THE MATHEMATICAL ASSOCIATION OF VICTORIA

THE COMMON DENOMINATOR 3/22

BUILDING STEM CAPABILITIES

INSIDE

Rachael Whitney-Smith - PhD Candidate, University of Notre Dame

It is well documented that there is a growing need for all students to develop sound Science Technology Engineering and Mathematics (STEM) capabilities to support the increasing demands of STEM skills in the workplace and for Australia to maintain its own STEM capable workforce in this rapidly changing world.

In 2015 Education ministers launched the National STEM School Education Strategy 2016-2026 that supported two clear goals relating to all students developing strong foundational knowledge and skills in STEM and inspiring students to choose more challenging STEM pathways in their Senior Secondary studies. So, what is STEM and what is the role of mathematics in building STEM capabilities?

Continued on page 5

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

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FROM THE PRESIDENT

Michael O'Connor

As I near the end of my tenure as MAV President I find it difficult to write this column. There have been many changes over the last three years, and many challenges.

The strength of any organisation is in its members and staff. The fact that MAV is in such a solid position both financially and pedagogically is testament to this. To the members of the board, past, present, and incoming I give my thanks and best wishes for the time ahead. There is always more to do. In the immediate and mid-term future, paramount among these are the next round of curriculum implementations at VCE and Prep – Year 10. To all members of MAV: may you continue to maximise your use of the excellent resource of MAV and all its offerings in the coming years.

MAV's AGM was held in May and three new board members were elected:

- Ann Downton, Monash University
- Patty Mete, Haileybury College
- Mei Ong, Senior financial professional

Kate Copping was re-elected to serve a further two year term. Congratulations to Ann, Patty, Mei and Kate. Four board members who served in FY22 are moving onto their next adventure and we wish them all the best. Thanks to Claire Delaney, Peter Karakoussis, Michaela Epstein and Kat

Rodriguez for your contributions to MAV. We deeply appreciate your time, expertise and efforts.

LIFE MEMBERS

Ann Downton and Allason McNamara received the honour of life membership at the AGM. Life members are nominated based on three criteria including their long-term involvement and support of the activities of the MAV, significant and long-term contribution to mathematics education in Victoria, and a significant and long-term contribution to valuing mathematics in Victorian society. Both Ann and Allason demonstrate these criteria in spades and congratulate them on this momentous achievement. Read more at www.mav.vic.edu.au/Services-and-News/News.

NEW VINCULUM EDITOR

After 10 successful years of editing MAV's secondary journal, *Vinculum*, Roger Walter has stepped down from the role to take on a new challenge of developing mathematical content for an educational publisher. MAV offers its heartfelt congratulations and thanks to Roger for his excellent work editing over 45 editions of *Vinculum*.

MAV welcomes Justine Sakurai as the new editor of *Vinculum*. Justine is an experienced secondary teacher and leader. She has written curriculum, served on multiple panels for VCAA and written articles for many educational publications. Justine is deeply passionate about maths education being accessible for all abilities. Much of Justine's work focuses around developing critical numeracy and mathematics skills in teaching and learning, and using real life context to spark engagement. With the increasing focus on evidence-based practice in schools, Justine is keen for authors to submit articles that are able to help both translate evidence into practice for the classroom teacher, and to showcase how great teachers are making a difference in their own classrooms.

To submit articles to *Vinculum*, email vinculum@mav.vic.edu.au. Author guidelines can be found at www.mav.vic.edu.au/Services-and-News/MAV-Journals.

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
Networks	13/7/22 Virtual	VCE	Jess Mount
Learnership series: Habits of mind	26/7/22 Virtual	4–10	James Anderson and Jess Mount
Wolfram tech for every Victorian secondary student	2/8/22 Virtual	7–10	Kelly Lean
Learnership series: Effort	9/8/22 Virtual	4–10	James Anderson and Jess Mount
Learnership series: Developing learnership	23/8/22 Virtual	4–10	James Anderson and Jess Mount
Wolfram tech for every Victorian secondary student (part 2): Wolfram research: interactive notebook follow up session	30/8/22 Virtual	7–11	Kelly Lean
VCE 2023 study design	2/9/22 Virtual	VCE	Various
ISV: New frontiers of learning	6/9/22	F–10	Various
The primary mathematics showcase: highlighting best practice and pedagogy	14/10/22	F–6	MAV consultants and special guests

ISV: NEW FRONTIERS OF LEARNING

NEW FRONTIERS OF LEARNING: ENGAGING MATHS MINDS THROUGH SOCIAL AND EMOTIONAL LEARNING

MAV and Independent Schools Victoria (ISV) invite educators from all sectors to a joint professional learning event for mathematics teachers of F – Year 10.

The keynote is *Social and emotional learning in mathematics; engagement for meaningful learning* and will be delivered by Louka Parry, the CEO and Founder of The Learning Future. Luca works globally as a speaker, learning strategist and education futurist. He speaks on innovation, leadership and change having worked with thousands of leaders and educators from diverse contexts all across the world, including in high-level policy fora such as the OECD, UNESCO, and the European Commission, and with all Australian States and Territories.

Explore the new frontiers of learning as we investigate the essential links between wellbeing, social and emotional learning in mathematics teaching.

Delve into the Victorian Curriculum: Mathematics, including proficiencies and capabilities a variety of learning settings (keynotes, workshops and facilitated conversations) with like minds looking to change and improve practice.

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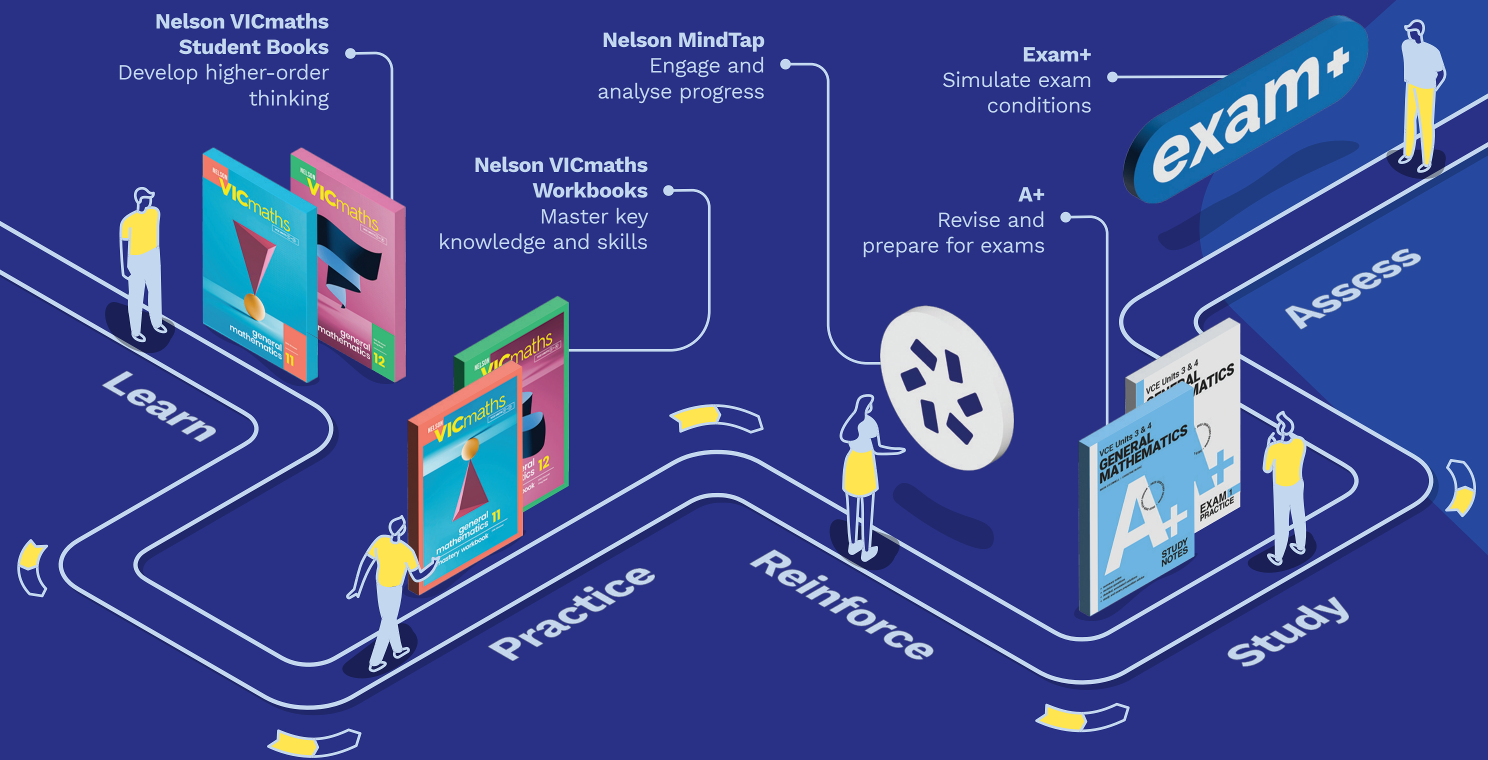

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BUILDING STEM CAPABILITIES

Rachael Whitney-Smith - PhD Candidate, University of Notre Dame

CONT. FROM PAGE 1.

WHAT IS STEM?

So, what is STEM other than an acronym that represents the four disciplines of Science, Technologies, Engineering and Mathematics and what do we mean by STEM skills and STEM capabilities?

In 2015, the Education Council defined STEM as:

> STEM education is a term used to refer collectively to the teaching of the disciplines within its umbrella: science, technology, engineering and mathematics and also to a cross-disciplinary approach to teaching that increases student interest in STEM related fields and improves students' problem solving and critical analysis skills. (p.5)

The Australian Curriculum defines capability as encompassing 'knowledge, skills, behaviours and dispositions' and students develop capability when they can confidently demonstrate, effective and appropriate application and transfer of knowledge and skills within and beyond the school environment. STEM capabilities are then the ways of knowing, thinking and working that draw on the various thinking and problem solving approaches of each of the disciplines in either an interdisciplinary or discipline specific STEM approach.

STEM skills are a subset of a much larger suite of 21st Century skills aimed at equipping young Australians with the necessary skills demanded of them in the workplace and to enable them to become a successful global citizen.

Using this definition for STEM and STEM skills and capabilities raises questions: What is the role of mathematics education in developing students STEM capabilities? What do STEM skills and STEM capabilities look like in a mathematics classroom?

STEM CAPABILITIES

If STEM capabilities are the ways of knowing, thinking and doing, then a STEM capable student can apply their knowledge and understanding, procedures and skills from one or more of the STEM disciplines to situations beyond the familiar. The thinking and problem solving processes are in themselves essential content for students to know and use.

Science	Scientific method (Inquiry process)	• Observation • Hypothesis • Experiment	• Analysis • Conclusion
Technologies	Design thinking	• Understand • Reflect • Ideate	• Reflect • Model • Reflect
	Systems thinking	• Big picture • Patterns • Structures	• Interactions • Implementation • Impact
	Computational thinking	• Decomposition • Abstraction • Pattern recognition	• Models and simulations • Algorithms • Generalisation
Engineering	Engineering design process	• Ask • Research • Imagine • Plan	• Create • Test • Improve
Mathematics	Mathematical modelling process	• Describe • Specify • Formulate • Solve	• Interpret • Evaluate • Report
	Statistical investigation process	• Pose question(s) or identify a problem • Plan • Collect data	• Analyse data • Interpret • Communicate findings

Figure 1. A generalisation of the various thinking components and problem-solving processes for the disciplines of Science, Technologies, Engineering and Mathematics.

STEM PROBLEM-SOLVING APPROACHES

Most of the processes in Figure 1 essentially draw on the components in Figure 2.
A STEM problem solving approach could involve students:

- understanding the context of the situation and identifying a problem
- planning an approach using their knowledge and ways of thinking from the various STEM disciplines
- applying their knowledge and skills to the identified problem, such as the traffic congestion at the school drop off and pick up
- reviewing the approach and considering any alternatives
- interpreting and communicating their solution within the context of the original situation, in this case providing a report to the school on an alternative plan for the traffic flow.

Figure 2. Components of a STEM problem solving approach.

BUILDING STEM CAPABILITIES

Rachael Whitney-Smith - PhD Candidate, University of Notre Dame

The adopted problem solving approach could either be drawing on all, some or a specific discipline's way of thinking, knowledge, skills and procedures.

However, when students use their attained knowledge and understanding from other disciplines to interpret the context and review the solution regardless of the planned problem solving approach, they are demonstrating their critical and creative thinking skills and subsequently strengthening their STEM capabilities.

For example, when using a mathematical modelling approach to investigate an issue such as sustainability, students will make assumptions, choose variables and identify relationships. Understanding the context of the situation may require a degree of scientific knowledge. Interpreting the problem mathematically by abstracting and decomposing it into more manageable parts draws on computational thinking skills and in order to effectively construct physical or virtual representations or simulations when investigating the mathematical models, certain engineering principles and design thinking skills are necessary.

APPLYING STEM SKILLS

Students can connect their attained knowledge and skills from each of the disciplines and apply them when working collaboratively on authentic problems in an interdisciplinary approach using problem solving process that can be driven by one or more of the STEM disciplines.

Different groups within the class may use different approaches. In the example above, the class may have identified a problem concerning too much traffic congestion at the school drop off and pick up which is becoming dangerous for students and parents.

One group may choose a statistical investigation process, analysing data collected through a parent survey while another group may create, use and test different models to experiment with different ways of altering the traffic flow adopting an engineering design process that draws on their measurement, geometric, spatial and proportional reasoning skills to construct, and test different solutions.

HOW TO SUPPORT STUDENTS

The role of the teacher is critical in supporting students to develop their STEM capabilities within the mathematics classroom. The teacher can provide learning opportunities for students to actively engage in the processes of mathematical modelling, computational thinking, statistical investigation and probability experiments and simulations, however, students need explicit guidance in learning the various components of these processes in order to effectively implement them.

The processes draw on students conceptual understanding, fluency with procedures, mathematical problems solving and reasoning skills in an interconnected way which enables students to demonstrate their proficiency in mathematics. There are many rich teacher and student resources to support the mathematical processes:

- Resolve
  www.resolve.com.au
- International Mathematical Modelling Challenge
  www.immchallenge.org.au
- Enablers of Mathematical Modelling
  www.mathsmodellingenablers.com
- NZ Maths
  nzmaths.co.nz/statistical-investigations-units-work
- AAMT's Top Drawer Teachers
  topdrawer.aamt.edu.au/Statistics
- Australian Maths Trust
  www.amt.edu.au/amt-resources
- Wolfram and CBM
  www.wolfram.com
  www.computerbasedmath.org
- Texas Instruments
  education.ti.com/en/activities
- CODAP
  codap.concord.org
- Gapminder
  www.gapminder.org
- Geogebra
  www.geogebra.org
- Desmos
  www.desmos.com

STARTING POINTS

So where do you start with choosing situations to present students with, to prompt the identification of a problem? You know your students best.

Consider what they would best engage with, examples are:

- real world global issues such as the UNESCO Sustainable Development Goals
- identify with a more localised problem situations such as queuing for COVID-19 tests, choosing the best mobile phone plan, designing an outdoor activity space for the local park or optimising ways to notifying the local community of alternative routes given immediate traffic hazards.
- Students may also choose to engage with using a STEM problem solving approach for solving created problems such as a marble run or bridge building challenge using optimal time, strength or cost of materials as a critical influence on decision making. See Figure 3.

Students may hypothesise and investigate why nature behaves the way it does such as why honeybees have hexagonal hives and native leaf cutter bees use cigar shaped lava pods made out of circular cuts from leaves. See the leaf cutter bee at work on the cover of this magazine.

Effectively using technology to build understanding through experimental exploration of functions, probability simulations, manipulating shapes and objects using dynamic geometric software or as a tool within a modelling or statistical investigation process not only develops their computational thinking skills in mathematics but also builds their digital literacy general capabilities.

THE FUTURE

The challenges we face as mathematics educators is to overcome the obstacles that are impacting upon all students achieving success in mathematics. Providing all students the learning opportunities to develop their STEM skills and capabilities will benefit not only the students themselves

Figure 3. Creating a bridge building challenge or a marble run is a great way to explore STEM problem solving. Nature provides lots of examples too, such as why honeybees have hexagonal hives.

but the wider community at large, as they are our future thinkers and problem solvers.

STEM learning is not for the few but needed for all students to prepare them for the future ahead. Mechanics today need to be data analysts, hair dressers need to use their proportional thinking skills as colour stylists and now more than ever before we are all required to have an enhanced level of digital literacy in order to adequately function in today's world let alone prosper.

Ongoing research by the OECD, the Australian Mathematical Sciences Institute (AMSI) and Australian Centre for Education Research (ACER) has highlighted a continual gender imbalance within the STEM fields and gender inequities in student engagement and performance in mathematics, growing mathematics anxiety in both students and teachers and the ever-present gap between the educational outcomes in mathematics of minority groups such as First Nations People, students from low socio-economic backgrounds, and from regional and remote locations to the majority of students living in metropolitan areas. Providing rich learning opportunities for all students to collaborate and actively engage in authentic problem solving benefits every student and will go a long way to addressing the negative dispositions many students hold towards learning mathematics.

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ONE MINUTE WITH VANESSA DESAI

I'M....

Vanessa Desai. I'm a digital consultant at EY. I manage a program of work to deliver the EY STEM App to schools and non-profit organisations, at no cost, across Australia and New Zealand. The app is a gamified learning experience, with rewards, seeking to spark curiosity in STEM subjects and inspire girls to pursue STEM careers.

I STUDIED...

A BSc (Hons) Neuroscience at Kings College London. I decided against an academic career in favour of the corporate world.

NEUROSCIENCE IS MY SUPER POWER...

It allows me to connect with people on a human level – with empathy and curiosity.

I HAVE A SCIENTIFIC APPROACH TO MY WORK...

I apply critical and analytical thinking, always testing assumptions, and measuring the human experience of digital solutions we design and implement.

I'M A BIG BELIEVER IN TRANSFERABLE SKILLS...

They prepare young people for the future of work. The theoretical/technical knowledge can be learned through experiential learning at work however a level of soft skills are required for that to occur in a meaningful way, for example: effective communication, teamwork and analytical thinking.

STUDYING MATHS AT SCHOOL ...

Is fundamental. Everything we advise our clients on needs to be measured, quantified, and explained. Maths allows us to communicate our analysis and findings in a way that is understood by everyone.

I NEVER THOUGHT..

I'd be delivering a STEM App! It allows me to bring my passion for STEM and business skills together. It is a program which aligns to my purpose, which is to support the next generation of girls in STEM.

COMMUNICATION IS VITAL...

Ultimately, business is all about people – working with, empathising and managing people; their expectations, experiences and needs. With a diverse workforce, adapting your communication style is important in demonstrating inclusive behaviours, working in multidisciplinary teams, and demonstrating the value of your work in a way that resonates.

MY #1 TIME WASTER IS ...

Pinterest. I love interior design images.

I'M ASPIRING TO…

Become a leader, coach and mentor for the next generation of girls

I HAVEN'T...

Picked up a paintbrush in a while... but I love oil painting and sketching people.

MY LAST READ WAS...

The Kite Runner by Khaled Hosseini.

MATHS AND DESIGN THINKING

Jennifer Palisse - Monash Tech School

With the increasing importance of collaborative classroom experiences geared towards 21st century skills, design thinking is being advocated by some as a preferred teaching approach for achieving team-based constructivist learning. For those new to design thinking, design thinking is a problem-solving framework driven out of human-centred design principles and includes a strong emphasis on identifying the problem, defining the problem, and focusing on solving problems of social significance.

To help get your head around this further, you might like to try the following exercise. Come up with as many questions as you can about sand. Next, categorise your questions by the domain that best addresses your question. This will help you think about what types of questions would be appropriate for different types of thinking and which classroom they might best belong in.

Here are a few examples:

- How many grains of sand are there? (mathematical thinking)
- What is sand made up of? (scientific thinking)
- How many grains of sand do I need until I have a pile? (philosophical thinking)
- Why don't sandwiches have sand in them? (linguistic thinking)
- How might I stop sand from getting in my shoe? (design thinking)

While this is a simplified exploration of design thinking, the main idea is that only the final question listed here involves a human component. Working out how many grains of sand there are on a beach is unlikely to lead to some improved human experience, while improving one's sand-walking shoes might make life easier for people who enjoy running along the beach.

With this in mind, I was given the challenge of embedding design thinking into the mathematics classroom. And a challenge it was. My goal was to generate a set of activities that allowed students to generate their own mathematical content knowledge, that utilised the collaborative framework of design thinking, and maintained the theme of being human-centred. In other words, it was important to me that the design thinking activity was not an add-on to the current curriculum but could be used in lieu of a current set of lessons on a particular topic (e.g., a design thinking activity that naturally leads to the generation of Pythagoras' theorem).

This meant combining two seemingly incompatible paradigms of mathematical thinking and design thinking – one is centred on abstracting the real world, solving problems for the sake of the problem itself, while the other focuses on the real world, solving problems to improve a human need.

I must point out my own biases here and acknowledge that yes, mathematics can be applied to real world problems, but I view this as the application of mathematical thinking, rather than a subset of mathematical thinking in its own right.

What follows are sample design thinking problems that could be used in the mathematics classroom. I argue that the first two were more fitting to my goals and offer some reflections on the types of tasks that were more likely to be successful at integrating mathematics and design thinking.

SHOULD WE REDESIGN THE MELBOURNE RUBBISH BIN COLLECTION?

Intended mathematics outcome: Measuring volume of compound shapes.

Activity: Students could measure the dimensions of their curb-side rubbish bins at home and calculate their volumes. Students could then compare these volumes with how often they are collected (weekly or fortnightly) and decide which bin is optimal for collecting the most rubbish. In other words, does the smaller bin collected weekly collect more or less rubbish in a year than the larger bin collected fortnightly?

However, phrasing the question in this way, while mathematically optimal, may not be the 'best' rubbish collection strategy overall.

Human-centred factors need to be taken into consideration. For example, the rubbish bin can become smelly and frequent collection is preferred. A smaller rubbish bin might psychologically encourage you to throw out less rubbish while a larger garden bin might encourage you to consider green waste more.

Perhaps collecting weekly requires garbage trucks to use more petrol than is necessary and a fortnightly collection is preferred. Students could prepare their optimal rubbish collection strategy that incorporates both mathematical and environmental justifications.

Design thinking: This activity lends itself to thinking about social and environmental issues related to waste management and the role humans play in generating waste at home.

MATHS AND DESIGN THINKING

Jennifer Palisse - Monash Tech School

HOW MIGHT WE REDESIGN THE KEYBOARD?

Intended mathematics outcome: Data collection, creating tallies, calculating frequencies, visualising frequencies.

Activity: Students could gather and analyse data regarding which keys are used the most/least frequently. They could then map this data against the QWERTY and other keyboards to judge whether our current layout is the optimal layout for human fingers. How students consider what 'optimal' means is where the human-centred component of design thinking enters.

Students would need to consider what type of layout is best for a particular user. Is the user a special needs user and the keyboard is controlled with eye movements? Is the user a gamer and more likely to rely on AWSD keys than others? Has the user never learnt to touch type and restricted to index finger typing only in which case horizontal distances between keys will be an issue? Students could then justify their choice of keyboard layout with statistical data.

Design thinking: This activity lends itself to empathising about other people's needs, particularly those with disabilities.

HOW SHOULD THE CLASSROOM BE REDESIGNED FOR SOCIAL DISTANCING?

Intended mathematics outcome: Areas of circles, packing problems.

Activity: Students could work out how their classroom desks could be optimally placed within their classroom so that a 1.5 metre social distancing recommendation is maintained. This can be modelled using circles of radius 1.5 metres, where the centre represents one student. For added fun, students could always model this in real life using hoola-hoops. This packing problem could easily be extended for further investigation and generalisation. For example, what is the maximum number of students we can fit in our classroom? What is the smallest sized classroom we need to fit 25 students? What shape is the easiest shape to pack 25 students/circles which also minimises unused space? However, mathematical solutions may not appeal to how students would really like to redesign their classrooms. An optimal solution for a packing problem may not allow for group work, break out spaces, ideal use of window or wall space, etc. This is where the mathematically abstracted problem of designing a socially distanced classroom may not align with human-centred individual wants and needs.

Design thinking: This activity removes much of the human element. There is little room to consider how one might use a space if the focus is constrained to a packing problem.

THOUGHTS AND REFLECTIONS

Upon reflecting on tasks that did and did not work well for design thinking, I noticed one key point – design thinking seemed to be most suitable for problems where the mathematically optimal solution was not necessarily the best solution. Both the keyboard and bin problems resulted in 'best' solutions that are influenced by social/human factors that could be supported with mathematical evidence. This allowed for a harmonious integration of design thinking with applied mathematics. On the other hand, the 'best' solution when redesigning a socially-distanced classroom could have been achieved without necessarily considering areas of circles, making the integration of design thinking and mathematics feel forced.

I come back to my guiding question: can mathematics be taught through a design thinking framework? From my perspective, if the intent is to learn mathematics, the answer is no. Design thinking is better suited for the application of already acquired mathematical knowledge. What does this mean for the teacher to use design thinking? It suggests that the design thinking lesson becomes an add-on – the mathematics content needs to be taught using current methods, and an application or modelling problem suited to design thinking is tacked on to the end of a topic. This makes design thinking something extra to be crammed into an already full curriculum rather than an approach that can be embedded into existing lessons.

So, is there anything of value a mathematics teacher might take from design thinking? Yes! For teachers new to constructivist approaches and wanting to shift away from traditional chalk-and-talk methods, design thinking offers a well rounded framework to organise a collaborative lesson around. This can be appealing to teachers who might perceive collaborative classrooms as somewhat chaotic, intimidated by the perceived lack of teacher control. The design thinking process follows a suggested set of stages (empathise, define, ideate, prototype, test) which can provide teachers with a sense of structure. As Scheer and Plattner (2012, p. 18) argue, 'design thinking can give especially critically minded teachers a guiding framework and support, until a dynamic sets up motivating and hopefully leading to confidence.' As such, Scheer and Plattner argue that teachers who trial the design thinking process with their own students were then more likely to repeat constructivist teaching approaches in subsequent lessons.

CONCLUDING REMARKS

What have I learnt through my journey of creating design thinking mathematics tasks? Firstly, I continue to believe that the paradigms of mathematical thinking and design thinking are ultimately incompatible – teaching design thinking skills and mathematical thinking skills cannot be done simultaneously. However, I did find design thinking a useful way of incorporating authentic social capabilities embedded within application or modelling problems.

Lastly, I would recommend the design thinking process for teachers wanting to shift towards student-centred collaborative approaches as such a framework provides structure and support.

However, for teachers already comfortable with this style of teaching, I would argue that there are better approaches available for teaching mathematical thinking.

FURTHER READING

Check out Matt Parker's video on index finger typing, *Why the longest English word is PAPAL and SPA is the pointiest*, www.youtube.com/watch?v=Mf2H9WZSlyw&t=1s

Quanta Magazine, *The Math of Social Distancing Is a Lesson in Geometry*, www.quantamagazine.org/the-math-of-social-distancing-is-a-lesson-in-geometry-20200713/

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Scheer, A., & Plattner, H. (2012). *Transforming Constructivist Learning into Action: Design Thinking in education. Transforming Constructivist Learning into Action: Design Thinking in Education*, *17*(3), 8–19.

Given the growing interest in the space of design thinking, Jennifer is interested in starting a community of practice for mathematics teachers. The purpose would be to foster exchange of ideas and capacity building.

If you are interested in joining, please contact jennifer.palisse@monashtechschool.vic.edu.au.

STIMULATING THINKING

Education consultants, The Mathematical Association of Victoria

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

EARLY YEARS - YEAR 2

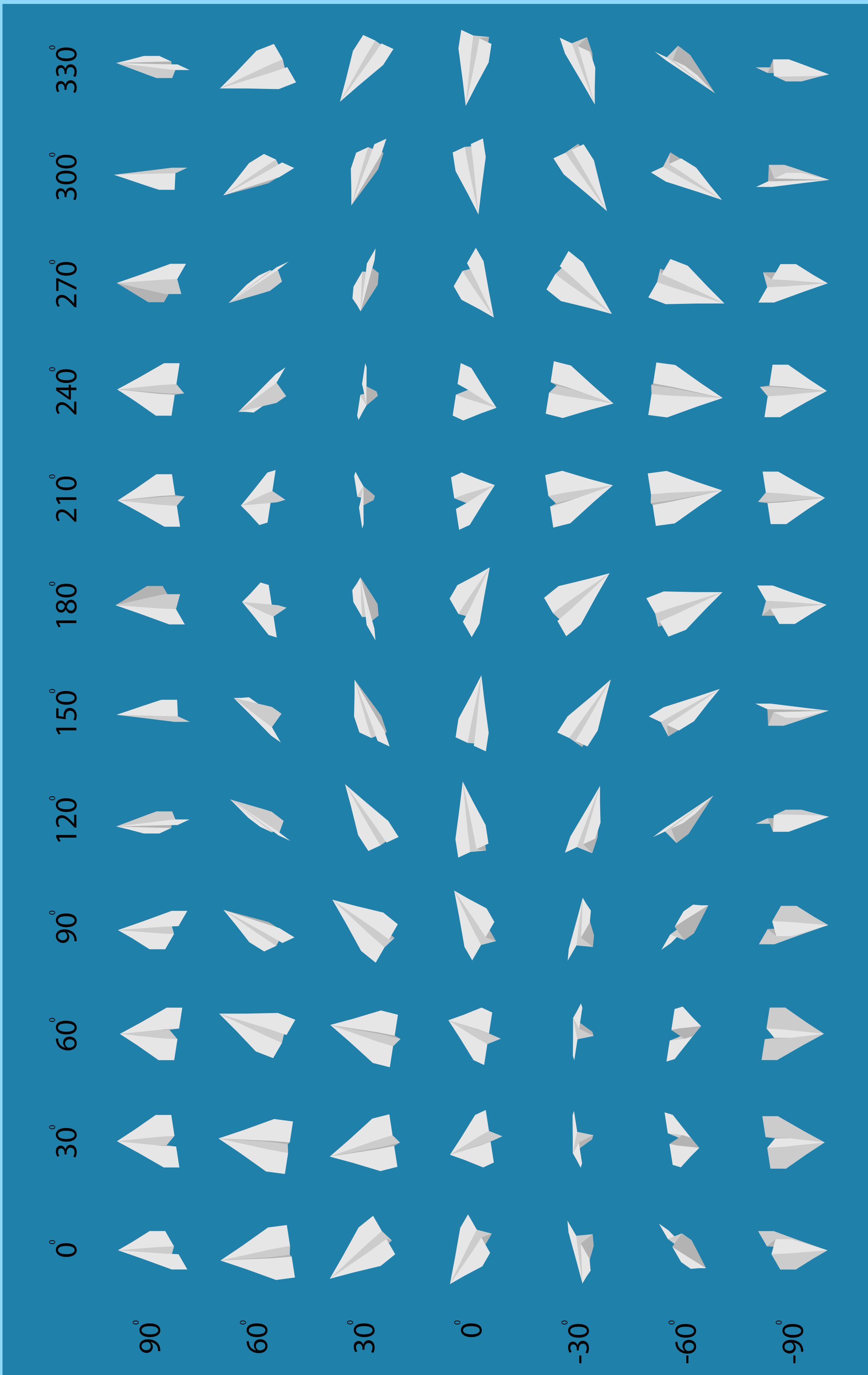
- What do you notice? What do you wonder?
- The numbers increase and decrease in a pattern, what is the pattern?
- Find a pair of planes that show a quarter rotation.
- Find a pair of planes that show a half rotation.
- Sort the planes into equal groups. Represent as repeated addition.
- Can you sort the planes into equal groups of 5? Show your working out to prove your answer.
- Identify a paper plane that would be the hour hand representing 5 o'clock on an analogue clock.
- Without counting each paper plane individually, how could you find the total number of paper planes? Show your working out.
- Design a paper plane like one in the image. Estimate how far it will fly. Which units of seconds, minutes or hours would be most accurate for measuring the flight time? Explain why.
- Write a story about how an enchanted paper plane flies through your school. Use as much mathematical language to describe its movement (between, near, next to, forwards, towards clockwise, anticlockwise, forward under).

YEARS 3 AND 4

- There are 84 paper planes, using what you know about arrays show more than two different ways to prove there are 84 planes.
- How many planes have a vertical line symmetry?
- Which pairs of planes could you put together to show rotational symmetry?
- How many paper planes are facing North? South? East? West?
- Identify the paper plane that best represents the South-West.
- Sort the planes into equal groups. How many different equal groups are possible without a remainder?
- Using your knowledge of arrays, design the floor plan of an airplane to hold 120 passengers.
- Create a paper plane, locate the right angles on the wings and use this to locate as many right angles in your classroom.
- Sort and classify the planes into groups. Describe and explain how you grouped your planes. Create a picture graph or bar graph to represent your data.
- Choose 12 planes that represent the position of each number on an analogue clock. Is it possible to choose planes that would demonstrate a full rotation of the plane around the clock?
- 210° means 210 degrees. In this case we are measuring the turn of a paper plane. What else do we measure in degrees?
- Many people choose to make paper planes out of A4 sized paper. Give a mathematical explanation as to why they choose this size paper.

YEARS 5 AND BEYOND

- How many paper plane pairs show a 180° rotation? How do you know?
- How many paper plane pairs show a 90° rotation? How do you know?
- What is the direction of the paper planes when we can see the most surface area, least surface area?
- How could you sort the paper planes? Explain your groups
- What angles do you see? How could you categorise them?
- How far might the paper plane travel? How do you know?
- Sort 30 paper planes according to their direction using N, S, E, W and NE, SE, SW, NW
- Using a grid system, apply the enlargement transformation to a paper plane of your choice.
- Estimate how many planes fly into Melbourne (or a busier airport such as Heathrow) in a 20 minute time period. Using PlaneFinder record the planes based on a question you have formulated. Example: different airlines, flight numbers, logos, countries of origin. Represent, record and analyse your data.
- Fold a paper aeroplane. Unfold it and measure the angles, can you find acute, obtuse or right angles? Record your findings.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WONDER IN MATHEMATICS (WITH HELP FROM CODING)

George Gadanidis - Western University, Canada

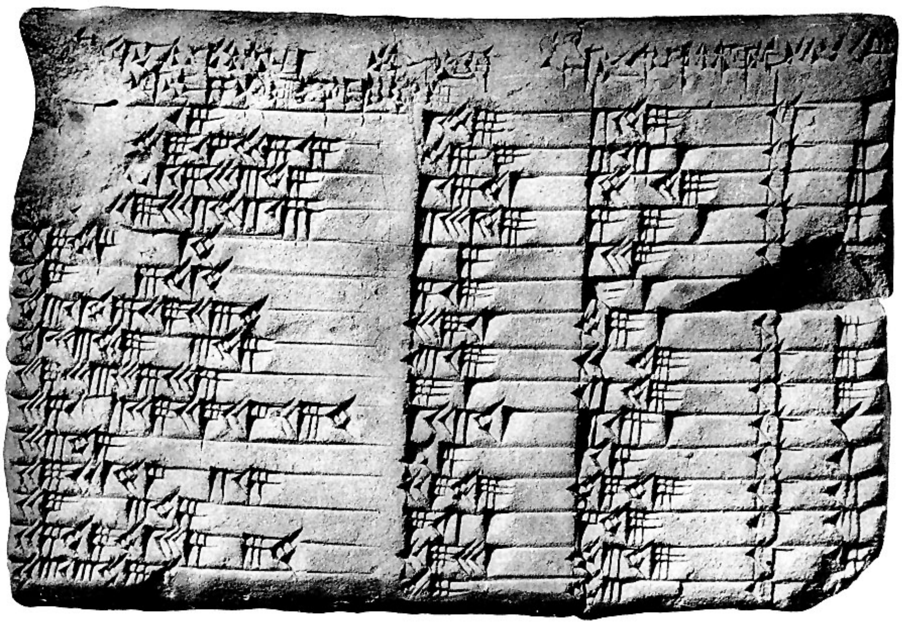


Figure 1. Plimpton 322 clay tablet of Sumerian triples. (Public domain due to age.)

When you were in school, how often did you experience a sense of mathematical wonder – a feeling of surprise and awe at something mathematically beautiful or unexpected?

Below I offer two examples, for Years 8-9 and 5-6, showing how computer programming may be used to potentially enhance mathematical surprise and awe. More such examples for Year 1 and up are freely available to learnx.ca/coding and learnx.ca/wonder. Animations and music videos are available at imaginethis.ca/videos and imaginethis.ca/songs.

SUMERIAN TRIPLES

Take the Pythagorean Theorem for example. With a bit of research, you may discover that ancient Egyptians knew about this well before Pythagoras. Their surveyors, sometimes referred to as rope-stretchers, carried a knotted rope with 12 equal spaces, which they stretched to form a 3-4-5 triangle to redefine property boundaries when the river Nile overflowed.

You may also discover that even earlier, the Babylonians and Sumerians etched 'Sumerian' triples on clay tablets, as shown in Figure 1. The first three Sumerian triples listed on the tablet are (119, 120, 169), (3367, 3456, 4825) and (4601, 4800, 6649). How did the Sumerians find these?

Looking at the tablet, you may wonder how you might find some Sumerian triples. You may also wonder whether you would discern a pattern.

Perhaps you could use Scratch programming to help you find integers a, b and c, so that $a^2 + b^2 = c^2$. And it might cross your mind to plot ordered pairs (a, b) on the Scratch stage to see what that looks like (Gadanidis, 2021). The Scratch code is shown in Figure 2 and the plot in Figure 3. The Scratch code is available at scratch.mit.edu/projects/588754331/editor.

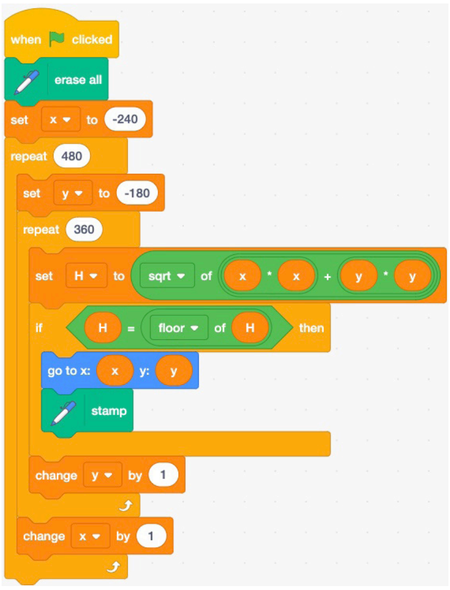


Figure 2. Scratch code.

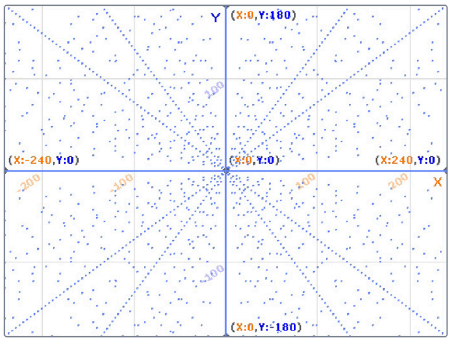


Figure 3.

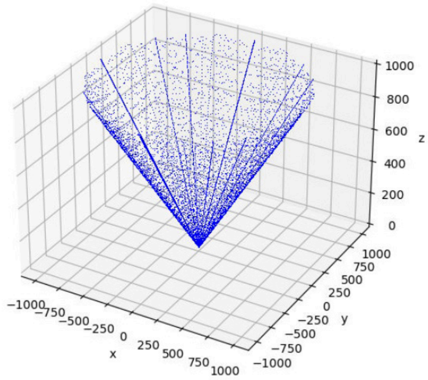


Figure 4.

What symmetries do you notice? What is the meaning of the lines of points that are visible? Can you see that some points create curves that open to the left and to the right? If you used Python code, you could plot triples (a, b, c) to create the 3D plot shown in Figure 4. Do these plots offer a sense of mathematical surprise and awe – a sense of mathematical wonder?

In Ontario, Canada, the new mathematics curriculum includes coding expectations for each of Years 1-9. Expectations relating to the Pythagorean relationship are listed in Years 8 and 9. In addition, in Year 9, students are expected to research and tell a math story, making both the historical connections and coding representations quite suitable.

INEQUALITIES AND CODING PUZZLES

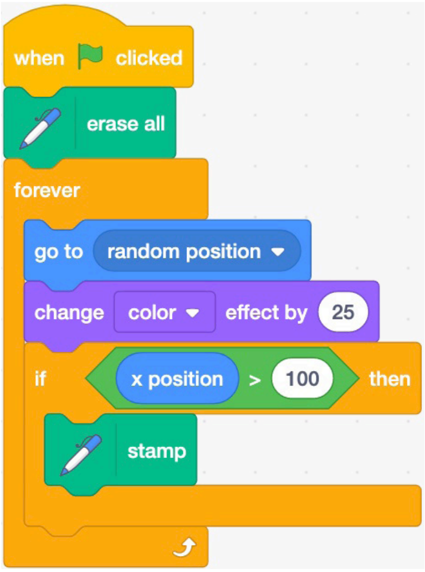
Try this:

1. Go to scratch.mit.edu/projects/666471112/editor.
2. Run the code to see the output shown in Figure 5.
3. What does this program do? How does it do it?

WONDER IN MATHEMATICS (CONT.)

George Gadanidis - Western University, Canada

4. Edit the code to create each of the outputs shown in Figure 6.
5. Create a puzzle for someone else to solve.



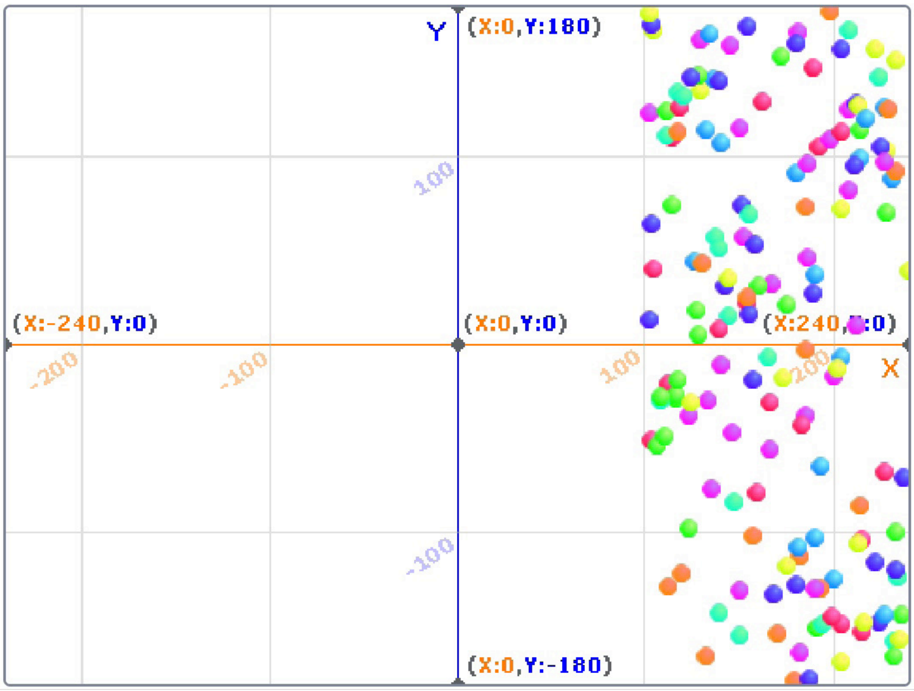


Figure 5. Inequality plot.

We have used such activities in Years 5 and 6 classrooms in Ontario, where students are expected to represent inequalities algebraically and graphically, and use conditional statements in code, such as the statement 'if *x* position > 100 then' in Figure 5. We have also used them in Years 6-8, where students develop an understanding of linear relationships.

Such puzzles, where students are given code that works that they must edit, offer a playful and non-threatening engagement with computer programming, draw their interest and attention, and provide opportunities for mathematical surprise and insight.

LESSONS LEARNED FROM CLASSROOMS

Prior to the COVID pandemic, I spent about 50 mornings or afternoons each year in Years 1-10 classrooms, collaborating and co-teaching with educators, to develop better ways of engaging students with mathematics. Here are some lessons we have learned.

Coding can help bring mathematics ideas to life

Usually, we start with code that works, which students edit, as in the puzzle in Figure 5. A computer program is alive. When well designed, it can dynamically model mathematics playfully, joyfully, and sometimes surprisingly. Students learn how to code incidentally as they use and edit code.

You don't have to be a coding expert

Learn along with students. Make understanding code a collective classroom responsibility. 'I have this code that appears to do something quite interesting mathematically. Can you help me understand what it does and how it does it?'

Use a variety of representations

For example, prior to using the inequalities puzzles, we place masking tape on the classroom floor to create an integer number line, and have students identify the numbers that satisfy various inequalities, such as $x > 3$. Then we add a second integer number line, perpendicular to the first one, to create a 2D coordinate grid. Students notice that the solution to $x > 3$ may also be a region (as in Figure 5). Finally, we tape a string from the ceiling to the origin of the 2D coordinate grid on the floor to create a 3D coordinate space. Students notice that the solution to $x > 3$ may also be a part of 3D space. The use of different representations can help create more robust anchors of conceptual understanding.

Aim for better mathematics

Don't assume that coding (or cooperative learning, or vertical whiteboards, or any other pedagogical tool) will improve mathematics on its own. Historically we have a long tradition of bringing to classrooms quite shallow mathematics. For example, we might replace the above Sumerian triples activity with one where students write code to simply find one of *a*, *b* or *c*, given the other two. Better pedagogy can only superficially improve such shallow mathematics.

You don't have to do this every day

Changing everything at once does not work. Don't throw away what you already know. Add to what you know and to what you do in your classroom by gradually and occasionally – perhaps once per unit of study – incorporating mathematics that offers surprise, play, curiosity, and quenches the natural human thirst for wonder. Students need a variety of learning experiences.

As Gadanidis, Borba, Hughes and Lacerda (2016, pp. 239-240) have noted:

> We believe that occasional, well-designed aesthetic mathematics experiences 'that are immersive, infused with meaning, and felt as coherent and complete' (Parrish, 2009, p.511), and the associated experience of complex, surprising, emotionally engaging, and viscerally pleasing mathematics, can serve as 'a process of enculturation' (Brown, Collins and Duguid, 1989, p. 33) with lasting impact on students' (and

teachers') dispositions, living fruitfully in future experiences (Dewey, 1938) by raising expectation and anticipation of what mathematics can offer, and what the intellectual, emotional and visceral rewards might be when quenching a thirst for mathematics.

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George Gadanidis is a keynote presenter at MAV's annual conference. MAVCON 22 will be an in-person conference and will include some virtual presentations.

Each year mathematics educators including teachers, academics, policy makers, curriculum experts and resource developers come together to share their collective expertise, experiences and ideas. This year the conference will focus on best practice, new ideas and innovative approaches around:

- Improving individual and societal outcomes
- Achieving greater equity
- Technology to enhance investigation
- Exploring effective pedagogies
- Valuing evidence

For further information go to www.mav.vic.edu.au/events.

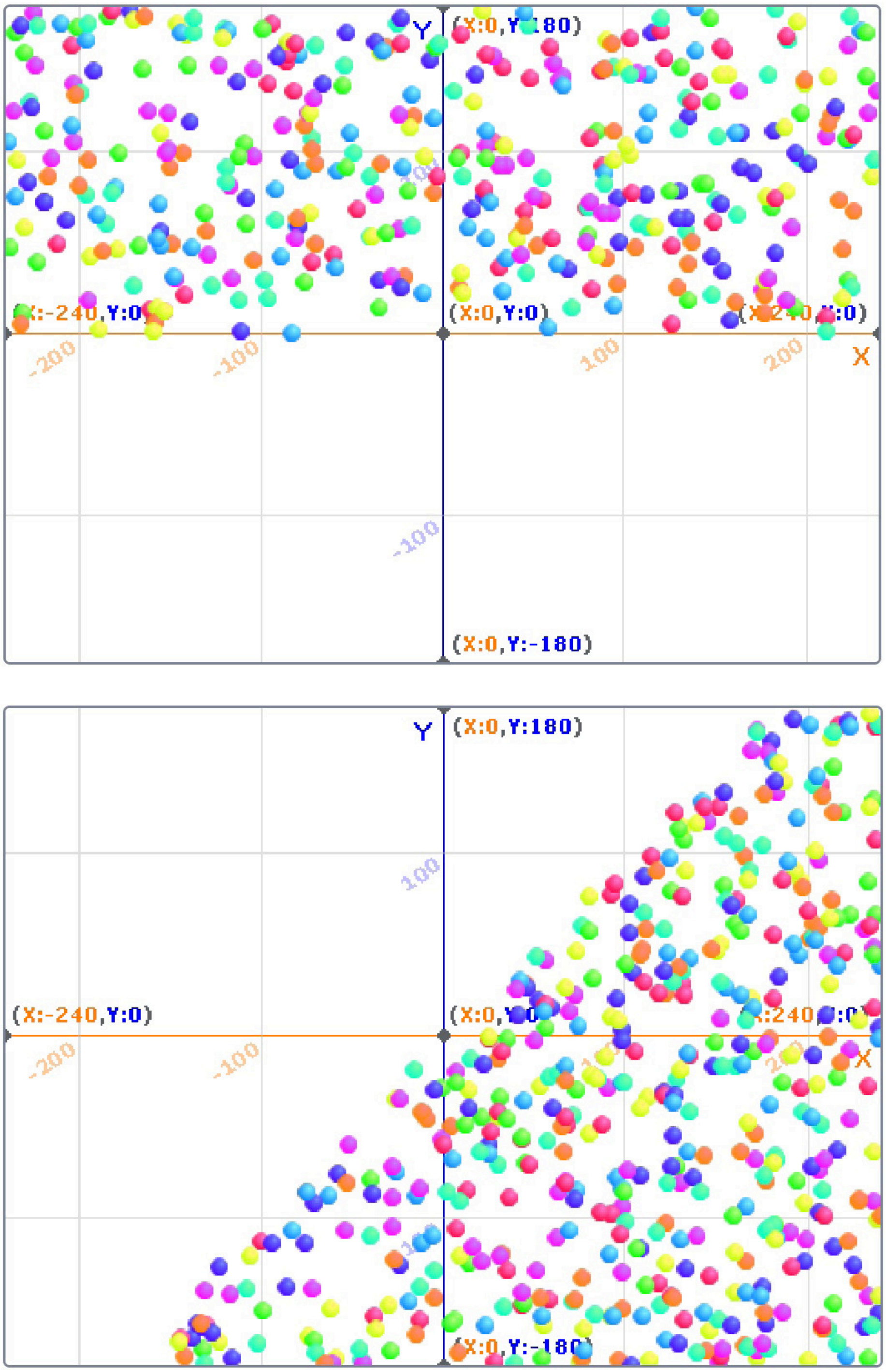

Figure 6.

GET CRYPTO-COOL FOR SCHOOL

Carly Sawatzki and Jill Brown - Deakin University and Peter Saffin - MAV

TALKING ABOUT INVESTMENT RISKS AND REWARDS IN THE CLASSROOM

In our recent work as part of Economics + Maths = Financial Capability, (https://pledhub.deakin.edu.au/economics-maths-financial-capability-2022/) a research and engagement project, secondary Mathematics and Commerce teachers have reported that their students are interested to learn about cryptocurrency.

This is somewhat unsurprising given the 'get rich quick' hype and range of well-marketed trading apps luring investors in. While it is estimated that around 18 per cent of Australians own digital assets (Vickovich, 2022), more and more everyday Australians are curious, and looking to participate in the market. In this article, we offer some simple orienting ideas to tune you into students' learning needs in this area.

WHAT IS CRYPTOCURRENCY?

A cryptocurrency is a form of digital asset that exists on high-powered computers solving complex mathematical equations. 'Crypto' refers to the various encryption algorithms and cryptographic techniques that provide secure online payment entries. Bitcoin, Ethereum and Dogecoin are examples of cryptocurrencies that are popularly traded by investors.

RISK, REWARD AND REGULATION

Trade of cryptocurrency is a largely unregulated process, and this leaves space for risky dealings. Crypto-crime is on the rise, with scammers creating fake cryptocurrency trading platforms or fake versions of official crypto wallets to exploit victims. The Australian Competition and Consumer Commission reports that Australians lost $99 million to crypto-asset scams in 2021 (ACCC, 2022).

Investors, young and old, need to be educated, informed, sceptical, and resilient. High risk can equate to high rewards. Successful investors have both the appetite and means to take informed risks, knowing there's a chance they'll encounter volatility and maybe even sustain losses.

WHERE ARE STUDENTS GETTING THEIR INFORMATION?

Many Australian 15-year-olds who completed the OECD PISA financial literacy assessment reported gaining financial knowledge outside the school environment, mostly from their parents or other adult family members, and the internet (Thomson, et al., 2020). In fact, students who reported receiving information about money management from their parents were up to three quarters of a year ahead in their financial literacy learning (Thomson, et al., 2020).

Research argues the important contribution of family, work and social networks to financial knowledge (see Salignac et al., 2020). As young people transition to adulthood, their family and social network remain trusted advisers, even when the quality of advice may be low (Marchant & Harrison, 2020).

In both mainstream and social media, there are stories of teen traders 'getting rich quick' (see Taylor, 2021). These teens tend to start with a small amount of savings and/or a financial boost from their parents, and market guidance from family and friends in the know.

Podcasts like Gen Z Money are making financial advice accessible. Platforms like TikTok make it easy for young people to spread their news (real and fake) with hashtags like #stocktok and #teentrading. Crypto fashion is also a thing, with tees featuring the Doge meme dog popular among the young.

In this context, schools and teachers have an important role to play. In the words of Michael Douglas' character Gordon Gekko in the Wall Street movies, 'The most valuable commodity I know of is information'.

THE CURRICULUM AND THE REAL WORLD

In the Australian Curriculum: Economics & Business, Year 9 students learn to explain why and describe how people manage financial risks and rewards in the current Australian and global financial landscape.

However, the word 'risk' is not mentioned in the Australian Curriculum: Mathematics. Even so, teachers are encouraged to teach Mathematics through real world contexts. There is scope to explore investment-related risks and rewards within statistics and probability, as you teach students to read, interpret and make predictions about chance and data representations.

In Victoria, Victorian Certificate of Education (VCE) Study Designs in Accounting, Economics, and Foundation Mathematics provide further opportunities to gain an understanding of financial risks and rewards. Similar senior secondary studies exist in other states and territories.

READING AND INTERPRETING DATA REPRESENTATIONS

As an example of a real world context, cryptocurrency offers a lot to explore with students economically and mathematically. It's hard to keep up, let alone become an expert. The only way to teach in this space is to position yourself as a learner, and model learning alongside your students.

A good place to start is simply by watching, monitoring and discussing cryptocurrency price trends over time.

We suggest that you might form a coalition of Commerce and Mathematics teachers at your school to do this together with students. Here are three tips that might help you to establish a 10-minute classroom routine once a fortnight or month:

- iPhone users can access the Stocks app free. You and your students can create a customisable watchlist to monitor daily performance, and tap any ticker to see interactive charts.
- You can find tabulated cryptocurrency prices at www.gemini.com/prices. Ask students to compare the price, 24-hour change and percentage change in popular crypto assets, like Bitcoin, Ethereum and Dogecoin.
- You can access Alan Kohler's reports for ABC News at www.abc.net.au/news/programs/kohler-report/. These quick videos offer a great way for you and your students to follow key investment markets.

PROMOTING CRITICAL THINKING ABOUT INVESTMENT MARKETS

There are also some questions you can explore with your students in order to promote critical thinking about investment markets:

- What do you notice? What mathematical and financial language can you use to describe what you're noticing? (trend, trajectory, rise, fall, boom, bust, crash)
- What mathematical calculations underpin this table, graph, or chart?
- Can you predict what might happen next?
- What might a skilled investor do?
- What do you wonder about? What questions might you pose?

We also recommend these podcasts to continue your learning about money and investing:

- Gen Z Money
- My Millennial Money
- She's on the Money
- The Australian Finance Podcast
- The Pineapple Project

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GAME THEORY

Sanjin Dedic - Digital technologies, King David School

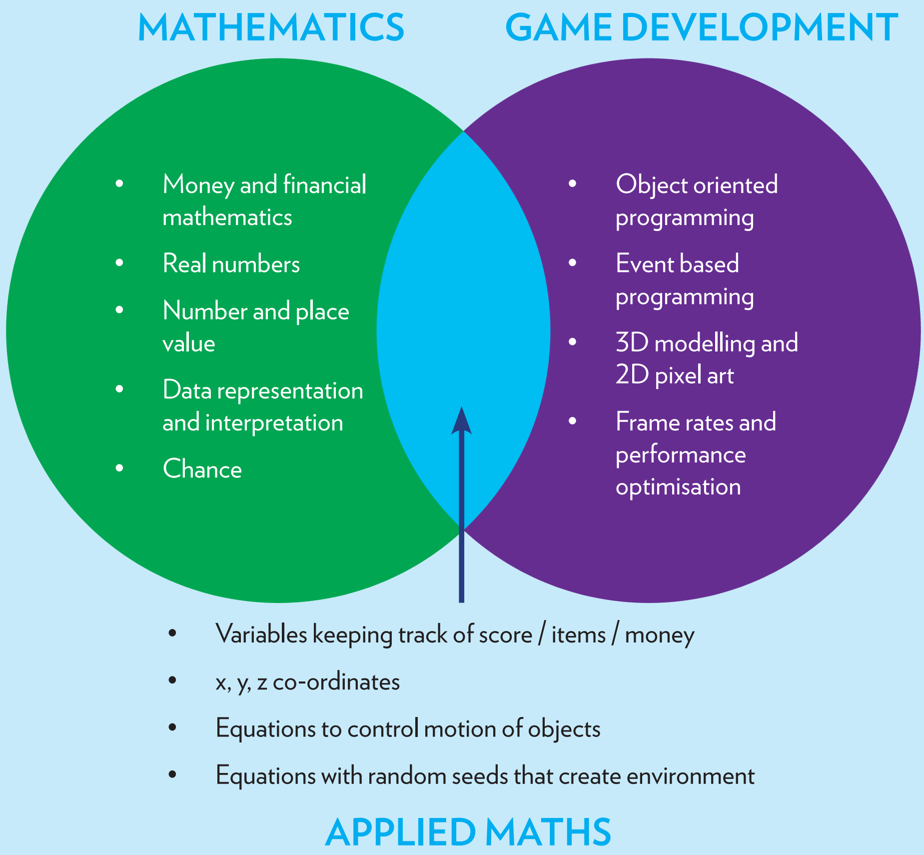


Figure 1. Overlap between mathematics in Years 7-10 and core concepts of game development.

It is very hard to exaggerate the extent to which most of our students are engaged by various aspects of computer games. They spend much of their free time playing games, they socialise on a platform called Discord while playing. They watch other people play games on Twitch. The real enthusiasts even take part in the 'modding' of games like Minecraft which involves creating original game content as well as coding game features.

In my personal experience, running extension coding classes for gifted and talented students, all my sold out classes are gaming related: modifying Minecraft, programming Discord bots and creating games with Python or JavaScript.

I imagine that many teachers will see this as a bleak dystopian trend, and I do confess to being a little bit alarmed myself, but there is a silver lining here! Most students pick up some useful mathematical knowledge playing games, and for us teachers games could be a great hook for teaching algebra and co-ordinate geometry (as well as some other topics that I will not get into).

Let's unpack some mathematical concepts embedded in games.

Learning about variables

Frankly, I think that in 2022 basic algebra is easier to teach than it ever was before. This is because most students have learned what a variable is usually through Scratch coding. It's almost impossible to build a game without basic algebraic calculations with variables which keep track of something tangible like score or location.

Cartesian coordinate systems

You can't put an object on a screen without specifying co-ordinates. You cannot move that object without some equations expressed in terms of time that involve these co-ordinates. I find that students who are advanced in Scratch coding in Year 6 have a massive head start learning about the Cartesian coordinate system.

Applied algebra

The latter stages of developing a game are often fine tuning the way the game gets more difficult or making the movements more crisp and realistic. Either of these involves maths. For instance, the act of jumping, if done correctly, is essentially the constant acceleration equations of projectile motion. Difficulty escalation is an asymptotic curve that enables the game to get harder without ever becoming impossible. Again, these are very challenging concepts experienced in a very intuitive manner.

CLASSROOM IDEAS

The next question is how you can use these connections to engage your students and illustrate these mathematical concepts in class. I have two suggestions:

Use Python or Scratch to write programs that illustrate co-ordinate geometry

This is not for everyone as it requires some basic coding knowledge on behalf of both the teacher and the students.

However, my experience teaching this in the classroom was quite rewarding and I had students tell me that these enhanced their mathematical understanding and made new connections between maths and computer science. Here are some handy video tutorials explaining these activities and how to run them in the classroom.

Algebra and arithmetic with scratch
https://techxellent.teachable.com/p/algebra-and-arithmetic?coupon_code=MAV

Co-ordinate geometry with scratch
https://techxellent.teachable.com/p/co-ordinate-geometry?coupon_code=MAV

Python mathematics
https://techxellent.teachable.com/p/python-mathematics?coupon_code=MAV

Lean on your students to make the connections and present them

In any classroom, there are at least a handful of Minecraft enthusiasts, and, more likely than not, over half of any secondary class in 2022 plays/has played Minecraft. This basically means that all these students have been extensively exposed to the use of co-ordinates.

I would suggest sharing the resources here with some Minecraft enthusiasts who are good communicators and asking them to create a class presentation illustrating co-ordinate systems and basic equations.

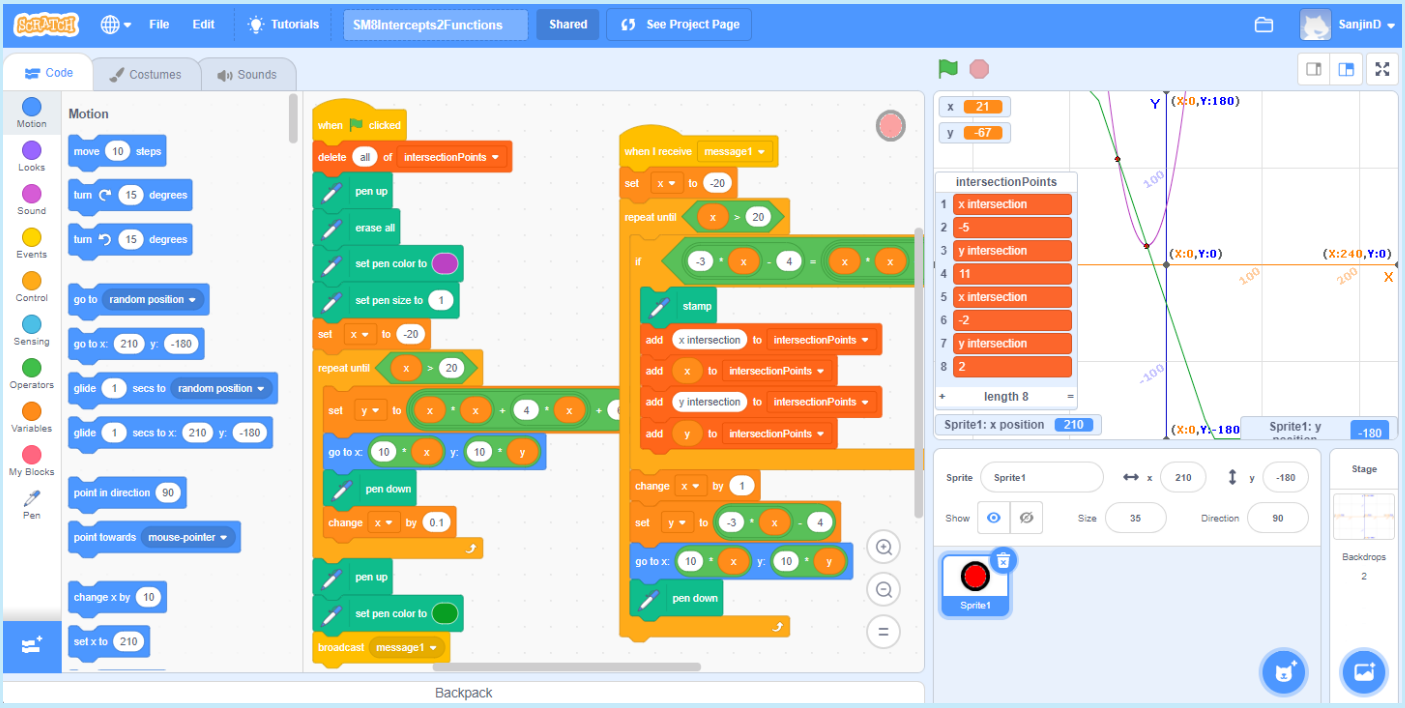


Figure 2. Intersection of two polynomials.

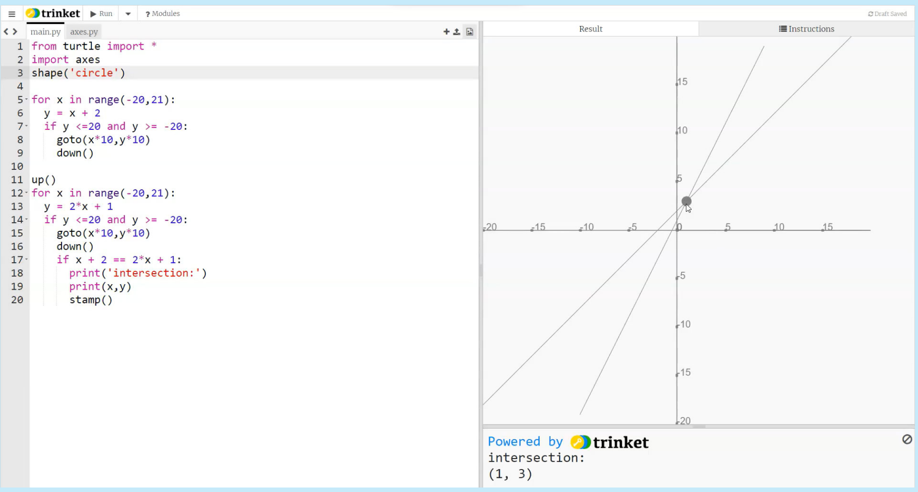


Figure 3. Using Python turtle to find intersection of two polynomials.

https://empireminecraft.com/blog/tips-and-tricks/design/533-mathcraft-linear-equations-2/

https://education.minecraft.net/en-us/resources/math-subject-kit

TRY THE CODING CHALLENGE

MAV, in collaboration with Digital Learning and Teaching Victoria (DLTV), have produced a series of engaging coding challenges to be experienced in various platforms. They're designed to extend your Year 5 - 10 students and captivate them with problem solving challenges that will require both their intellect and creativity.

This is a great way to immerse your students in engaging and educational coding tasks, with no preparation required by the teacher! The VCC is made up of two stages. In Stage 1, students get access to a virtual platform with some challenges they can complete at their own leisure – at school or home. All resources, videos and relevant materials are provided.

Should students wish to continue to Stage 2, this is when they get to really extend themselves in a state-wide competition, working in teams, and against other schools. In 2022 this will be a hackathon style event and will be sure to leave students buzzing! Cool prizes are up for grabs too – as are major bragging rights should your team be crowned as one of the best student hackers in Victoria!

This project is funded by the Victorian Department of Education and Training, and is only available to Victorian government schools. If you wish to gain access and are not a DET school, you are welcome to attend one of our coding webinars. Visit www.mav.vic.edu.au/events.

For more information on this exciting and **free** program, visit www.mav.vic.edu.au/Student-Activities/Victorian-Challenge-and-Enrichment-Series/Victorian-Coding-Challenge.

CAREERS IN STEM

Jess Mount and Helen Haralambous - Mathematics education consultants, MAV

The Mathematics in Careers investigations are designed to help students experience what careers in leading STEM industries can look like, through collaborative projects that solve real word problems using real data and tools. The investigations were created by Helen Haralambous and Jess Mount as part of the Connecting Learning with Work Project.

MATHS CAMP INSPIRATION

Each year MAV invites Year 10 students to take part in a Maths Camp, aimed at demonstrating the connection between mathematics and its real world application.

Prior to the camp, students are asked to rank STEM careers that they are interested in, such as biomedical science, scientific research, engineering, economics and coding/ICT. At the camp, students work in teams on an open-ended industry problem, for example, the engineering team were invited to investigate vehicle safety.

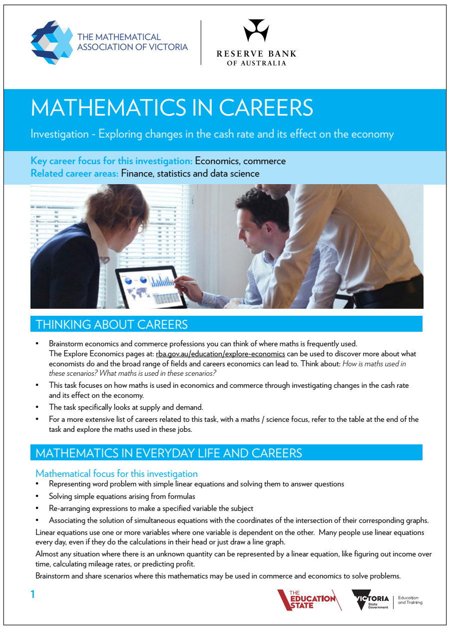
The Maths Camp is a collaboration between MAV and various industry partners such as Ford, Biarri, The Reserve Bank of Australia and Texas Instruments.

CONNECTING LEARNING WITH WORK PROJECT

MAV were keen to broaden access to the Maths Camp investigations. Now, all schools across Victoria can access ten investigations based on actual problems our industry partners deal with in their workplace. Through a contextual investigation based on real industry scenarios, the investigations demonstrate how mathematics is applied in a variety of careers.

Each investigation includes both a student and teacher version. Ideally, students should collaborate in small groups to allow them to utilise and develop the skills required by industry, including problem solving, critical and creative thinking, communication, and teamwork.

Each student investigation is broken into four parts, increasing in order of complexity. Part 1 could include completing a table, Part 2 takes this data and displays it graphically it, Part 3 includes analysis and Part 4 asks for a summary of findings, demonstrating



THE MATHEMATICAL ASSOCIATION OF VICTORIA | RESERVE BANK OF AUSTRALIA

MATHEMATICS IN CAREERS

Investigation - Exploring changes in the cash rate and its effect on the economy

Key career focus for this investigation: Economics, commerce
Related career areas: Finance, statistics and data science

THINKING ABOUT CAREERS

- Brainstorm economics and commerce professions you can think of where maths is frequently used.
  The Explore Economics pages at: rba.gov.au/education/explore-economics can be used to discover more about what economists do and the broad range of fields and careers economics can lead to. Think about: *How is maths used in these scenarios? What maths is used in these scenarios?*
- This task focuses on how maths is used in economics and commerce through investigating changes in the cash rate and its effect on the economy.
- The task specifically looks at supply and demand.
- For a more extensive list of careers related to this task, with a maths / science focus, refer to the table at the end of the task and explore the maths used in these jobs.

MATHEMATICS IN EVERYDAY LIFE AND CAREERS

Mathematical focus for this investigation

- Representing word problem with simple linear equations and solving them to answer questions
- Solving simple equations arising from formulas
- Re-arranging expressions to make a specified variable the subject
- Associating the solution of simultaneous equations with the coordinates of the intersection of their corresponding graphs.

Linear equations use one or more variables where one variable is dependent on the other. Many people use linear equations every day, even if they do the calculations in their head or just draw a line graph.

Almost any situation where there is an unknown quantity can be represented by a linear equation, like figuring out income over time, calculating mileage rates, or predicting profit.

Brainstorm and share scenarios where this mathematics may be used in commerce and economics to solve problems.

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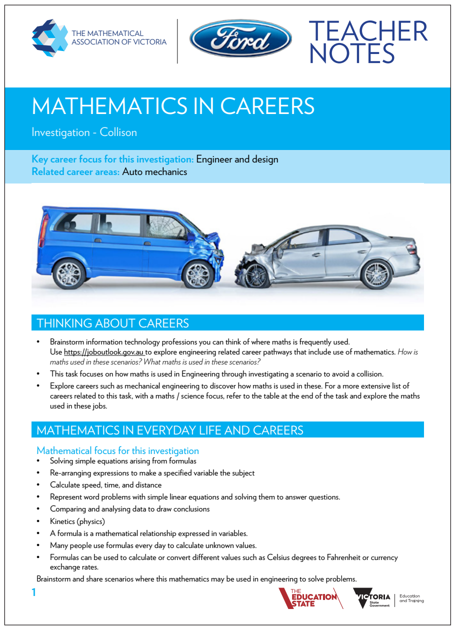
THE EDUCATION STATE | VICTORIA State Government | Education and Training



THE MATHEMATICAL ASSOCIATION OF VICTORIA | Ford | TEACHER NOTES

MATHEMATICS IN CAREERS

Investigation - Collison

Key career focus for this investigation: Engineer and design
Related career areas: Auto mechanics

THINKING ABOUT CAREERS

- Brainstorm information technology professions you can think of where maths is frequently used.
  Use https://joboutlook.gov.au to explore engineering related career pathways that include use of mathematics. *How is maths used in these scenarios? What maths is used in these scenarios?*
- This task focuses on how maths is used in Engineering through investigating a scenario to avoid a collision.
- Explore careers such as mechanical engineering to discover how maths is used in these. For a more extensive list of careers related to this task, with a maths / science focus, refer to the table at the end of the task and explore the maths used in these jobs.

MATHEMATICS IN EVERYDAY LIFE AND CAREERS

Mathematical focus for this investigation

- Solving simple equations arising from formulas
- Re-arranging expressions to make a specified variable the subject
- Calculate speed, time, and distance
- Represent word problems with simple linear equations and solving them to answer questions.
- Comparing and analysing data to draw conclusions
- Kinetics (physics)
- A formula is a mathematical relationship expressed in variables.
- Many people use formulas every day to calculate unknown values.
- Formulas can be used to calculate or convert different values such as Celsius degrees to Fahrenheit or currency exchange rates.

Brainstorm and share scenarios where this mathematics may be used in engineering to solve problems.

1

THE EDUCATION STATE | VICTORIA State Government | Education and Training

Each of the ten investigations contains a comprehensive investigation for students along with a guide for teachers.

any relationships found, and requiring students to explain their understanding and reasoning in drawing conclusions.

Once students have completed the real-world work investigation, it is important to encourage them to present their findings to their peers.

The teacher guide includes career focus areas, the core mathematical skills focus, links to the Victorian Curriculum and the relevant mathematics proficiency focus.

Most investigations contain a step-by step-solution guide and enabling prompts to assist teachers in working with their students. It is recommend that teachers use the solutions only to prompt students to assist them in getting started with the investigation. Once students have completed the core component of the investigation, suggested extension materials are provided.

WHO CAN USE THE INVESTIGATIONS?

The investigations are aimed at students in Year 10 to VCE and they can be adapted as SACs or SAC starting points. The investigations have varied degrees of complexity and the teacher guide provides support for easy implementation, including enabling prompts and extension ideas.

Included within each investigation is a career focus section which contains a table of careers linked to the mathematics and content covered in the investigation. Students can explore the various careers and key skills required for the relevant industry and learn more by following the relevant weblinks provided.

ACCESSING THE INVESTIGATIONS

The investigations are free to access and are easily downloadable at www.mav.vic.edu.au/resources/mathematicsincareers.

WHAT DO STUDENTS THINK?

'The aspect of the investigation I enjoyed most was being able to work in a team to solve a real-world application problem and look at the math/science behind the topic.'
– Jack, a student who explored vehicle safety, one of the engineering investigations.

All ten investigations can be accessed for free at www.mav.vic.edu.au/resources/mathematicsincareers. If you've used the investigations, please get in touch to share your experience, email Helen Haralambous or Jess Mount, hharalambous@mav.vic.edu.au or jmount@mav.vic.edu.au.

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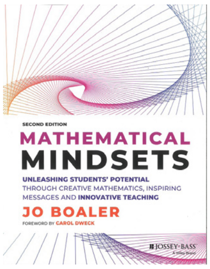

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Mathematical Mindsets is based on thousands of hours of in-depth study and research into the most effective—and ineffective—ways to teach math to young people. This new edition also includes:

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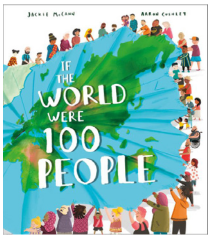

IF THE WORLD WERE 100 PEOPLE

3–7

Imagine the world's population as 100 people: what would it look like?

There are almost 8 billion humans living on Earth, but it's tricky to picture so many people! So instead, let's imagine the whole planet is a village where 100 people live – each person representing around 80 million people in the real world. So what does our global village of 100 people look like? Are they all grown-ups? Are there more males or females? How many have black hair or blue eyes? What languages do they speak? Who can read and write? How many have access to the internet or have enough food to eat? Does everyone have access to electricity or clean water?

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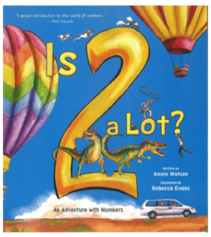

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F–2

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F–3

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