

# MATHTECH26 - Abstracts

## **Title: Beyond Memorisation: Making Trig Click**

So often students struggle to develop a conceptual understanding of the unit circle, degrees and radians, and trigonometric functions, particularly how these concepts are interconnected. Memorising rules and procedures will only get them so far before they need a deeper understanding to effectively apply their knowledge. As a result, students may be able to recall and apply familiar procedures but experience difficulty adapting their knowledge to more unfamiliar problems.

In this session, I will explain an interactive Desmos resource designed to help teach the unit circle, degree and radians, and trigonometric functions, and how these topics all interconnect. This resource is designed as a teacher-led visualisation that can be displayed to the class to demonstrate these relationships though it can be easily adapted into a student-friendly interactive too.

## **Title: Matrix transformations: Transforming student understanding**

Matrix transformations aren't just about algebra! When learning about matrix transformations, it is easy to simply apply formulas to solve problems without understanding the geometry of these transformations. Visualising transformations provides an opportunity for students to see the connection between calculations and how these transformations affect points and shapes in the Cartesian plane.

In this session, we'll explore how GeoGebra can be used to develop students' understanding of matrix transformations. I'll share strategies and resources for using GeoGebra to start discussions, engage students, and explore transformations.

## **Title: A unique solution to teaching systems of equations**

Students often can't move fluently between graphical, algebraic, and verbal representations of the same mathematical idea. Systems of linear equations are a clear example as a student can often produce a correct response procedurally without being able to say what the result means geometrically. When the links are missing, procedures stay isolated from meaning, so students can't check whether an answer is reasonable or explain why a system has a unique, infinitely many or no solution.

This session introduces Desmos Notebook, which lets teachers place graphs, expressions and written notes on one page. I'll show how it can be used to introduce solutions to systems of linear equations visually, with students able to interact with the graphs and record their observations alongside. Starting with two variables, the notebook links the determinant to the geometric meaning of unique, infinitely many, and no solutions of three-variable cases in Unit 3.

## **Title: Exploring Statistics with CODAP**

How can we bring statistics to life beyond textbook examples and calculator functions? Normal distributions, sampling and proportions can be challenging for students to conceptualise, particularly when exploring how changing parameters and sampling methods influence results.

In this hands-on workshop, discover how CODAP (Common Online Data Analysis Platform) can turn real-world NASA climate data into engaging mathematical investigations. Explore whether Brisbane's temperatures really follow a normal distribution, experiment with probability and quantiles, and put random sampling to the test. Can a larger sample always be trusted? What happens when our samples tell different stories?

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Come ready to investigate, manipulate data and discover how this free digital tool can support inquiry, reasoning and statistical understanding in your classroom.

## **Title: A turning point in sketching the graph of the derivative.**

Simply presenting the derivative does not answer the questions students are often hesitant to ask: *Why are the  $x$ -intercepts there? How is that a point of inflection? Why does the derivative turn there?* Textbooks can provide limited visual explanation, graphing tools often present the finished product, and realistically, we cannot individually walk every student through every sketching question.

This presentation explores a scaffolded GeoGebra applet designed to bridge that gap. Through progressively revealing stationary points, gradient direction, concavity and derivative tracing, we will investigate how technology can help students develop a stronger understanding of the relationships between  $f(x)$ ,  $f'(x)$  and  $f''(x)$ —without simply giving them the answer.

## **Title: Maths in Motion**

Many Maths Methods students who haven't studied physics have a shaky grasp of the fundamental aspects of motion. Without this base knowledge applying calculus in the context of displacement, velocity and acceleration feels abstract.

In this session, participants will use The Physics Classroom's free Pace Tracer interactives, which turn a laptop camera into a motion detector so students can walk their way through displacement-time and velocity-time graphs. We will explore how physical movement builds intuition for key Unit 2 concepts, including constructing and interpreting displacement-time and velocity-time graphs, understanding what negative velocity means, and identifying the nature of stationary points. You'll leave with classroom-ready activities for linking calculus to real motion.

## **Title: Using Desmos to visualise numerical integration techniques**

Numerical integration is introduced in Unit 4 in Methods and Specialist. Students are introduced to left- and right-endpoint approximations before moving to the trapezoidal and Simpson's rules. These processes are conceptually rich, yet how often do we provide opportunities for students to see these in action? No one has time to draw 3.5 million rectangles, trapeziums or parabolas.

Without this exposure, these rules often look like intimidating walls of symbols. So, students end up plugging numbers into formulas they don't understand.

In this session, I'll share a Desmos applet that allows students to visualise the definite integral as a limit of sums, explore the trapezoidal rule as a natural progression from the left- and right-endpoint approximations, and introduce Simpson's rule to approximate the value of a definite integral. You'll leave with a question guide and a ready-to-use resource you can adapt for your own classes to help explore these fundamental

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## **Title: Parametric Equations: Don't Lose Track of Time**

Vector Calculus, introduced in topic 4, Unit 3 of Specialist Mathematics, includes significant conceptual hurdles as students encounter vector functions. Any sense of comfort students have with Cartesian equations is disrupted by the introduction of a third variable,  $t$ , on which both  $x$  and  $y$  depend, widening the conceptual gap created by vector-valued functions.

At this point in the learning sequence, students have only modelled position against time in one dimension, so tracing the path of a moving particle is unfamiliar territory. Yet, the physical contexts underpinning vector calculus provide a natural opportunity to leverage visualisation to support understanding.

Together we will explore the use of a GeoGebra applet to visualise particles moving through a plane, focusing on path intersection, particle collisions, and velocity vectors. The applet can be embedded at multiple stages of a learning sequence, helping students connect vector functions with their prior knowledge of displacement and velocity.

## **Title: Seeing the Mapping: Building Relational Understanding of Functions with GeoGebra**

Senior students can sketch, transform and differentiate functions, yet many treat a function as a formula to manipulate rather than a mapping that sends each input to exactly one output. Without that mental image, inverse functions, composite functions and domain restrictions become separate rules to memorise, rather than a coherent concept.

This workshop introduces Dynagraphs (dynamic mapping diagrams) to visually explore the concept of functions and relations. Using Dynagraphs, we will explore functions as the concept of mapping points, what this means for different functions, their domains and how teachers might use this applet for explaining any function-related topics.

Attendees will leave with customisable applets ready for Methods and Specialist classrooms across multiple topics.

## **Title: Same Slope, New Lens: Unifying Rates of Change Concepts with Desmos.**

Ask a senior student what the differential operator has to do with "rise over run" and you might be met with blank stares. Senior mathematics students frequently view introductory calculus as a series of disconnected formulas rather than the natural evolution of a single core concept that they have been working with for years. This conceptual breakdown leads many to rely on memorised algorithms while viewing limits as abstract, unreachable barriers.

In this hands-on workshop, we will explore a Desmos tool designed to dismantle these cognitive silos. By using this tool to scaffold concepts, we can strengthen students' foundational understanding and support them in connecting simple ideas such as gradient as rise over run to more abstract concepts like the first principles definition of the derivative.

We'll explore how leveraging flexible dynamic technology can reduce cognitive overload, address persistent limit misconceptions and build a unified, intuitive understanding of rates of change.