTS NEED TO KNOW…

How to be critical thinkers. With 'fake news', students will need to be statistically literate, otherwise they will easily be manipulated.

STUDENTS WHO NEED INTERVENTION BENEFIT FROM…

Teachers who care for the child first, and use their knowledge to guide the student. No one size fits all so even if you use a program (e.g. Bond Blocks) teachers will need to make adjustments along the way.

PERTH IS …

A long way from anywhere! I travel to events like the MAV conference to keep up-to-date with to other educators' thoughts.

WORDED PROBLEM-SOLVING QUESTIONS…

Solving these questions requires understanding of vocabulary, graphics, symbols, and the way these problems are structured (e.g., comparison problems). Then you have a chance at comprehending the problem. Then you need to apply the appropriate mathematics to solve the problem. Then the student needs to check if the result answers the question. (Polya's 4 step approach).

MY BEST ADVICE IS…

To focus on the students you teach rather than on the content.

MATHS EDUCATORS HAVE THE POWER TO…

Inspire, bore, or intimidate. Please choose the former.

Create real VCE Maths exam practice fast with exam+

Create VCE Maths practice exams in minutes with this **easy-to-use online platform** that gives you access to **hundreds** of filterable and difficultly graded past **VCAA** and unseen **VCAA-style questions and answers**.

Save Time

Stop drafting and creating your own revision questions and **access hundreds of unique exam-style questions** that will test your students

Personalise

Create pre-unit and post-unit tests and determine what content your students **know and where you should focus** your attention in Term 2

Simulate real exam experience

Boost your students' confidence with VCAA-style exams that demystify the exam experience

Available NOW for Year 12 VCE Maths
General, Methods and Specialist

Trial or subscribe today at **examplus.cengage.com**

Trials provide free 30-day access

MATHS GAMES: A TEACHERS JOURNEY

Helen Haralambous – Mathematics education consultant, MAV

I have always had a love for maths games and have been passionate about incorporating games into my teaching practice with students. Many of you will know this if you have worked with me or attended a MAV Games Day or a MAVCON workshop session. Where did this stem from? And why?

I always was a bit of a maths nerdy kid and loved maths puzzles and games. Many maths teachers have a competitive streak – this can manifest at staff trivia comps or being the Monday morning footy stats analyst!

My final year university lecturers encouraged me to join the MAV and it quickly became one of my richest sources of resources. I was a fresh graduate teaching at a school that was widely considered 'difficult to work at'.

I was constantly trying to find resources and ideas to engage my students and quickly realised that most students – no matter how disengaged – enjoy winning.

My initial exploration of games in the classroom was short and simple activities. I saw an opportunity for Year 7 students to compete in a Maths Games Competition hosted at Victoria University (formerly FIT) and as an enthusiastic first year teacher I thought 'why not our students?' So to the disbelief of some staff, I went along with eight students to the first competitive games day and was proud that one of our teams placed third.

My next challenge was the end of year program, I had to decide what to offer for half day sessions. Sports activities were popular, but I was more of a spectator then participant. I enjoyed craft which most likely wouldn't have sat well with all students. So maths games it became! I adapted some of the games from the competition but made sure that I stuck with games that had an element of chance. My aim was to deliver something fun, and include a hidden element of learning ... which many students were unaware of!

In the classroom, and in the situations I mentioned above, I reflect on the statements by Kitty Rutherford, 2015, The National Council of Teachers of Mathematics:

- Games are an important tool for learning in mathematics classroom.
- Further, they afford opportunities for students to deepen their mathematical understanding and reasoning.
- Playing games encourages strategic mathematical thinking as students find different strategies for solving problems and deepen their understanding of numbers.
- Games present opportunities for practice, often without the need for teachers to provide the problems. Teachers can then observe or assess students and work with individuals or small groups of students.

A couple of years later, I took on another MAV initiative, the Family Maths Program, and ran a series of evening workshops for Year 7 parents students and their parents. It became another avenue to introduce maths games to students.

I'll bet there is not a maths teacher amongst us who has not heard the parent teacher interview statement 'I was never any good at maths'. Once you introduce games, suddenly the competitive streak comes out in parents and, as they share their strategies for winning they suddenly forget their 'inability to do maths'. Again, Kitty Rutherford:

- Games support a school-to-home connection. Parents can learn about their children's mathematical thinking by playing games with them at home.

A successful strategy to promote further engagement is to enable students to take games home. I always found that they returned the games and shared their strategies with enthusiasm.

HINTS FOR INCORPORATING MATHS GAMES SUCCESSFULLY

- Incorporate maths games within your curriculum, this will ensure it becomes part of your routine and tie it within your topic or lesson objective. And not just a lesson filler or 'last period Friday'
- 'Make sure the game matches the mathematical objective, use games for specific purposes, not just time-fillers.' (Alridge & Badham (1993)).
- Games are a great tool for allowing differentiation. By choosing games that have an element of chance, you are enabling all students the opportunity of winning. However you can challenge your stronger students to find the strategy for winning and show or tell you why it works. Does it work for all situations?
- 'The game should have enough of an element of chance so that it allows weaker students to feel that they a chance of winning'. (Alridge & Badham (1993))

I specifically use this strategy when running games as part of an end of year program. I recall one girl reluctantly coming in after recess saying she didn't want to be there, she didn't choose maths games, didn't like maths and wanted to do computer games. At the end of the session, the *Game of 31* appealed to her so much that she asked if she could come back after lunch because she wanted to work out how to win!

I've compiled a book sharing my favourite games which you might find useful to use with your students, *Games for Maths Games Days* available at www.mav.vic.edu.au/mav-shop, it includes *Game of 31* in case this article has made you curious!

MAXIMISE MINIMISE GAME

Helen Haralambous – Mathematics education consultant, MAV

Following the MAVCON workshop where a few games were trialled and played by participants, delegates voted *Maximise Minimise* the game they'd use in class and also the one they enjoyed the most.

Materials

- Four 10-sided dice per pair
- Pen or pencil
- Scoring record sheet (see table on the right) for each player
- Calculator (optional)

Aim

To be the player to first reach or go past 25 000.

The rules

- Game for two or more players.
- Each player starts with 7000, records this on their score sheet.
- Each player, takes turns to roll four dice and form a four digit number with the result.

Play

Round 1: Add the four digit number to 7000.

Round 2: Roll the four dice again, form a number. Subtract this from previous total.

Round 3: Roll the four dice again, form a number. Add to this to the previous total.

Round 4: Roll the four dice again, form a number. Subtract this from previous total.

Continue until a player reaches or exceeds 25 000.

Reflection or class discussion

What strategies did you use when choosing your four digit number?

Content proficiencies

- Number and algebra
- Probability and statistics
- Understanding
- Fluency
- Reasoning

Player 1 score sheet

Instructions	Score
Starting number 7000	7000
+ number to 7000	
- number from previous total	
+ number to previous total	
- number from previous total	
etc...	

Player 2 score sheet

Instructions	Score
Starting number 7000	7000
+ number to 7000	
- number from previous total	
+ number to previous total	
- number from previous total	
etc...	

TIME FLIES!

Judy Gregg – Mathematics education consultant, MAV

The melting clock is the most recognisable of Salvador Dali's creations. The clock appears to be literally dancing, unrestrained by the rigid laws of a watch or clock. Time, for Dali, moves to the rhythm of a perpetual dance, speeding up, slowing down, stretching out, liquefying. Time bends to individual meanings.

The teaching of time involves more than just learning to read a clock (Kamii & Long, 2003). It is a complex topic. It cannot be seen or felt, but it is important to understand that time is measured. Time is perceived as series of events in a sequence, separated by durations of various lengths. We also experience a plurality of overlapping events, sequences, and durations. An awareness of the passage of time is an essential ingredient in understanding time. Deep conceptual understanding of time is a developmental process which occurs gradually from infancy to adolescence (Friedman, 2011; Piaget, 1969; Trosborg, 1982).

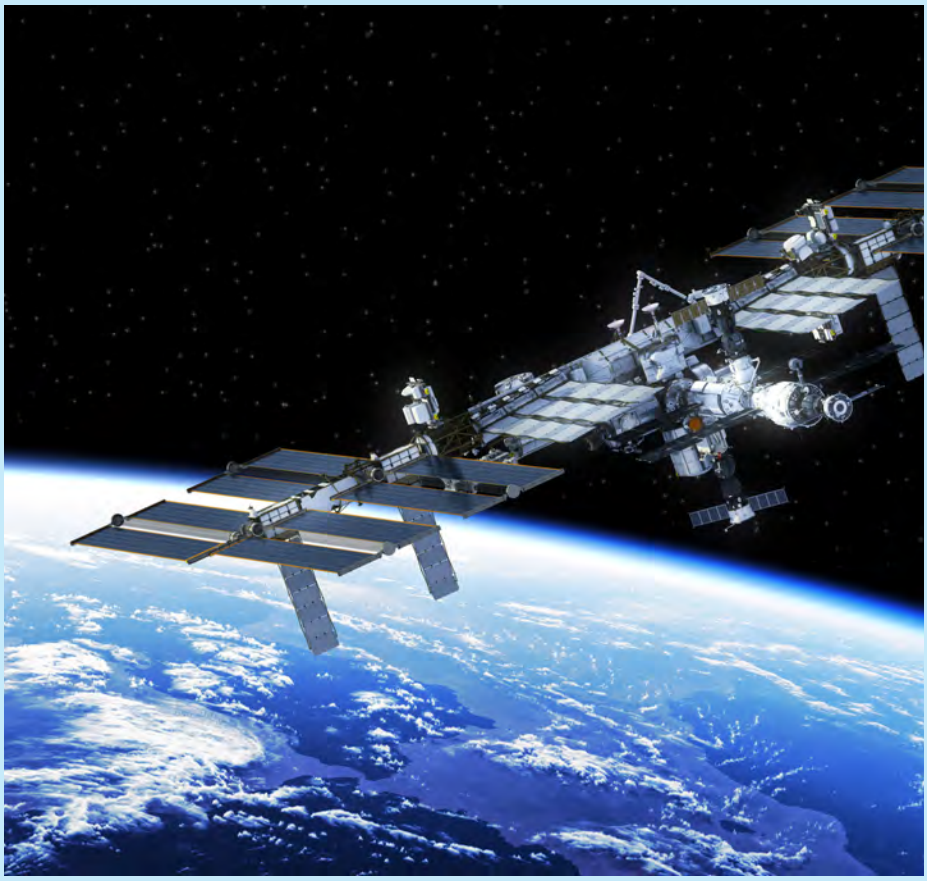
Margaret Thomas has developed a framework for the teaching and learning of time. This framework involves four major components of time:

- awareness
- succession
- duration
- measurement.

Although all these components of time are intertwined and interconnected, each one will be described separately.

Awareness of time involves an understanding that temporal patterns occur with regularity, and the concept of a year, month, week, and day are related to the earth's movement. The language of time includes specific terms, such as 3.00 o'clock and informal words and phrases, such as 'soon' and 'later'. Using benchmarks help us to understand how much time has passed. For example, 2.00 on a clock represents 2 hours has passed since the benchmark of 12.00 noon or 12.00 midnight.

Succession of time involves an understanding that events are ordered sequentially, sometimes involving a recurring pattern, such as days and months. Events can also occur simultaneously with other events.



It involves the past, present, and future. It involves a repetition of units of time, such as seconds or minutes being repeated.

Duration of time is an unbroken interval of time between the beginning of an event and the end of the event. A unit of time is constant, and it can be large or small. For example, a unit of time can be a second, an hour, a year, or a century.

Measurement of time involves having a full understanding of the structure and operation of time measuring devices. Time measuring devices includes such things as clocks, calendars, and sand timers, etc. To measure time accurately, the relationship between units of time needs to be understood as well.

ACTIVITY: MISSION CONTROL TO ISS

www.resolve.edu.au/time-mission-control-iss

Launch

Watch a video about the International Space Station www.youtube.com/watch?v=SOCixRhRGDw

You can also tune students in by watching the power point (within the reSolve activity) with information about the space station. This will help set the scene for the tasks that are to be completed.

Explore

Task 1

Students are asked to develop a 24-hour schedule for three astronauts. There is a list of general duties as well as a list of individual duties. These lists must be worked on together to ensure that each astronaut is able to carry out each of their duties without any conflict. Students need to decide how they will lay out their schedule and what size time units they will use in their schedule.

Task 2

The stage is set for the students by informing them that a film crew has arrived at the space station to interview the flight director. She is asked many questions about the people at the space station and what they do, when, and for how long. Students will need to develop a timeline to keep track

of the many things that are happening. Some final questions are asked by the film crew regarding how long and when certain events occurred. The students need to use their timelines to answer these questions.

Reflect

Students will be asked to reflect on their learning. Students can share their solutions and strategies. Similarities and differences can be discussed.

Summary

What a great activity this is for students as it encompasses all four components of time. It can also be cross linked to the Science curriculum: Earth's rotation on its axis causes regular changes including night and day (Years 3/4), and Earth is part of a system of planets orbiting around a star (the Sun) (Years 5/6). The initial power point for Task 1 gives the students some information about ISS, such as the time it takes for the space station to orbit the Earth.

This relates to the science curriculum. Discussing how the Earth's orbit around the sun determines the length of a year, and the rotation of the Earth on its axis determines the length of the day helps develop students' *awareness* of time.

The first task encourages students to set up a 24-hour schedule for the astronauts, which is a good lesson in the *succession* of time. Students learn how to develop a schedule and lay it out so that it is easy for others to read and interpret.

Students decide what units of time they will use in their schedule. For example, they may use half hour or one-hour blocks. They need to know the relationship between units of time so that they can *measure* time.

In Task 2, the flight director is asked a series of questions about what different people on the space station are doing. Students need to refer to their timelines to answer these questions some of which involve the *duration* of time.

MORE TIME ACTIVITIES

Exploring Indigenous Seasons
www.youtube.com/watch?v=_vQVjCdq-2I

Two Clocks
https://nrich.maths.org/4806

Wonky Watches
https://nrich.maths.org/1002

Fractions of an Hour
https://fuse.education.vic.gov.au/MCC/CurriculumItem?code=VCMMG227#Resources

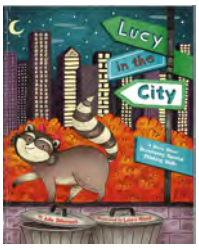
Five on the Clock
https://nrich.maths.org/1981

Train Timetable
https://nrich.maths.org/958

Elapsed Time (Open Number Line)
https://fuse.education.vic.gov.au/MCC/CurriculumItem?code=VCMMG227#Resources

BOOK REVIEW: LUCY IN THE CITY

Hannah Marino – St John XXIII Primary School,



Go on an adventure with Lucy the raccoon as she follows her family out of the den and into the city to explore garbage bins. Lucy gets distracted by a jar of peanut butter and becomes separated from her family. With the help of a owl and his bird's eye view, Lucy becomes aware of the world around her and navigates herself home! *Lucy in the City* focuses on supporting students to develop spatial thinking skills, including:

- **Spatial relationships:** understanding how different objects relate to each other in space, e.g. setting the table.
- **Spatial memory:** remembering where things are.
- **Special representations:** reading maps, diagrams and charts.
- **Spatial language:** understanding and using positional language: on, above, below, near, next to and between.
- **Sense of direction:** navigating and finding your way.

The author provides a range of fantastic suggestions of tasks that align with different types of spatial thinking as outlined above.

While the book is suitable for F-4, it could be utilised in Level 5-6 with a particular focus on viewpoints and bird's eye view. The tasks suggested in the books can be adapted for levels F-4, depending on the focus. Students could develop spatial thinking by focussing on:

- **Spatial relationships:** Students in Foundation can build a mini-city with blocks. Students could be encouraged to play within their city with a focus on exploring spatial language such as 'Would this piece fit on top of that?' 'Can you build a wall around your city?'
- **Spatial memory:** Students in Level 1-2 can focus on landmarks and create their own map to include landmarks, creating a route and writing instructions using spatial language.
- **Spatial representation:** Students in Level 3-4 can create a map with a focus on landmarks, cardinal directions and create different routes reasoning about how they differ and in what way.
- **Spatial language:** An object could be hidden in the room and directions using spatial language are given to find it. Students could then create their own.
- **Sense of direction:** Activities to develop this skill are applicable from Year 1-6. Students can be taught to navigate a compass. Additionally students can use their body to find the cardinal directions.

YOUR COMMUNITY

Claire Embregts – Mathematical Association of Victoria

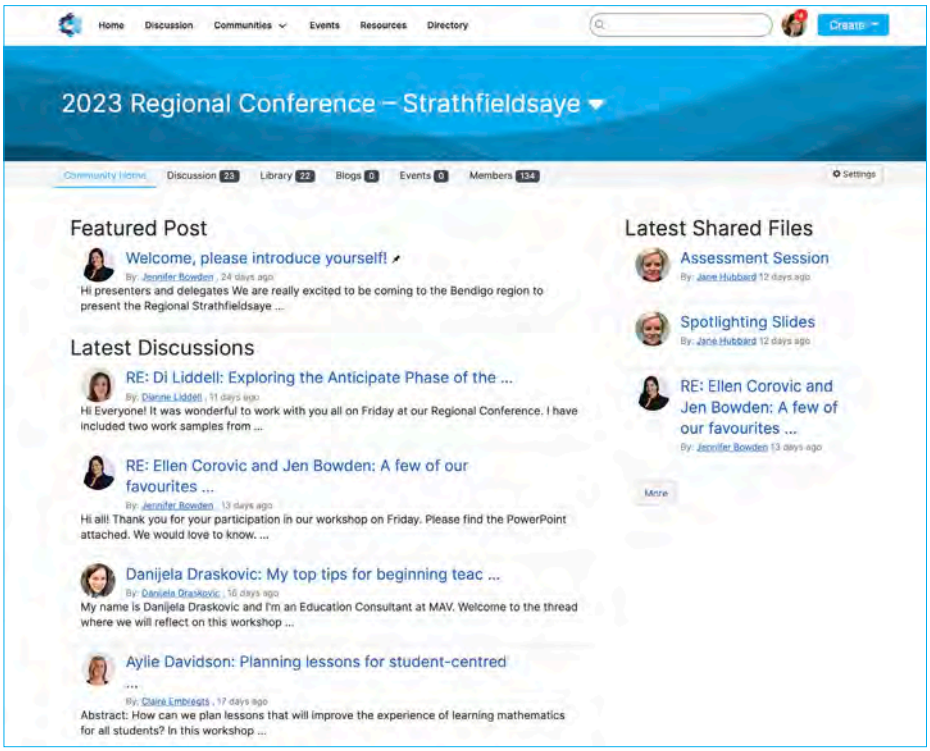
If you're a maths educator in Victoria looking for a community to help you grow your skills and knowledge - we have some new updates regarding our online community.

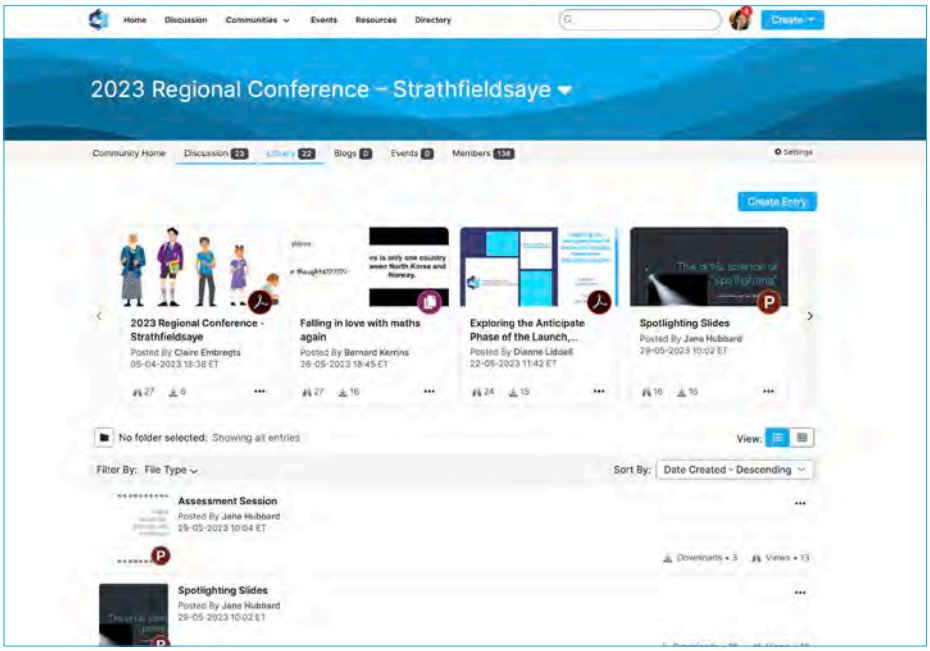
The MAV Maths Educator Community is designed to foster collaboration and idea sharing among Victorian maths educators. It offers a wide range of features tailored exclusively to meet the needs of educators in Victoria. You'll find engaging discussion forums, resource sharing opportunities, professional development materials, and networking avenues within this platform. The community enables you to connect with fellow educators, collaborate effectively, and access valuable teaching strategies.

We are designing our community using the Minimal Viable Community (MVC) approach, providing a valuable space for educators to enhance their skills and expand their knowledge. The concept of MVC emphasises creating compact, connected, and self-sustaining ecosystems where members collaborate and support each other. We want to build the best foundations and create as much value as possible to help all Victorian educators the best way we can.

We're currently trialling a closed community group exclusively for the recent Strathfieldsaye regional conference delegates. This group aims to facilitate ongoing conversations related to the conference sessions. Delegates can connect with presenters, access valuable resources, and expand their network by engaging with other delegates who attended the conference. It's a fantastic way to continue learning and make the most of the conference experience.

As our community continues to grow, we have exciting plans to establish specific groups tailored to cater to your unique needs and interests. Picture engaging communities focused on implementing the latest 7-10 Victorian Curriculum, exploring the fascinating realms of STEM and coding, delving into the depths of specialist maths, and embracing the enriching world of thought-provoking tasks. By joining these groups, you'll unlock a treasure trove of enhanced skills, profound knowledge, and the invaluable opportunity to play a pivotal role in nurturing the community's collective growth. Let's embark on this transformative journey of shared learning and endless possibilities together.





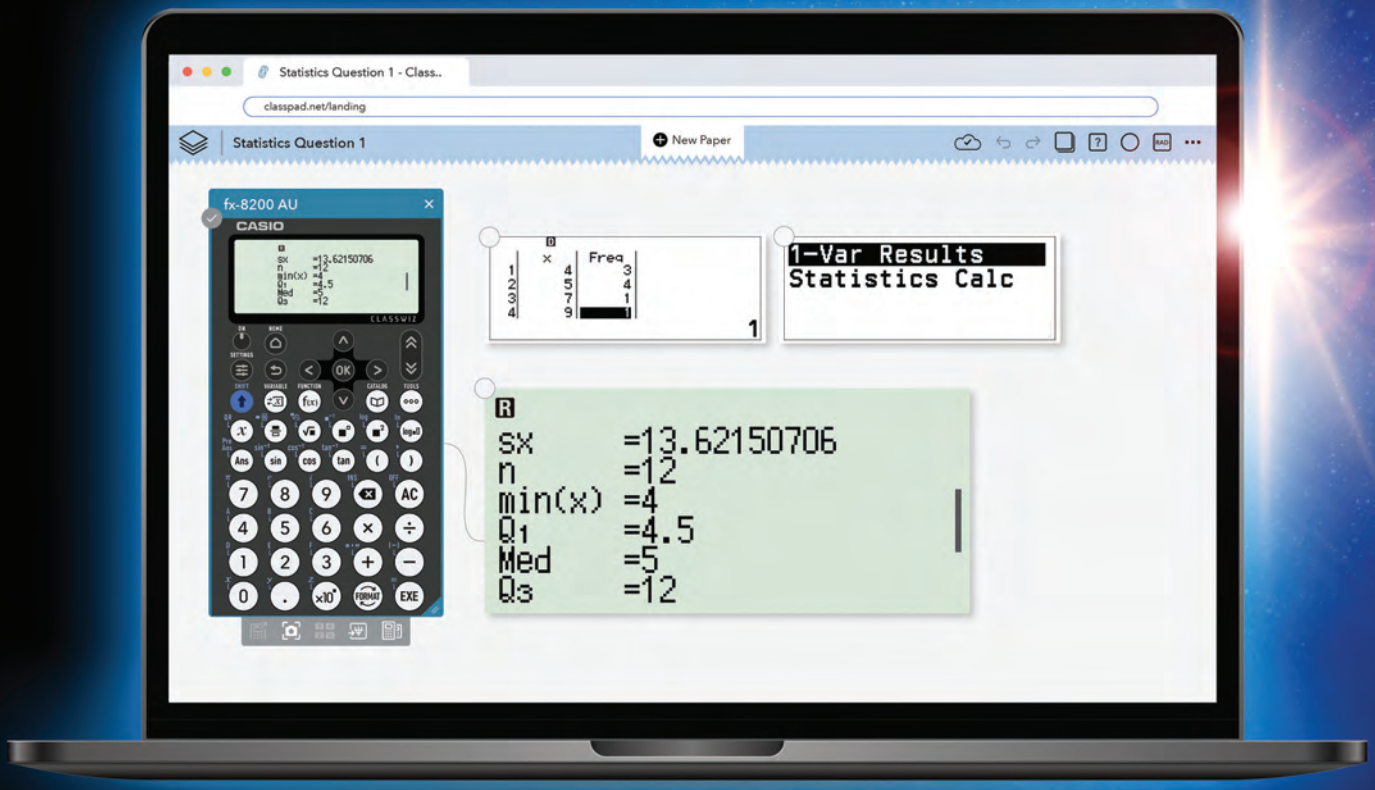
REFERENCE

Sherry, n.d. *A guide to building a Minimum Viable Community (MVC)* https://rosie.land/posts/a-guide-to-minimum-viable-community-mvc.

If you're a maths educator looking to grow your skills, expand your network, and access valuable resources, you can put forward your expression of interest at www.mav.vic.edu.au/Membership/Community or contact Claire Embregts, cembregts@mav.vic.edu.au. Together, let's forge a collaborative learning environment and shape the future of maths education in Victoria.

A NEW fx-8200AU

WEB-BASED EMULATOR



WHAT'S NEW?

+ No need to install anything (and no updating)
+ Accessible on any device, using any operating system (Laptop, tablet, OSX, Windows, iOS, and Android)*
+ As it is part of ClassPad.net, you can create graphs and interactive geometric constructions, and easily take screenshots for your classroom documents
+ Free access to the fx-8200 AU emulator is available to approved Prime Schools Plus schools who booklist the calculator. If your school is not already a member, visit our website

**A device with a web browser and internet connection is required.*

See more on the fx-8200 AU and supporting software at www.casioeducation.com.au

MAVSHOP

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

MAV MEMBERS GET A DISCOUNT ON ALL STOCK

SNAPPY MATHS CLASS SET

K–6

This is the mathematical adaptation of 'Spot it'. Each pair of cards has exactly one mathematical match. Be snappy, the first to find it scores a point. This fast-paced game will help:

- Improve fluency and flexibility with numbers
- Promote multiplicative thinking
- Develop spatial reasoning
- Expose students to different representations of fractions
- Create discussion about shape properties.

The deck contains 31 game cards, links to online games and resources. This class set includes 7 decks.

$126 (MEMBER)
$150 (NON MEMBER)

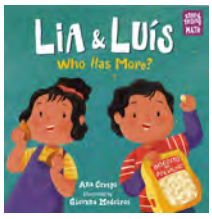
MAPPING MY DAY

1–5

Meet Flora, a precocious little girl who loves drawing, especially drawing maps - of her buried treasure, the breakfast table, the route to school, and more! Follow Flora and her family as she takes us through her day with maps.

Learning to read and draw maps is a fun and interactive way for children to develop spatial thinking skills - how we think about and understand the world around us and use concepts of space for problem solving. Early exposure to map concepts can help foster this type of cognitive development in children and boost their maths and science learning as they progress through school.

$21.85 (MEMBER)
$27.30 (NON MEMBER)



LIA & LUIS...WHO HAS MORE?

F–2

Twins Lia and Luís argue over who has more of their favorite snacks. Can the siblings use maths - and a little sharing - to pick the winner? A playful exploration of measurement, counting, and estimation.

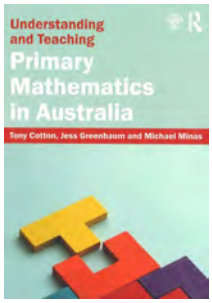
$12.70 (MEMBER)
$15.90 (NON MEMBER)

MAV 2023 TRIAL EXAMS

VCE

Prepare effectively for VCE mathematics examinations with the MAV Trial Exams for Mathematical Methods, General Mathematics and Specialist Mathematics studies. Each trial exam features: Original questions, highly relevant to the current course, fully worked solutions for all sections and clear marking schemes. Exam formats are similar to those used by the VCAA. The purchasing institution has permission to reproduce copies for its students.

ALL STUDIES	$559.60 (MEMBER) $699.50 (NON MEMBER)
INDIVIDUAL STUDY	$232 (MEMBER) $290 (NON MEMBER)



UNDERSTANDING AND TEACHING PRIMARY MATHEMATICS IN AUSTRALIA

F–6

Written by best-selling author and teacher educator, Tony Cotton, in collaboration with experienced Australian primary maths teachers, Jess Greenbaum and Michael Minas, this book combines pedagogy and mathematics subject knowledge to build teachers' confidence both in their mathematical subject knowledge and in their ability to teach mathematics effectively.

Adapted for Australian pre and in-service teachers, the book covers all the key areas of the Australian Curriculum: Mathematics, from teaching number and calculation strategies, to exploring geometry and statistics. Chapters deal with the teaching of mathematics in the early years; inclusive approaches to mathematics teaching, teaching mathematics using digital technologies, as well as assessment and how to teach mathematical topics across the curriculum. Learning is scaffolded by a clear chapter structure that includes starting points, big ideas, teaching points, portfolio tasks, chapter summaries and reflections, as well as taking it further sections to extend learning.

This book is stimulating, accessible and contains a wealth of practical ideas for use in the classroom.

$53.20 (MEMBER)
$66.50 (NON MEMBER)

THE MATHEMATICAL ASSOCIATION OF VICTORIA

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

Prices are subject to change.