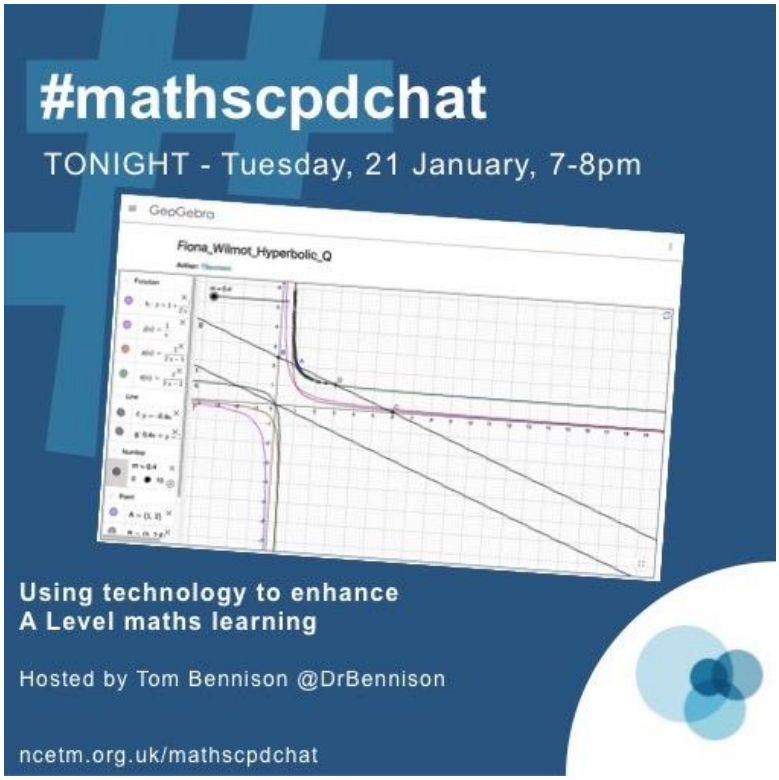
#mathscpdchat 21 January 2020

Using technology to enhance A level maths learning.

Hosted by Tom Bennison

This is a brief summary of the discussion – to see all the tweets, follow the hashtag ***#mathscpdchat*** *in Twitter*



Some of the areas where discussion focussed were:

contributors' 'favourite' technology resources for teaching and learning A level maths:

- a 'self-made' **GeoGebra file** for student exploration of the **properties of an ellipse**;
- **a visualiser** … 'it has changed my practice for ever';
- **Autograph** software;

- **Underground Maths resources** … that include ‘in-built’ suggestions-directly-to-students about where, and for what reason, they might helpfully/effectively use **Desmos or GeoGebra software**;
- **MEI tasks** that provide ideas/suggestions/guidance for **incorporating into lessons student-exploration using dynamic geometry software** such as GeoGebra;
- **ClassWiz calculators** … that being able to use them efficiently boosts students’ confidence … that teachers ‘show’ students ‘little tricks’ such as how to make the calculator show the prime-factorisation of a number, how to use the built-in ‘Newton-Raphson solver’ and the equation-solvers … that students show each other what they discover (for themselves) that they can do with the calculator;
- **Casio ClassWiz 991-EX calculator** … for example, using the imperial/metric conversion functions on it … using a calculator as a ‘checking tool’, challenging students to ‘justify’ the results that it displays;
- using **Wolfram Alpha** to show students ‘what can be done’ to/in/with particular mathematical ‘situations’ and problems;
- using **Desmos or Geogebra applets** to **‘demonstrate’ a procedure** (such as standardising a normal distribution);
- using the mathematics toolbar in **OneNoteEdu** (link provided below);

whether it is **teacher demonstrations or student explorations** that make the greatest contributions to students’ learning:

- that **‘minimal’ teacher demonstration followed by considerable student-exploration** is effective;
- that **‘teacher Desmos activities’** provide opportunities for students to **communicate their ideas and their reasoning verbally using appropriate vocabulary**;

whether students are better-served by having a graphical calculator to use in A level exams, or by having had lots of experience of exploration using graphing software (Autograph, Desmos, GeoGebra), and then having only an advanced scientific calculator in the actual exam:

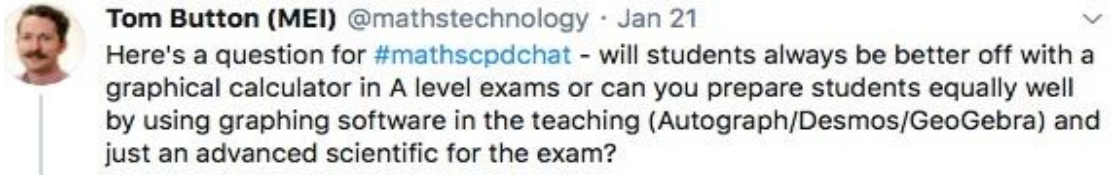
- that **relying too heavily on a graphical calculator** may result in students **focussing on ‘getting answers’** rather than on understanding ideas and procedures;
- **‘locking down’ phones** so that while, for example, students are **using GeoGebra** on them, the phones **can’t be used for anything else** … if a student sets their phone to ‘airplane mode’ outside the GeoGebra app, and then selects ‘exam mode’ from the menu a timer shows how long the screen has been pinned to GeoGebra;

two final focus points:

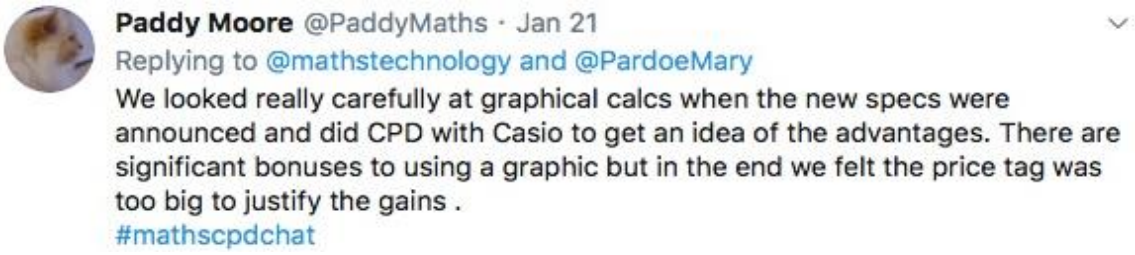
- using technology to aid **learning about polar curves (link below)** … the possibility of showing two sets of axes side-by-side, rather than superimposed;
- that the five short **AMSP PD videos (link below)** on use of technology in A level maths include useful questions to prompt reflection on issues raised during the discussion.

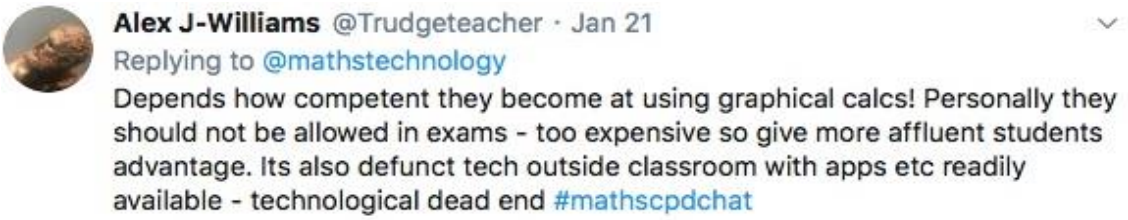
In what follows, click on any screenshot-of-a-tweet to go to that actual tweet on Twitter.

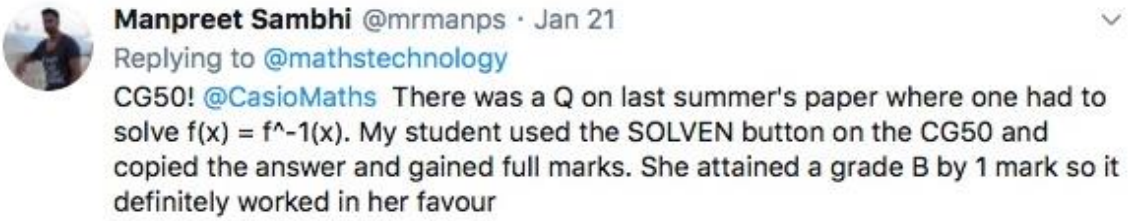
This is part of a conversation about whether it is better for students to use graphical calculators in A level exams, or to have had a great deal of experience with using graphing software in lessons, and use just an advanced scientific calculator in the actual exams. The conversation was generated by this tweet from Tom Button (MEI):

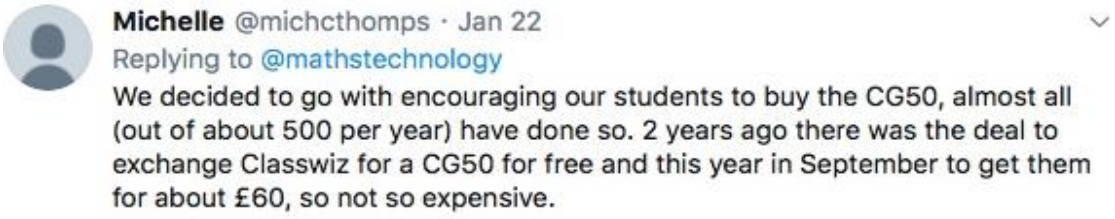


and included these from Paddy Moore, Alex J-Williams, Manpreet Sambhi and Michelle:

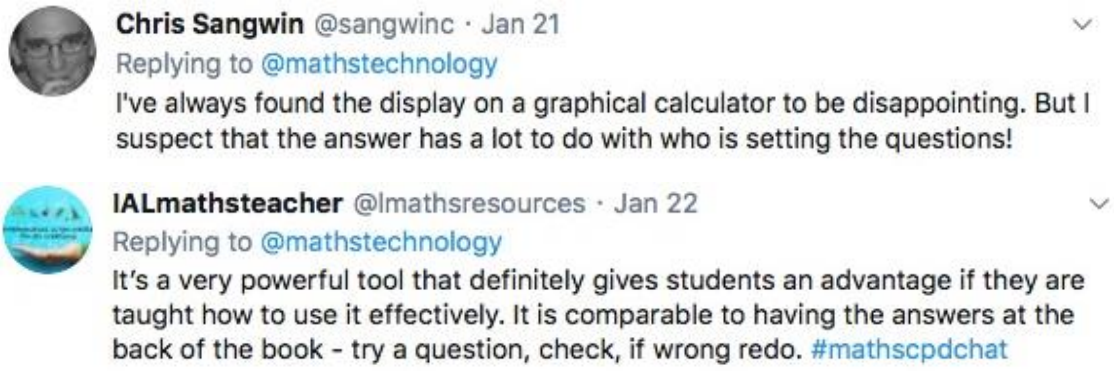




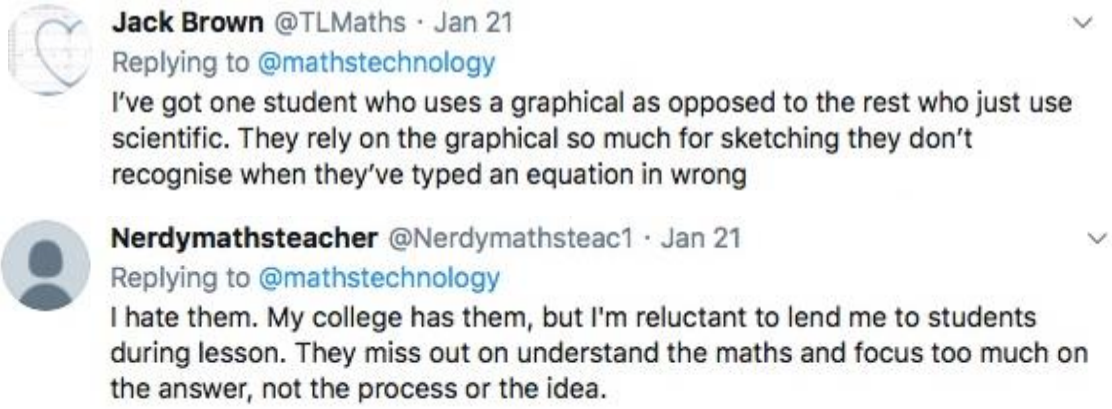




these from Chris Sangwin and IALmathsteacher:



and these from Jack Brown and Nerdymathsteacher:



(to read the discussion-sequence generated by any tweet look at the 'replies' to that tweet)

Among the links shared were:

AMSP PD Videos:Technology which are five videos from the Advanced Maths Support Programme showing various ways that technology can be used in A level Mathematics/ Further Mathematics lessons. Each video demonstrates a different approach to using technology such as Graphing software and Graphical calculators. It was shared by Tom Button (MEI)

Polar Plotting which is a blog by Tom Bennison written specially for the discussion. In the blog Tom explains that he hopes to help inspire and empower other teachers to create their own technology resources for teaching and learning mathematics. Tom also provides a link within the blog to one of his own recent Desmos creations for student-exploration … 'Polar Plotting'. It was shared by Tom Bennison

The parametrisation of the ellipse which is a Geogebra applet created by Tom Bennison which allows the student to explore the parametrisation of the ellipse and explore the foci property of the ellipse. It was shared by Tom Bennison

GeoGebra app: Binomial distribution which is a GeoGebra application by Constantinos Koudounas designed to aid exploration of the binomial distribution. The user can explore what happens as they vary any combination of the values of n, the number of trials, x, the number of successes, and p, the probability of success. It was shared by Atul Rana

LoopSpace's Code Projects which is a collection of programs designed for mathematical exploration, much of which is useful at A level. For example, one program demonstrates the histogram for the sum of Bernoulli distributions with varying values of p and n, and another is a program for visualising complex numbers and operations on them. It was shared by Loop Space

Match My Parabola which is a Desmos resource consisting of a series of scaffolded quadratic graphing challenges intended to develop students' proficiency with standard, vertex, factored and other quadratic function forms. It was shared by Phillip Walker

Action Enquiry which is an interesting blog by Jack Nicol about his classroom work to help students develop a deeper understanding of mathematical concepts through using graphing software such as GeoGebra and Desmos. It was shared by Jack Nicol

PHET Interactive Simulations which is a collection from the University of Colorado of simulations involving mathematical 'topics', such as 'vector addition' and 'curve fitting'. It was shared by Mr Winstanley

Underground Mathematics which are interesting resources for A level mathematics, many of which have their own Desmos or Geogebra interactives built in. Suggestions and instructions are provided direct to students to guide them in using specific aspects of the software for specific purposes related to mathematical problems posed. It was shared by Mary Pardoe

WolframAlpha computational intelligence which are AI technology resources that enable students to explore much of the A level maths 'content'. For example, they can solve, plot and find alternative forms of polynomial expressions in one or more variables, or plot a conic section and identify its type. It was shared by Jack Brown

Draw graphs of math functions with Math Assistant in OneNote which enables the user to graph handwritten or typed equations. You can even manipulate variables to see the visual effect of changes. It was shared by Mark Richards

CASIO FX-991EX Advanced Engineering/Scientific Calculator (UK VERSION) which is a calculator! It was shared by Paddy Moore

CASIO CLASSWIZ Calculator Tutorial which is a calculator tutorial. It was shared by Paddy Moore

Numbas which is a resource from Newcastle University that can be used to create online mathematical challenges for students complete with videos and interactive diagrams. It was shared by Tom Bennison