THE MATHEMATICAL ASSOCIATION OF VICTORIA

THE COMMON DENOMINATOR 2/24

SWIFTOMATICS

MAV Education consultants, Steven Goldberg, Prahran High School and Louise Gray

If you haven't heard about the 'diva math' behind Taylor Swift's February Melbourne show, where she played to a record-breaking audience of 96,000 over three nights, totalling 288,000 attendees, you might be unfamiliar with the term 'Swiftonomics' which refers to the economic impact of Taylor's concerts. While the economic injection is definitely worth exploring, in this article we'll explore the connections between Taylor Swift and mathematics, 'Swiftomatics'.

Regardless of your stance on Taylor Swift's music, the fever of her fans, or the impact of her visit to Australia on your students, it's an undeniable concept that can inspire some real-world mathematics! One MAV staff member found it hard to justify spending hundreds of dollars on a ticket, but her teenage daughter, who earned money from a part-time job, felt

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THE COMMON DENOMINATOR
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FROM THE PRESIDENT

Kerryn Sandford

At a recent principal forum, I was reminded of how far we have come in a relatively short time towards recognising the need for a focus on mathematics and numeracy teaching and learning.

Supporting the improvement of mathematics and numeracy outcomes for students has become a key priority for the wider system with a clear emphasis on ensuring that schools and teachers have access to resources to support this work. This new emphasis is clearly in response to the latest data from places such as PISA and NAPLAN about the 'decline' in performance by students of this country and our state.

This attention to mathematics and numeracy is both welcome and needed however, we still have far to go when it comes to identifying those strategies that work to support improvement. At the system level, there has been clear messaging around the need for explicit instruction to be a key part of mathematics pedagogy, a reality that I am sure no experienced teacher of the subject would deny, however, what this term 'explicit instruction' is meant to mean receives less clarity in the messaging.

Given the rising challenges that we see in our classrooms and schools around student management and engagement, this idea of explicit instruction is one that we need to unpack.

In this edition of *Common Denominator,* there are many examples provided by teachers as to how explicit instruction can be incorporated into mathematical experiences for students that are rich, informative, and engaging. From investigating the mathematical phenomena that is Taylor Swift to dining out in monster restaurants, activities that inspire curiosity and connect to the lived experiences of students provide opportunities to engage and challenge student thinking and reasoning whilst building strong numeracy and mathematical skills.

With growing recognition of the need to consider ideas such as maths anxiety and student's sense of connectedness to school and curriculum, explicit teaching methods that connect the learning to engaging contexts have to be what we prioritise in schools if we are going to see the improvement in outcomes that the system is seeing. I encourage you to reflect on the articles contained in this edition to build and expand your repertoire of explicit teaching pedagogies that draw from student identified interests and experiences.

MAV AGM

Notice is hereby given that the Annual General Meeting for The Mathematical Association of Victoria will take place on Wednesday 22 May 2024. Please arrive from 5pm for a 5.30pm start. The AGM will be held at Cliveden, home of the Mathematical Association of Victoria, 61 Blyth Street, Brunswick.

All members and interested parties welcome. Come and meet the MAV Board, Life members and the launch of the 2024 – 2026 Strategic Plan.

Agenda

- Welcome
- Minutes of previous meeting
- Annual report
- Financial reports
- Election of Directors if required, and announcement of appointed Directors
- Thank you to retiring Directors
- Launch of 2024 – 2026 Strategic Plan

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

RSVPs close Monday 13 May. RSVP at www.mav.vic.edu.au/events. Email Jen Bowden to arrange a proxy vote, jbowden@mav.vic.edu.au.

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
Metacognition matters: empowering student learning	6/5/24 Virtual	7–12	Rachael Gore
Bendigo regional tour	10/5/24	F–10	Various
Bendigo regional tour	10/5/24	VCE	Various
Algorithmic thinking	14/5/24 Virtual	5–7	Toan Huynh
Navigating conceptual and procedural learning	27/5/24 Virtual	5–8	Nadia Abdelal
Spotlighting: The importance of catching students learning	5/6/24 Virtual	F–6	Jane Hubbard and James Russo
Spotlighting: The importance of catching students learning	6/6/24 Virtual	7–12	Danijela Draskovic
Melbourne Mathematics Conference: Leader's day	13/6/24	F-12	Various
Melbourne Mathematics Conference: Teacher's day	14/6/24	F-6	Various
Mathematics Masterclass: Reaching more students in less time	19/7/24	F-10	Pam Harris
MAV annual conference: Curriculum, pedagogy and beyond	5/12/24 6/12/24	All	Various

BUILD ME UP

Danijela Draskovic, Mathematics education consultant, MAV

BUILDING CAPACITY OF SECONDARY MATHEMATICS TEACHERS

The landscape of mathematics education is evolving, with a revised curriculum and pressure through teacher shortages MAV is working to support our schools. Build Me Up is an on-demand professional learning program for secondary maths educators seeking to enrich their teaching practices. Designed to provide comprehensive content, pedagogical guidance, promoting Department of Education initiatives and a nurturing network of teachers and mentors.

At its core, Build Me Up offers a dynamic learning experience through 12 online modules. These modules, available self-paced, on-demand, feature a wealth of resources, including engaging videos and access to our online MAV Community. Live Q&A sessions held each term offer tailored support to address specific challenges faced by teachers.

The stark reality of maths teacher shortages, particularly in regional areas, highlights the need of this program. Many teachers find themselves teaching out of their field, struggling with confidence, and grappling with misconceptions that can impede student progress. Build Me Up steps in to bridge this gap, offering flexible and accessible professional development opportunities to all secondary teachers.

Our target groups – encompassing out-of-field, beginner, rural, and returning teachers – highlight our commitment to inclusivity and equity in education.

This program is free to all government secondary schools thanks to the funding of the Department of Education Strategic Partnerships Program. This funding has also enabled MAV to offer the program to non-government schools at a low cost.

To express your interest and find out more please complete the survey.

www.surveymonkey.com/r/EOI_BMU

SWIFTOMATICS

Education consultants, MAV, Steven Goldberg, Prahran High School and Louise Gray

CONT. FROM PAGE 1.

that it was worth the hype. People flew from all over the world to see Swift's Australian shows. According to those who attended, it certainly lived up to expectations. This situation raises questions about financial literacy: was the initial expense worth the long-term impact on savings? Research conducted by RMIT University estimated the economic impact of Taylor Swift's Eras tour to be over $500 million nationally. Amazing!

Associate Professor of Finance at RMIT University, Angel Zhong, scrutinised the financial dynamics of this phenomenon, estimating an average expenditure of $900 per person encompassing tickets, accommodation, travel, merchandise, and dining. With 620,000 tickets sold across Australia, Zhong's calculations project the tour's direct economic contribution to surpass half a billion dollars, stimulating economic activity beyond state borders.

Taylor Swift's Eras tour is rich in mathematical explorations, here we unpack investigations ranging from early years right through to VCE. The examples here are an excellent way to embrace the focus on investigations in the V2.0 curriculum.

EARLY YEARS – YEAR 1

Let's make Taylor's fashion choices the centre of attention! Across 12 different outfit changes, how many unique combinations of dresses, skirts and tops could she have rocked?

Swifies went crazy creating friendships bracelets. Using only pink, yellow and blue coloured beads, what combinations of patterns could you create?

Let's uncover Taylor's pre-show routine step by step! What's the sequence of actions Taylor takes to get ready for each performance? List them from first to last.

One of Taylor's songs is titled *22*. How many ways can you represent 22?

The concert lasted for approximately 3.5 hours. How many minutes is that?

YEAR 2 – 4

If you live in Adelaide and have $1000, what is the maximum amount you can spend on flights to Melbourne and still be left with enough money to purchase tickets and accommodation. How much would you be left with? What are some ways to solve this? What strategies did you use? What is a reasonable answer?

If you go to the concert on Saturday night, how many nights accommodation would you need? How much could you spend per night? How can you work out this total using additive and multiplicative strategies.

Taylor's first album in 2006 sold 2.5 million copies. Using place value how can we rename 2,500,000?

Taylor has released about 327 songs over 10 albums. How many songs might have been on each album?

If the approximate length of the MCG oval is between 160 and 170 metres, how long is the stage that Taylor performs on? How do you know?

Tay Tay is 1.78m tall! Can you work out how many centimetres or millimetres that is? What are some other things around the classroom that are roughly the same height as her? Are any teachers the same height? Are there any other celebrities that she is the same height as? Group items that are shorter, the same as and taller than Taylor.

'You need to calm down, you're being too loud!' 96,000 people attended the Eras concerts at the MCG each night. Taylor performed three shows. How many people attended altogether? Can you estimate first? How can you prove your thinking? (Additive and multiplicative strategies).

Taylor Alison Swift is her full name - how many letters does she have altogether? How many of these are vowels? How many consonants? Can you write this as a fraction or decimal in their simplest form?

The Eras tour covers songs from 9 of Taylor's albums. Research the song list. Can you make a graph of how many songs from each album were played? Can you make a pie chart?

YEAR 5 – 6

Taylor's Melbourne concert literally broke the internet. Over 288, 000 fans at her Melbourne concerts endured snail-paced speeds when using their mobile phones. At one stage 96,000 people were using their phones at the exact same time! What might fans have been using their phones for? How might you represent this information using your knowledge of fractions, decimals and percentages?

The MCG hosted Taylor's Melbourne concerts, while her Sydney concerts were held at the Accor Stadium. What comparisons can you make between the two stadiums? You might like to consider seating arrangements, ease of access from the CBD via public transport, the size and shape of the venue, food stall availability and location, or you may have some ideas yourselves. How might you represent your findings in two different ways?

Many people missed out on a ticket. Some people flew to other countries just to see the concert. Which is the most economical country to travel to: Singapore, France or Poland? Be sure to factor in flights, accommodation, travel to the stadium, food and at least one item of Eras tour mechandise.

YEAR 7 – 10

Using information in Figure 1, use the Fermi Estimate technique to to determine approximately how many seats are in each section.

Use a protractor and basic trigonometry to determine how far each section is from the stage.

Let's assume that ticket prices were $700 for A reserve, $600 for B reserve and so on. If you were in G reserve, conduct an analysis to determine how much extra you would have to pay to get one metre closer to Taylor? How much extra would you need to pay to move from G reserve to right in front of the stage (section C7)?

Assuming the houses of people who attended are evenly distributed around Melbourne, can you approximate how many people travelled on each of the train lines? This can include research into the proportion of people that travelled by different methods (car, tram, train, cycle, walk).

Using Google Maps, and making assumptions about traffic and queuing,

what would be the time difference between different modes of transportation from your house to the concert?

There was chaos when tickets for the Australian concerts went on sale. Ticketek allowed users to purchase tickets in a randomised fashion. People were not in a virtual line for tickets. Assuming that 10% of the audience had tickets for all three shows, and a further 10% had tickets to two shows, how many unique individuals witnessed the three Melbourne concerts?

Taylor has 10 albums. In each show, she plays two surprise songs. If she cannot repeat a song that already appears in the show set list, how many surprise songs does she have to choose from? Taylor is playing 152 shows worldwide, will she need to repeat a surprise song? How many combinations of surprise songs are there?

Review Professor Zhong's research (see references). Follow her steps, compiling research on the average cost of flights from different capital cities to Melbourne, the average price of a hotel, food, merchandise, etc. Use evidence to approximate the proportion of attendees who would need to travel to Melbourne and include the travel expenses for that fraction of the attendees. Detail your assumptions and methodology.

What is a reliable way to estimate the proportion of tickets that were sold to people in different states? What proportion of people would have stayed with friends and not paid for a hotel? (This task could begin with heavy scaffolding and then end as an open-ended investigation).

More than 4 million Aussie's logged on to secure tickets to the seven Australian concerts. Estimate how many people missed out on tickets. How many concerts would Taylor have to play at the MCG in order to completely satisfy the demand for tickets?

VCE

Figure 1 shows an interesting arrangement on the oval. Why were the seats set up this way? Could they be arranged in a different way to accommodate more people? What other considerations are there when arranging seat configurations?

If a Swiftie decided not to go to the show and put their money into a savings account, what would it be worth in 5, 10, 50 years?

There was a wealth transfer during these shows from the pockets of Swifties into the pockets of restaurant and hotel owners, airlines, Taylor, her production crew and the music industry, etc. Countries around the world have realised the economic power of Swift playing a concert. Conduct an investigation into the economic benefit of two countries that Taylor is playing in. Which country benefitted most? Why?

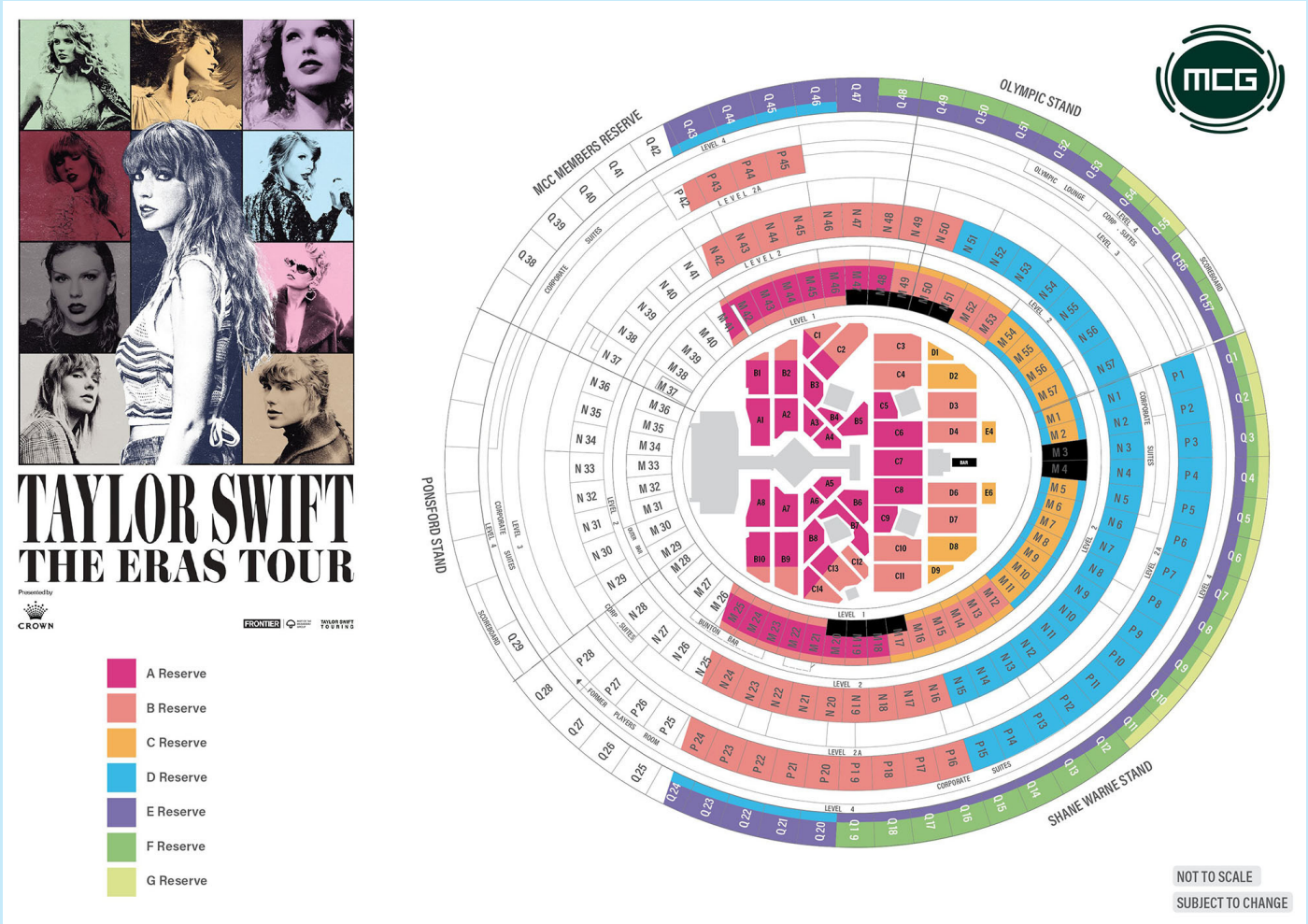


Figure 1. The seat map for Taylor's MCG concerts. Image from austadiums.com.au.

SWIFTOMATICS

Education consultants, MAV, Steven Goldberg, Prahran High School and Louise Gray

How does the economic impact of Taylor's concert compare to a regular weekend in Melbourne? What does the typical Swifty spend on a normal weekend versus during the shows?

How much did Taylor earn from her Australian shows? How does that compare to the average Australian wage earner?

If Taylor lived in Australia, how much tax would she need to pay assuming that her annual income is equal to the amount she earnt during the Australian shows.

Now that you've estimated Taylor's gross earnings, let's think about her costs. She flew from Japan to Australia on a private jet, her crew travelled too. Her concert is a huge production. The crew, dancers, costumes, the stage, props and lights all need to travel from country to country. The crew need to be accommodated and fed, the stage needs to be set up and packed down. Estimate these costs and any others you can think of. Then, determine Taylor's likely net earnings

Merchandise sales were also open to non-ticket holders. How would the promoter determine how many units of each item should be available in Melbourne to satisfy demand?

ENGAGING STUDENTS

The 2023 PIVOT report on enhancing student engagement in mathematics, conducted in collaboration with AAMT and AMSI, delved into various strategies to invigorate students' interest in maths. Through surveys of 80 educators and 2,500 students, alongside comprehensive literature reviews and statistical analyses, the study identified pivotal factors such as fostering positive classroom environments, nurturing relationships, and maintaining high expectations.

Whilst it would be irresponsible to divert from a well-planned curriculum to appease the Swifties, it is undeniable that drawing inspiration from the Taylor Swift phenomenon to design tasks that meet the specific needs and interests of your students will increase engagement. Leveraging pop culture can make mathematics more relatable and engaging for learners. By incorporating elements from the tour into mathematics activities, educators can infuse excitement and relevance into the curriculum.

The PIVOT report encourages teachers to explore diverse teaching strategies and prioritise building strong relationships within the mathematics classroom. When investigating elapsed time, why not use Talyor's generic concert playlist as an inspiration, her flight itinerary or the timeline of all Eras concerts across the globe.

Collaborating with teaching peers to design tasks inspired by the Taylor Swift tour and implementing the recommendations outlined in the report, educators can foster a dynamic and an engaging learning environment that nurtures students'enthusiasm and proficiency in mathematics.

REFERENCES

www.forbes.com.au/life/entertainment/taylor-swift-australian-eras-tour-sparks-558m-economy-boost/

www.pivotpl.com/maths-report-2023

Real-world events serve as powerful catalysts for engaging learners, offering practical applications of mathematical concepts. MAV education consultants collaborate with educators and leaders to build capacity to create mathematical tasks tailored to students' needs and contextual relevance.

To discover more about how MAV can support your school, reach out via email to our friendly team: primary@mav.vic.edu.au or secondary@mav.vic.edu.au.

If you can't get enough of Taylor, be sure to check out the Term 2 edition of MAV's primary journal, *Prime Number* for more Taylor Swift links to mathematics.

100 DAYS OF SCHOOL

Renee Ladner - Primary education consultant, MAV

This year marks 45 years since the very first 100 Days of School celebration took place in California.

Teacher, Lynn Taylor, sought to mark the first 100 days of students' schooling to emphasise their understanding of the number 100. Since then, the day has skyrocketed in popularity and many schools now have different and varied ways of celebrating 100 days of school. Most schools mark the special occasion in the Prep or Foundation classes.

In my teaching experience, 100 days of school was a day completely dedicated to all things around 100, often also shared with treats, dress ups and a huge amount of excitement. It is a big day in the calendar, and so it should be! Beginning school is a big shift from kindergarten in so many ways and celebrating this milestone is very important. As educators, it is vital that we don't lose focus of that magical number, 100.

Children are captivated by the number 100, it seems so large to them and often they are still building their comprehension of what 100 looks like. Giving students images where there are exactly 100 objects in the picture or maybe a few more or less and asking them to assess if there are more or less and hearing their reason behind their answers can be fascinating.

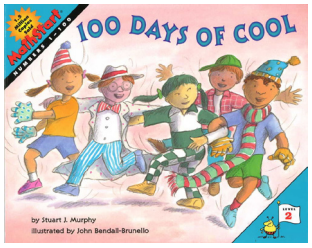
Many classrooms begin their year by counting how many days they have been at school. There are various ways to count such as:

- using sticks to count and bundle for every 10
- placing a pompom or counter on the hundreds chart to indicate how many days
- writing the amount in words
- focusing on what comes before/after
- showing the numbers using fingers and toes to count and so on.

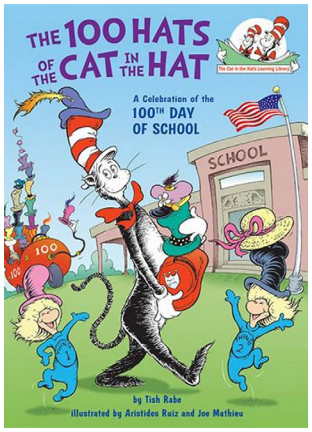
100 days of school falls at the time of year when the weather is dreary and tiredness is creeping in for both students and teachers. So! Let's share ideas to help you kick off 100 days of school, 100 days of learning, 100 days older, 100 days smarter with a bang!

PICTURE BOOKS

Picture books are a brilliant way to build anticipation and celebrate the milestone, here are some suggestions:



100 days of Cool by Stuart J. Murphy is an engaging mathematical story that follows the lead up to 100 days of school along a timeline with a variety of activities that the students are a part of to be 'cool' at school.



The 100 Hats of the Cat in the Hat by Tish Rabe is a delightful take on the Dr Seuss adventures and goes through the many ways of using materials to explore the number 100 through hundreds charts, tens frames and number lines using rhyme to engage children and setting the scene for an exploration.

100 Dogs by Michael Whaite is a fun book that counts dogs five at a time on each page until it gets to 100 different dogs. A simple task could be to look at the number of dogs before reading the book to see if students could estimate the total or if they have some strategies to skip count quickly, group the dogs logically or sort them into categories.

CELEBRATION IDEAS

- School-community connections: invite grandparents to talk about how school has changed since they were in Prep.
- Use the milestone as an opportunity to pick up 100 pieces of rubbish to clean up our environment.
- Collect $100 and donate it to a local charity.
- Get moving: estimate how far you can get in 100 steps, jumps, leaps.
- What does 100 metres look like?
- How long does it take to run 100 metres?
- How long would 100 Preps be? Would it be different if the students are standing up or laying down?
- Make and represent 100 using a variety of materials. This could be a home project to engage family members in the lead up.
- Learn how to say 100 in different languages.
- Is this 100? Investigate various ways to represent 100 abstractly or by renaming.
- Create a scavenger hunt around the school to find numbers in order to 100, counting by twos, fives or tens.
- Dress up with a creative costume that represents 100.

MAV have a range of picture story books that can help you celebrate 100 days of school, check out the range at: Visit www.mav.vic.edu.au/mav-shop.

We would love to hear how your school celebrates 100 days of school. If you have a great story to share, please get in touch office@mav.vic.edu.au.

MONSTER'S DELIGHT

Michael Nelson – Maths learning specialist, Drysdale Primary School

I love reading to my class, especially a high-quality picture story book. One of my personal favourites is the adventures of Marcel the Monster in *Monster Chef* by Nick Bland. This article follows the approach outlined by Russo and Russo (2017) known as the Narrative-First Approach, involving 'beginning with rich narratives, and mapping on the mathematics'.

At the end of *Monster Chef*, Marcel opens a restaurant called Monster's Delight and other than boiled brussels sprouts, we don't see the remainder of the menu. Which leads perfectly into our lesson on money, and in particular change received from a purchase.

After reading the story, our lesson begins with the students creating the menu for their own Monster's Delight. The students love exploring how creatively disgusting they can make their own menu of dishes and it is a perfect opportunity to incorporate student writing, both descriptive (when describing the dishes) as well as persuasive (to convince the other monsters in the room to come to their restaurant). I usually have students create three entrees, three mains and three deserts, but this can be adjusted depending on the amount of time available.

Before getting into the purchasing and change components, this is the time to explore the power of an open number line and the 'building up' strategy. Whilst subtraction and the associated algorithm are both perfectly acceptable approaches to solving these problems, I would contend that the open number best represents both the mental process going on as well as allowing the maximum number of students to engage.

The other powerful idea around the open number line is using it to identify the components of the problem, in a similar way to a bar model. Teachers often lament that students lack the ability to read and comprehend worded problems.

One area of need of students is to understand the structure of different types of problems. If you think about it, change problems involving money are addition/subtraction problems. Therefore, they will contain a part (the cost of the item), the other part (the change) and the whole (the total given to the other party).

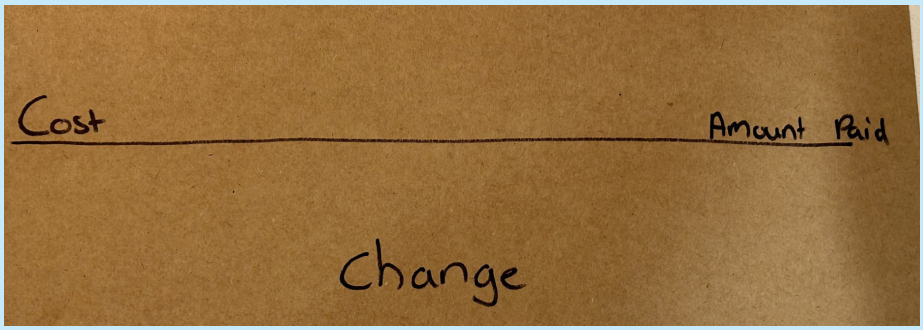


Figure 1.

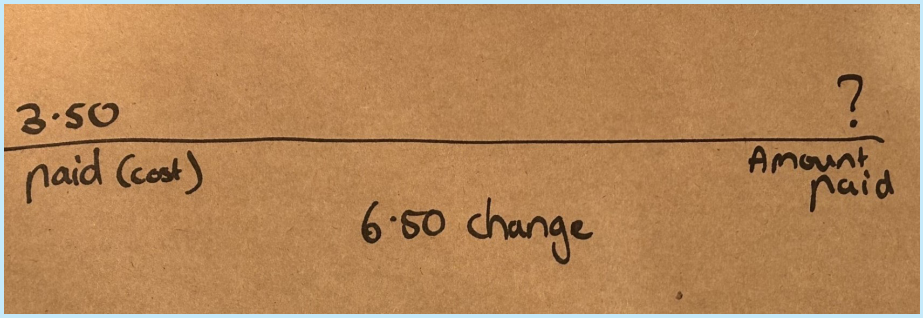


Figure 2.

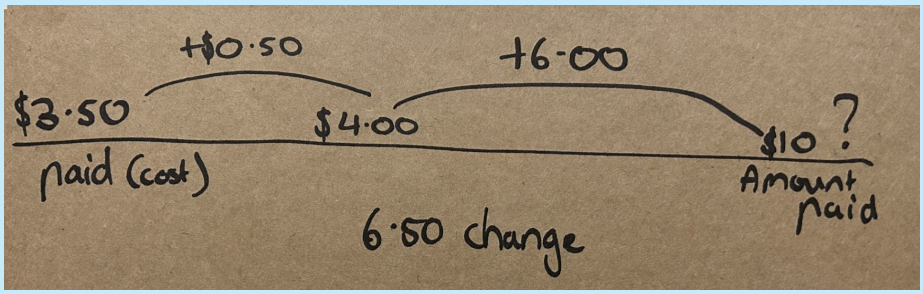


Figure 3.

So, problems can take one of three forms:

1. Find the change: Mike bought a drink that cost $3.50 (part). He gave the shop keeper $10 (part). How much change did he get (whole)?

2. Find the amount paid: Mike bought a drink. It cost $3.50 (part) and he got $6.50 in change (part). How much did he pay? (Whole)

3. Find the cost: Mike bought a drink. He paid $10 (whole) and he got $6.50 change (part). How much did it cost? (part)

Using the number line in Figure 1, we can plot the pieces of information we have and identify the information we don't have.

From work within the classroom, as stated before, the building up strategy is my favoured approach, however if a student could efficiently and confidently use another strategy, I would never stop them.

When we know the two parts, as in Question 2 above, it is simply an addition problem (Figure 2 and 3). In Questions 1 and 3, the building up strategy requires the problem solver to start at the part known and go up to the whole. Depending on the numbers, it may be more efficient to work dollars and then cents or vice versa (Figures 4, 5, 6 and 7).

Once armed with appropriate strategies for solving problems, it's time to eat! Students will walk around and decide on a restaurant. Once they have selected, I have them choose meals based on a variety of questions (Figure 8).

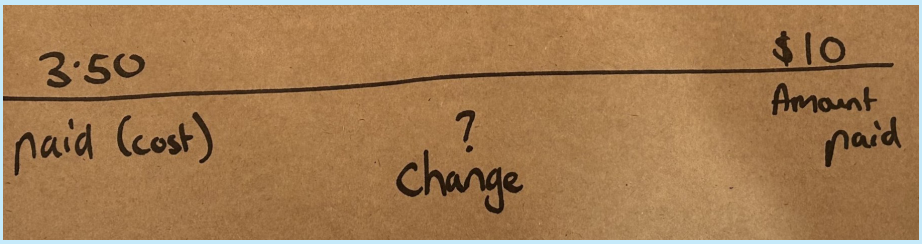


Figure 4.

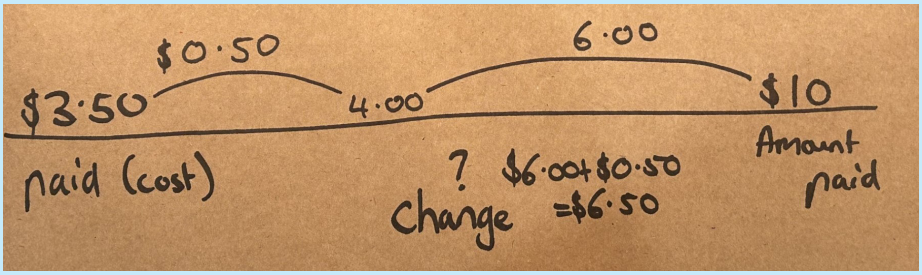


Figure 5.

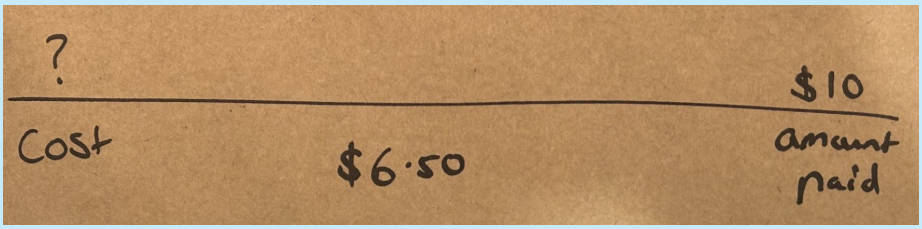


Figure 6.

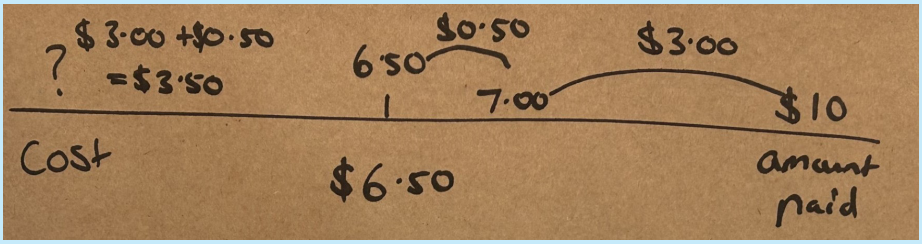


Figure 7.

1. Select one entree, one main and one dessert from your partner 's menu. Record the name of the dish, the price and how much change you would get from $20.
2. Which item out of the nine would give you the most change?
3. Which item out of the nine would give you the least change?
4. If you were given $50, what is the most amount of food you could buy? Record the names and prices of the dishes.
5. If you were given $50, what is the least amount of food you could buy? Record the names and prices of the dishes.

Figure 8.

These questions can be easily adjusted based on the needs of your students and can include extending and enabling prompts.

Whilst when we did this activity, the focus was exclusively on change, another component could simply be representing the coins and notes used to purchase the items at cost price. On the higher end, exploring the idea of purchasing the ingredients (profit and loss) and having sales and/or buying ingredients at a discount (percentages) allow the activity to go into upper primary and lower secondary with ease.

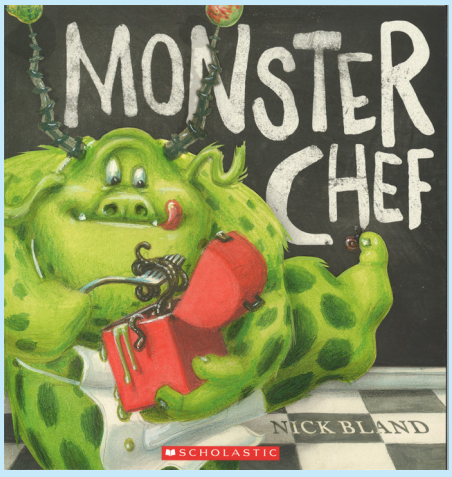
Once finished, students share their delicious meal and discuss the maths they used to purchase it.

Monster's Delight is a fantastic activity for engaging students at any level as well as being flexible enough to be applicable across the curriculum.

REFERENCE

James Russo and Toby Russo (2017), Using rich narratives to engage students in mathematics: A narrative-first approach. *Mathematical Association of Victoria Annual Conference*.

You can see more from Michael Nelson, at https://michaeljnelson09.wixsite.com/mike-nelson-maths.



Monster Chef is available to purchase via the MAVshop.
Visit www.mav.vic.edu.au/mav-shop.

SUPPORT FOR DYSCALCULIA

Jennifer Sze – The University of Melbourne

A MIDDLE YEAR LITERACY AND NUMERACY SUPPORT TEACHER'S CASE STUDY OF SUPPORTING YEAR 6 STUDENTS WITH MATHS LEARNING DIFFICULTIES

In January 2022 after months of research to find an appropriate professional body to learn more about dyscalculia. I could not find any organisations that offered a practical course with evidence-based research on how to teach students with maths learning difficulties in Australia.

Through prior professional learning at SPELD Victoria, I encountered Dyscalculia Association UK and started the year long online course. The course is an interactive hands-on course designed by Professor Steve Chinn and Judy Hornigold of the Dyscalculia Association UK. This reflection is the Final Practicum I submitted after successfully completing 10 hours of teaching maths to a group of learning difficulties students in Year 6.

In this article, I have outlined critical evaluation and reflection on the lessons. I have included a structure of a multisensory maths lesson plan based on the Singapore Maths pedagogy (Chinn, 2017; Hornigold, 2017). I then tailored the lessons to the students' learning needs and taught accordingly.

THE NATURE OF DYSCALCULIA AND GENERAL MATHS DIFFICULTIES

Dyscalculia is defined as 'a condition that affects the ability to acquire arithmetical skills. Dyscalculic learners may have difficulty understanding simple number concepts, lack an intuitive grasp of numbers, and have problems learning number facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence.' (Bird, 2021, p 5).

To understand Maths Learning Difficulties (MLD) and their connections to ADHD and dyslexia, it is helpful to look at the two types of cognitive processes involved in doing math. Researchers break these processes down into domain-general processes and domain-specific ones. (Emerson & Babtie, 2014). Domain-general processes refer to the basic processes of the brain, such as working memory, processing speed, executive functioning, and language processing, which underlie many tasks. These are the processes responsible for most of the overlap with other learning disabilities. (Henderson, 2012). Domain-specific processes solve math problems using the brain's hard wiring, often referred to as the 'number module.' These processes specifically affect maths and are responsible for maths learning disabilities. And, of course, everyone will have a different profile of MLD and co-morbid ADHD and other Learning Difficulties (Bird, 2021; Chinn, 2017).

Numeracy teaching should aim to help learners build up a sound mathematical understanding of numbers and their relationships (Chinn & Ashcroft, 2017). The basis of my own teaching approach with students with special learning needs such as dyscalculia would be to focus on the mastery of number sense. These include arithmetic and using a variety of manipulatives. My main manipulatives are the Integer blocks, Cuisenaire rods and counters. Once a numeral concept has been understood at the concrete level, then, I will begin to lead the students towards abstract. That is, the students would need to build, draw, and write. Abstract always come last.

Critical evaluation and reflection on the lessons

Throughout the ten lessons, I followed the Multisensory Maths Lesson Plans and used manipulatives throughout each lesson. These included the Maths U See's Integer Blocks and Fraction tiles. In addressing the students' learning diversity as all students had learning difficulties such as Dyslexia, Developmental Language Disorders and ADHD. I had to keep the lesson short and sharp with a clear focus and chunking information to ensure that the messages got through to them.

Here are the main steps I took in planning each lesson in alignment with the Dyscalculia Association UK's Multisensory Maths Lesson Plan (Dyscalculia Association UK, 2022):

Review

Previous learning/concept: multiplication is fast counting of the same number.

New concept or review of recently introduced skill/concept

The review concept section of the lesson provided an opportunity to revise the materials presented in the last lesson, and for the teacher to clarify any misconceptions.

Word problem

The word problems I used have been adopted by Singapore Maths strategies. Where possible, I used the bar model to show student how to solve a word problem using the Singapore Maths method. There are five steps in a Singapore Maths lesson:

- Metacognition
- Processes
- Concepts
- Skills
- Attitudes

If children develop these skills in a maths lesson, they will develop as mathematician and work collaboratively with their peers.

Students talk for 85% and teachers talk for 15%. Furthermore, there is constant exploring in Singapore Maths. In Australia, once the students provide the answer to a maths problem, the solution stops there. It is a closed question. Whereas with Singapore Maths, the students are encouraged to find different solutions to a problem. This in turn creates critical and creative thinking. These are important skills for 21st Century not just in school but in the real world.

Reflection

I always ask students to reflect on what they learn and what they want to work on for the next lesson. That way, I can plan for the next lesson to teach at point of needs.

RATIONALE

The rationale behind my intervention and lesson content was based on my knowledge of the students and where are they at on a given topic.

The structure was as follows:

- Understanding
- Fluency
- Problem Solving
- Reasoning

Using concrete materials to support students' understanding of the communicative relationship between these numbers. In addition, most students who are struggling with maths do not know the basic number sense. The students did not know their timetables. Timetables are often taught by memorisation. This can be very daunting for children, more so for children with maths anxiety and maths difficulties.

HOW SUCCESSFUL WAS THE INTERVENTION?

In designing the ten lessons to support these students and teaching them at point of need, I kept in mind what the students know and their gaps of knowledge and taught them accordingly.

My objective was to ensure students could explain how they arrived at a particular answer and can explain the concept. I wanted to make sure they understood the concrete concept by using manipulatives to demonstrate understanding. I avoided launching into the abstract form of concept when they had not fully grasped the fundamental numeracy concept of number sense.

Before introducing any new concepts, I ensured that the students understood what we learned in the previous lesson. By doing so, I was hoping to avoid the cycle of confusion for the students. As Sharma & Chinn (2022) articulated, many teachers begin at the abstract form of the concept. The students may face difficulty in learning the concept being taught. In a later lesson, when the teacher begins a new concept, they may assume that the mastery in the previous lesson has been understood by the students. The teacher then would begin teaching the new concept at a higher level. When this occurs, the students might not understand the teacher's explanations and might have difficulty in learning mathematics, which then results in the failure and the fear of mathematics. (Sharma & Chinn, 2022)

REFERENCES

Bird, R. (2021). *The Dyscalculia Toolkit* (4th ed.). Corwin.

Chinn, S. (2017). *The Trouble with Maths* (3rd ed.). Routledge.

Chinn, S. & Ashcroft, R. (2017). *Maths and Dyslexia and Dyscalculia: A Teaching Handbook* (4th ed.). Wiley.

Dyscalculia Association UK. (2022). Online Accredited Course. Access: www.dyscalculiaassociation.uk/services.asp#training

Emerson, J. & Babtie, P. (2014). *The Dyscalculia Solution*. Bloomsbury.

Hornigold, J. (2017). *Understanding Maths Learning Difficulties*. Open University Press.

Henderson, A. (2012). *Dyslexia, Dyscalculia and Mathematics: A Practical Guide (2nd ed.)*. Taylor and Francis.

Sharma, M. & Chinn, S. (2022). *A Model for Acquisition of Numeracy by Children*. Accessed: https://mathlanguage.wordpress.com/author/mathlanguage

MAV consultants can assist teachers at your school with implementing strategies to support students with dyscalculia. Contact Renee Ladner, rladner@mav.vic.edu.au to learn more.

STIMULATING THINKING

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

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

EARLY YEARS

- Which fruits are small? Which fruits are large? Can you see anything around you that looks to be the same size as the small fruits? Can you see anything around you that looks to be the same size as the large fruits? What are some other words for small and large?
- How many different types of fruit are on the platter? How did you count to make sure you didn't miss any or didn't count any more than once? If I took one fruit away, how many different types would be left? How do you know?
- What shapes can you see in this picture? Describe one of the shapes you can see without saying the name of the shape!
- Are there more green grapes or more raspberries? How can you be sure?
- Which fruits have more than five pieces on this platter? Which fruits have less than five pieces on this platter? How do you know?
- Which fruit do think would be the quickest to eat? Which fruit do you think would take the longest to eat? Why? Do you have some fruit you could try and see what takes the longest / shortest to eat?
- Are there any fruits you can think of that have zero pieces on this fruit platter?
- I made a fruit platter that had four different fruits on it. Can you draw (or make) what it might look like?
- Make the shapes of the fruits using playdough, and then describe the shapes to someone else and see if they can guess what fruit you made.
- Use the picture as a game board. You have ten counters. Close your eyes and throw one counter at a time. Each time you land on the pomegranate you get one point. How many points can you get?

FOUNDATION - YEAR 2

- How many pieces of each fruit can you see? Which fruit has the most number of pieces? Which fruit has the least number of pieces? How do you know?
- Choose three of the fruits on the platter, and order the size of them from smallest to largest.
- When the berries are in a pile, they are hard to count! Draw a picture that makes it easy for someone else to count a group of 27 berries.
- My friends and I each want to eat five strawberries. How many friends might I have and how many strawberries would we need altogether? How many different possibilities are there?
- How many green grapes do you think there are? If you eat half of them, how many would you eat?
- Use pictures, symbols or letters to represent the fruits (e.g. S = strawberry), how many different repeating patterns can you create using two or more of the fruits on this platter? Give your patterns to someone else and see if they can continue the pattern correctly!
- On another fruit platter there are 30 grapes altogether. Some are red and some are green. How many might be red? How many might be green? How many different combinations can you come up with?
- At school we eat our fruit when the minute hand is on the six. What are the possible times we could eat our fruit?
- The oranges have been cut in half. I have a big bag of oranges. How many oranges might I have, and how many halves would that be? Prove your answer is correct! Can you come up with more than one answer?

YEARS 3 - 6

- Create two different graphs that both show the amount of each individual type of fruit on the platter. Which graph is easier to interpret and why?
- I need to share this fruit platter with my friends so that we all get the same amount of each fruit. How many friends might I have, and how much of each fruit would each friend get?
- What fractions can you see on this platter? For each fraction you can see, can you show it in a different way?
- The fruit platter is $35.50, with a 20% discount for purchases of 5 or more platters. If I intend to buy six platters, what is the cost? What savings would I incur compared to the full price?
- The combined weight of fruits on this platter amounts to 750 grams. Raspberries are the lightest, and contribute a total of 50 grams. What could be the individual weights of the remaining fruits, and how many unique combinations can you generate?
- The cost of purchasing the fruit to make this platter was $30. The cost of the three different berries combined was 25% of the total cost, and the green grapes were 15% of the total cost. In dollars and cents, how much might each of the fruits have cost?
- It took my family 45 minutes to eat this fruit platter. On a digital clock, the digit representing the hours was different when we finished eating compared to when we started. What time might we have started eating, and what time would that mean we finished? How many different possibilities are there?
- How many lines of symmetry does each of the fruits on this platter have? Draw them to prove you are correct. Which ones have both line and rotational symmetry? Prove it!
- I picked a piece of fruit off the platter at random. What fruit do you think I had the most chance of picking and why? Which fruit do you think I had the least chance of picking and why?

YEAR 7 AND BEYOND

- Draw the four quadrants of the cartesian coordinate system over the top of the picture, and provide the location of each of the fruits.
- Estimate the radius of the cross-section when an orange, grapefruit, and pomegranate are cut in half to form circles. Use these estimations to calculate the diameter, circumference, and area of the cross-section for each fruit. Do this for as many other fruits as you can. If you have some of these fruits nearby, check your measurements!
- A green grape is three quarters of the size of a blackberry. What might the volume of the blackberry be, and what volume would the green grape be? How many different possibilities can you come up with?
- A customer has placed an order for a fruit platter with three fruits only. They have been very specific about the ratios of each fruit on the platter. The ratio of strawberries to blackberries must be 2:3 and the ratio of blackberries to raspberries must be 1:2. What combinations can you come up with for the numbers of each fruit on the platter that would meet the requirements?
- If the scale of the picture is 1cm = 3cm, which fruits can you work out the volume of? Which fruit has the largest volume? Which fruit has the smallest volume? What is the difference between the largest volume and the smallest volume?

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.

ONE MINUTE WITH CHRIS MATTHEWS

I AM...

Professor Chris Matthews FTSE, CEO of ATSIMA.

MY SCHOOL EXPERIENCE INFLUENCED ME DEEPLY...

Dealing with racism from teachers and students had a huge impact on my school life. My maths teacher consistently humiliated me about being Aboriginal. I was born and raised away from my Community on Minjerribah in Toowoomba. I was the only Aboriginal student in my cohort. I felt angry, frustrated and a strong sense of not belonging: the system was not there for me. You can easily head down a self-destructive pathway or aim to make a change in the world and prove everyone wrong. My journey moved between these paths. I value all the people who kept me on a positive journey. Not one of them was a teacher.

MY INTEREST IN MATHEMATICS EDUCATION WAS SPARKED BY....

Science fiction fuelled my interest in the sciences. I was obsessed with the Commodore 64 and taught myself to program in Basic. I learnt about the intersection between mathematics and computing. This focus eventually led to a PhD in applied mathematics. I started my career as a research mathematician at a University in Queensland but again, I was continually pushed outside and found it difficult to deal with the racism I was experiencing from my colleagues. I moved to mathematics education because I wanted to make a change in the teaching and learning of mathematics for all Indigenous learners across Australia that supported and valued their identity and culture. I know our children are smart and the statistics that we continually hear are not a true reflection of their ability. I wanted to take what I had learnt and give back to Indigenous communities across Australia

INDIGENOUS STUDENTS FACE CHALLENGES IN MATHEMATICS...

The education gap has not moved and in some areas the gap has widened. Indigenous people are simply not valued in the education system. ATSIMA advocates for a culturally responsive teaching practice in mathematics and one that is connected to Indigenous culture and people. We are still fighting for bilingual education for first language speaking communities across all learning areas as a valid and successful approach. We still measure Indigenous students on standard tests that have very little to do with their language and culture of their people and get judged by their test performance. We still do not have an adequate pre-service teacher training in a cross-cultural context particularly in relation to Indigenous peoples.

GIVE IT A GO....

Teachers have a lot of fear when it comes to being more culturally responsible in their planning, teaching and learning. I encourage all mathematics educators to have the courage to give it a go. If you are worried about whether you are doing it right, you can practice a simple test. During the planning process simply ask yourself, 'will this activity respect and value Indigenous people and culture?' If you can answer with a yes, chances are that you are on the right track, which will improve as you develop your practice.

Start with areas that are your strength, explore the cross-curriculum priorities elaborations in the mathematics curriculum and explore books like *Dark Emu* that re-tell our history and demonstrate the sophistication of Indigenous culture in Australia.

I LOVE TO GO....

Camping in the bush on Minjerribah away from tourists, swimming, fishing and sitting around a fire.

I LISTEN TO....

Aboriginal rock bands like Warumpi Band, Blues, Billie Holiday and Nina Simone. I am a big fan of Archie Roach, Ruby Hunter and Kev Carmody whose lyrics had a profound impact on my life.

ATSIMA and AAMT have partnered to develop national, state and territory action plans to make a difference in mathematics education for Indigenous learners. Visit www.atsima.com.

STUDENT **GAMES** DAYS

MATHEMATICAL ASSOCIATION OF VICTORIA VICTORIAN CHALLENGE AND ENRICHMENT SERIES

Date: Various, see below. Most events run from 9.30am - 2.30pm.
Cost: Thanks to the Department of Education, the events are free to all Victorian government schools.
Registration is essential: www.mav.vic.edu.au/events

A VCES Games Day offers an engaging platform for high ability students to actively participate in a diverse range of math games carefully designed to challenge their mathematical thinking and reasoning skills.
Our aim is to provide students with opportunities to enhance their productive learner dispositions through team challenges, all while fostering curiosity and a sense of fun. We encourage you to seize this opportunity and register teams from your school to participate.

VENUE	TERM	DATE
Warragul Regional College	2, 2024	Year 7 and 8 30 May
Box Hill North Primary School	2, 2024	Year 5 and 6 26 June
Box Hill High School	2, 2024	Year 7 and 8 27 June Year 9 and 10 28 June
Wodonga Primary School	3, 2024	Year 5 and 6 7 August
Myrtleford P-12 College	3, 2024	Year 7 and 8 8 August Year 9 and 10 9 August
Elwood Primary School	3, 2024	Year 5 and 6 14 August
Heathmont Secondary College	3, 2024	Year 7 and 8 15 August
Geelong High School	3, 2024	Year 9 and 10 16 August
Mornington Primary School	3, 2024	Year 5 and 6 30 August
Balwyn High School	3, 2024	Year 7 and 8 5 September

VENUE	TERM	DATE
Balwyn High School	3, 2024	Year 9 and 10 6 September
Grahamvale Primary School	3, 2024	Year 5 and 6 11 September
Mirboo North Primary School	4, 2024	Year 5 and 6 16 October
Mirboo North Secondary College	4, 2024	Year 7 and 8 17 October Year 9 and 10 18 October
Virtual Games Day	4, 2024	Year 9 and 10 14 October Year 7 and 8 21 October Year 5 and 6 28 October

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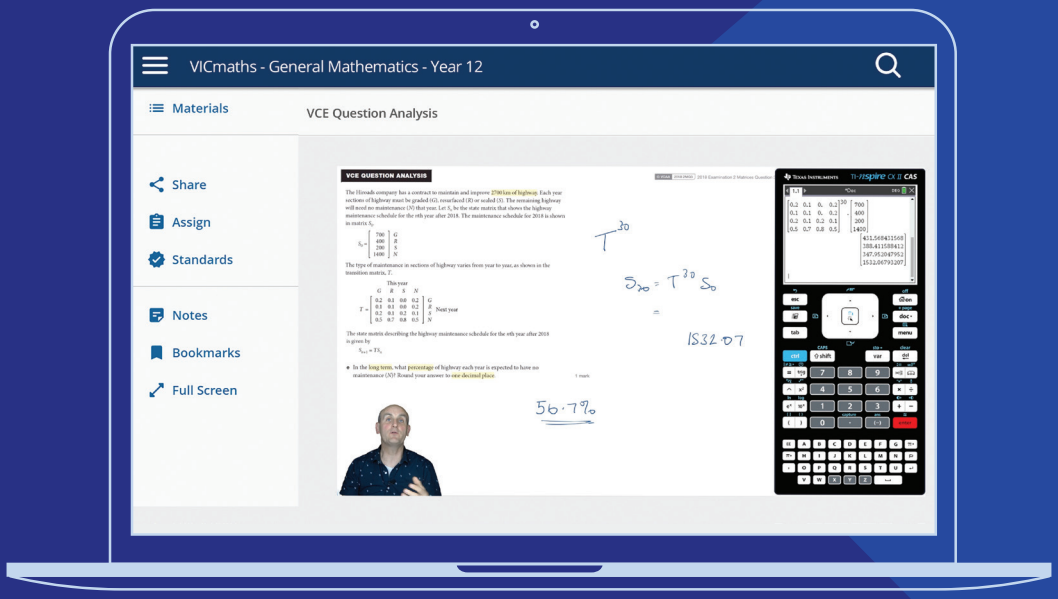

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PATTERNS OF QUESTIONING

Pam Harris – Math is Figureoutable

Asking students better questions is a lot less about the individual questions we ask and a lot more about the *pattern* of questioning.

Those patterns are best described as either more *funnelling* or more *focusing*.

The key difference between the two extremes, and thus the learning outcomes, rests on the teacher's ability to draw on the context of the learning to empower the student to use what they already know, rather than merely corral them to the answer. Getting one answer is great, but taking the time and care now to best position a student to get all future answers to similar questions is better.

A FUNNELLING PATTERN OF QUESTIONING

A pattern of questioning on the far end of the funnelling side of the spectrum might go something like this:

'What is the question asking for?'

'Where is that formula on your fact sheet?'

'What is the radius?'

'What is that number cubed?'

'What is that number multiplied by Pi?'

'What is that number multiplied by four thirds?'

Notice those questions are less questions and more a sequence of instructions worded as questions. Also notice that there's nothing student specific here, nothing to ground the student in what they do understand about the situation. Teachers who use funnelling patterns of questions will often use the exact same pattern for every student. While certainly straightforward, this approach cannot take advantage of anything the student already has going for them.

In a world where mathematics is a series of steps to be memorised, this makes an amount of sense. If a student is stuck, they must not remember the next step. So the teacher asks a question intended to prompt the student to find that next exact step. This is where endless, time draining math drills come from. It's all about steps that must be memorised.

Consider how inefficient this is. After days of drills, perhaps a majority of the students have this sequence memorised (for now, more drilling will be required later as much of this will be forgotten by the time the high stakes test rolls around)

But it never is just 'use the radius to find the volume', is it? No, we have to add 'find the volume using circumference'. 'Find the radius given the volume.' 'Find the volume of a sphere with twice the radius of this other sphere.'

Every single one of those questions now requires their own sequence of memorised steps. And so the funnelling teacher changes their pattern of questioning to match the new sequence for the new problem.

Note how fast the number of required memorised sequences grows and how similar so many of them are. With that similarity and quantity, it's no wonder students get the steps confused, even if they manage to remember them all.

Question funnels are simple and straightforward, but so is filling a swimming pool with a teaspoon. Simplicity does not equal desirability.

A FOCUSING PATTERN OF QUESTIONING

Patterns of questioning on the focusing end of the spectrum are very different. Rather than the context of the questioning beginning and ending with the wording of the problem, a focusing teacher considers the breadth of everything they know about this specific student and landscape of learning surrounding the problem. They consider what comes next and what came before in the content. They evaluate all the connections that need to be made and the different ways they are related.

Frequently the first question in a focusing pattern might be some derivation of 'What is this problem about?' But notice how if the teacher is taking into account the student and the content, their next question will always be different between students, because the students will respond with different answers to that first question. 'Oh, this question is about finding the volume? What does that mean?' or 'Oh, this is about finding the surface area? Is that what you said this kind of thing was about yesterday during our bowling ball exercise?'

The premise here is that the student has some prior understanding to build off, they just haven't connected enough of the dots to make the leap with this particular problem yet. So you help them remember what they already know, and then, if necessary, nudge them towards applying it. You are making the jump easier, but you are not making it for them.

A word of warning to teachers undertaking the switch to a focusing pattern of questions. Previous exposure to funnelling questions, whether inside your classroom or prior to, has likely conditioned students to expect to be funnelled.

Frequently students who have only ever been funnelled will be resistant to patterns of questioning that want them to actually think about their reasoning. They are expecting their teacher to spoon feed them the steps via orders worded as questions. Creating a classroom culture of learning out of an atmosphere of mimicking is its own whole thing, but be aware that changing expectations is a process that takes time and is best accomplished with patience and understanding.

Pam is visiting Australia in July and will present a PD with MAV, *Mathematics Masterclass: reaching more students in less time*. This workshop is aimed at teachers from F–10. To register, visit www.mav.vic.edu.au/events.

Pam's podcast episode on patterns of questioning can be found at www.buzzsprout.com/1062400/12136560

MATRICES IN A SPREADSHEET

Andrew Stewart

In the Term 1 2024 edition of *Common Denominator*, Andrew explored building a spreadsheet, arithmetic, inverse determinant, transpose and multiplication. This article is part two in his series on matrices in a spreadsheet targeted towards the VCE study of General Mathematics. If you missed the first part, head to MAV 's website and download *Common Denominator* at www.mav.vic.edu.au.

SHEET 5 (TRANSITION)

Set up a spreadsheet page as shown in Table 1. Select cells G2:G4. Enter: =MMULT($A$2:$C$4,E2:E4). Press and hold the control and shift keys, and then press return.

Select cells G2:G4, copy and paste into cells H2:H4. Select cells H2:H4, click on the formula line and edit it to read: =MMULT($A$2:$C$4,G2:G4).

Press and hold the control and shift keys, and then press return. Select cells H2:H4 and fill right to cells K2:K4. The spreadsheet will now look like Table 2.

Notes: The selected array for the MMULT calculation must have the order of the product matrix, not necessarily one of the data matrices.

In this case, (3 x 3) x (3 x 1) = (3 x 1), so the product array would be G2:G4.

Changing a single value in either, or both, of T or S_0 will lead to new values being automatically being calculated in all of the new state matrices.

As with normal transition matrix multiplication calculations, the number of columns in matrix T must equal the number of rows in matrix S_0 for the array process to be completed correctly.

The use of "$" signs addressing the T matrix means that those cells will always be read regardless of how far H2:H4 is copied to the right.

If the values of higher powers, such as S_{10} or S_{20}, copy cells K2:K4 out to columns P (for S_{10}) or Z (for S_{20}). Then, in cell G7, say, type in =P1 and press Return. Copy F7 down to F10 to see the full set of values for S_{10}. Repeat the process in H7 for S_{20}.

	A	B	C	D	E	F	G	H	I	J	K
1	T				S0		S1	S2	S3	S4	S5
2	0.80	0.05	0.10		240						
3	0.14	0.82	0.10		220						
4	0.06	0.13	0.80		200						

Table 1.

	A	B	C	D	E	F	G	H	I	J	K
1	T				S0		S1	S2	S3	S4	S5
2	0.80	0.05	0.10		240		223	210	201	194	189
3	0.14	0.82	0.10		220		234	243	250	254	257
4	0.06	0.13	0.80		200		203	206	209	212	214

Table 2.

	A	B	C	D	E	F	G	H	I	J	K
1	T				S0		B		S1	S2	S3
2	0.81	0.12	0.1		245		4				
3	0.09	0.82	0.1		230		7				
4	0.1	0.08	0.8		225		5				

Table 3.

	A	B	C	D	E	F	G	H	I	J	K
1	T				S0		B		S1	S2	S3
2	0.81	0.12	0.1		245		4		253	260	268
3	0.09	0.82	0.1		230		7		240	249	258
4	0.1	0.08	0.8		225		5		228	232	236

Table 4.

SHEET 6 (COMPLEX TRANSITION)

This sheet deals with transition matrix equations of the type $S_n + 1 = TS_n \pm B$. Set up a spreadsheet page as shown in Table 3.

Select cells I2:I4. Enter: =(MMULT($A$2:$C$4,E2:E4))+$G$2:$G$4.

Press and hold the control and shift keys, and then press return. Copy cells I2:I4 and paste into cells J2:J4. Select cells J2:J4, click on the formula line and edit it to read =(MMULT($A$2:$C$4,I2:I4))+$G$2:$G$4.

Press and hold the control and shift keys, and then press return. Copy cells J2:J4 to cells K2:K4. The spreadsheet will now look like Table 4.

Notes: The selected array for the MMULT calculation must have the order of the product matrix, not necessarily one of the data matrices.

In this case, (3 x 3) x (3 x 1) = (3 x 1), so the product array would be I2:I4.

Changing a single value in any one, or all, of T, S_0 or B will lead to new values being automatically being calculated in all of the new state matrices.

The use of "$" signs addressing the T matrix means that those cells will always be read regardless of how far J2:J4 is copied to the right. As with normal transition matrix multiplication calculations, the number of columns in matrix T must equal the number of rows in matrices S_0 and B for the array process to be completed correctly.

For $S_1 = TS_0 - B$ type situations, replace the

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1											ANSWER					WORKING			
2	KEY			P					Q		1	2	3	4		1	2	3	4
3	6	E		0	0	1	0		6										
4	7	L		1	0	0	0		7										
5	8	S		0	0	0	1		8										
6	9	A		0	1	0	0		9										

Table 5.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1											ANSWER					WORKING			
2	KEY			P					Q		1	2	3	4		1	2	3	4
3	6	E		0	0	1	0		6		S	A	L	E		8	9	7	6
4	7	L		1	0	0	0		7		E	S	A	L		6	8	9	7
5	8	S		0	0	0	1		8		A	L	E	S		9	7	6	8
6	9	A		0	1	0	0		9		L	E	S	A		7	6	8	9

Table 6.

"+" with a "−" before the last array in these formulations.

Only three calculations have been shown since that has usually been the maximum number of calculations required in examination questions to date. This can be extended for SAC or problem-solving situations.

SHEET 7 (PERMUTATION)

Unfortunately, spreadsheets are unable to perform permutation matrix calculations involving letters directly (as in the calculator), as they are designed to work with numbers only. Since the largest permutation matrices usually encountered in the examinations, for example, are 6 x 6 then the other eight digits than the "0" and "1" required in the permutation matrix could be used to represent the word.

Set up a spreadsheet as shown in Table 5. Select cells P3:P6. Enter: =MMULT($D$3:$G$6,I3:I6).

Press and hold the control and shift keys, and then press return.

Select cells P3:P6, copy and paste into cells Q3:Q6. Select cells Q3:Q6, click on the formula line and edit it to read:

=MMULT($D$3:$G$6,P3:P6)

Press and hold the control and shift keys, and then press return.

Select cells Q3:Q6, and FillRight to cells S3:S6. Select cell K3. Enter: =VLOOKUP(P3,$A$3:$B$6,2) and press return. Select cell K3 and FillDown to K6. Select cells K3:K6 and FillRight to cells N3:N6. The spreadsheet will now look like Table 6.

Notes: The selected array for the MMULT calculation must have the order of the product matrix, not necessarily one of the data matrices.

In this case, (4 x 4) x (4 x 1) = (4 x 1), so the product array would be P3:P6. The use of "$" signs addressing the P matrix means that those cells will always be read regardless of how far Q3:Q6 is copied to the right. The **key** allocates a number to each of the letters of the word to be permutated.

The **working** area contains the actual matrix calculations for the permutation of the digits in column I.

The **answer** area uses the key to identify each of the permutated letters from the matrix calculations in the working area. In this case, after four permutations we are back to the original word.

Altering the values in the permutation matrix in cells D3:G6 will initially lead to error notes until there is just a single "1" in each row and column. The number of columns for the answer presentation and the working presentation are the same as the number of rows/columns in the permutation matrix.

A 5 x 5 permutation matrix would require five columns for both answer and working, (The position of Q and the answer and working columns would have to be moved to the right compared to the sample above.)

QUESTION

What structure of P would create the word SALE in the first calculation?

THE ESSENCE OF COMMUNITY

Claire Embregts – Community strategy manager, MAV

In education, especially in the landscape of online learning, community experience and connection are crucial. When it comes to a specialised domain like mathematics education, fostering a robust community experience can be transformative for educators and learners. So, what exactly is community experience, and why is it vital in the educator community?

COMMUNITY EXPERIENCE

Community experience encapsulates the collective interactions, shared knowledge, and supportive networks within a group of individuals with common interests or goals. Online communities extend beyond collaboration and communication; they embody a sense of belonging, empowerment, and continuous learning.

One of the defining aspects of the online community experience is the exchange of insights and best practices. Through discussions, resource sharing, and collaborative problem-solving, MAV Community members can enhance teaching methodologies and address student needs with diverse perspectives.

Community experience cultivates a culture of support and mentorship. Having a supportive network can be invaluable in an environment where educators encounter various challenges, ranging from curriculum design to student engagement. Experienced educators can offer guidance, share strategies for overcoming obstacles, and encourage during moments of uncertainty. This supportive space fosters professional growth and instills confidence and resilience among educators.

Furthermore, community experience facilitates ongoing professional development. In the evolving education and technology landscape, staying updated with the latest trends, tools, and pedagogical approaches is essential. Online communities serve as dynamic hubs where members can access relevant resources and discuss emerging topics. This continuous learning journey ensures educators remain agile and adaptable in their teaching practices.

In addition to professional development, community experience fosters a sense of camaraderie and shared passion for mathematics education. Educators are not merely isolated individuals, but part of a cohesive group united by their dedication to fostering mathematical literacy and critical thinking skills among their students. This shared mission creates a sense of belonging and camaraderie, strengthening the bonds within the community.

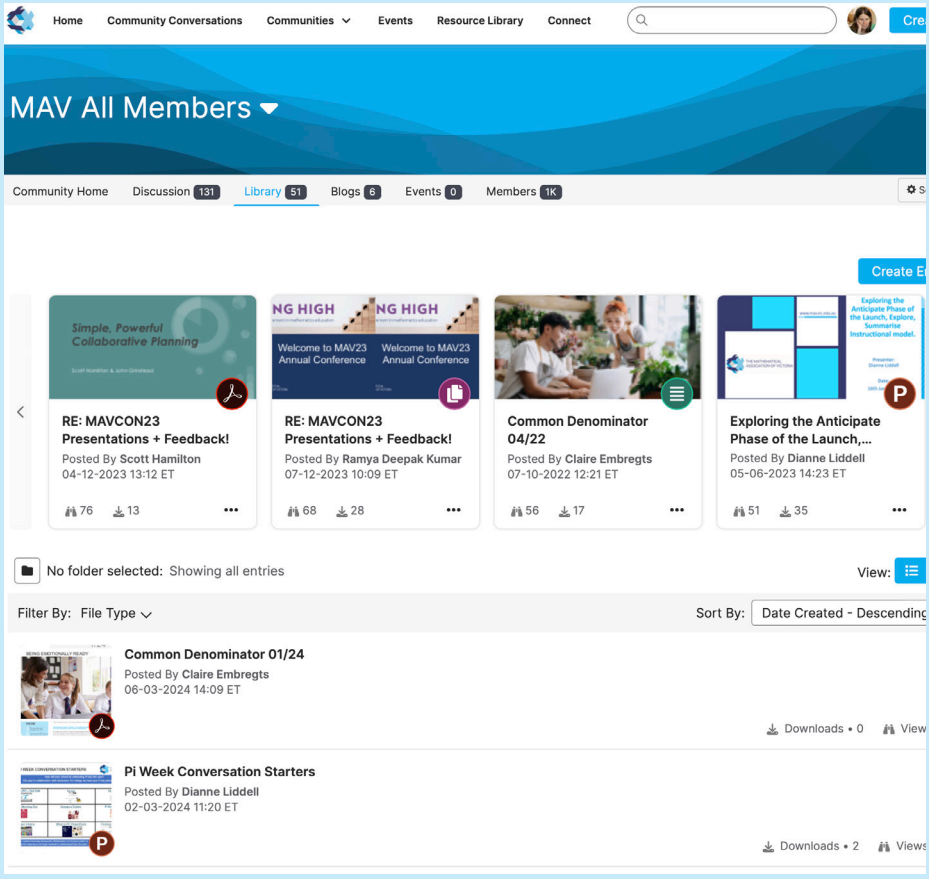

Figure 1. The resource library on the online MAV Community.

Importantly, community experience transcends geographical boundaries and time constraints, especially in the digital age. Online communities unite educators from diverse backgrounds, cultures, and locations, enriching discussions and promote cross-cultural understanding. This exposure to innovative approaches globally enhances learning. Through the online MAV Community, maths educators can seamlessly connect and collaborate, regardless of physical distance.

However, nurturing a vibrant community experience requires deliberate efforts and ongoing engagement. Community leaders play a pivotal role in fostering a welcoming environment, facilitating meaningful interactions, and addressing the diverse needs of members.

Additionally, active participation from members through contributions, feedback, and peer support is essential for sustaining the community's vitality.

In conclusion, online community experience is multifaceted, encompassing collaboration, support, professional development, and shared passion. By leveraging MAV Community's collective expertise, educators can enrich teaching, inspire students, and contribute to advancing mathematics education. As we continue to navigate the evolving landscape of online learning, investing in community experience remains imperative for nurturing a vibrant and resilient community of mathematics educators.

If you're a maths educator looking to grow your skills, expand your network, and access valuable resources, you can join our community at www.mav.vic.edu.au/Membership/Community.

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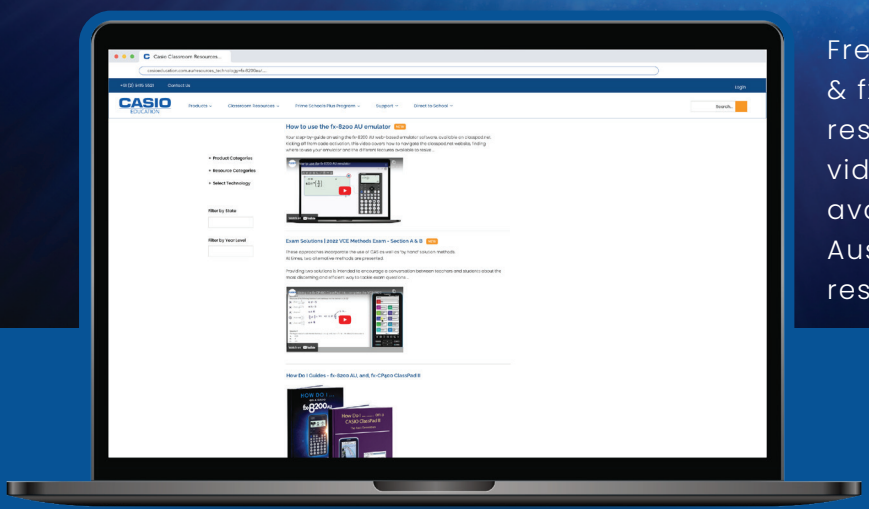

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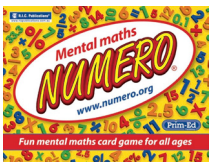

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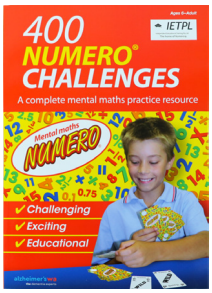

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