

AUTOGRAPH IN THE CLASSROOM

Alan Catley presents a user guide to some of the functionality of Autograph

Autograph is possibly the best general tool for the mathematics classroom because it is:

- easy to use
- designed by a teacher
- incredibly flexible
- brings school and college maths to life.

I gave a taste of this at the NCETM Digital Technologies Conference (Institute of Education, London, 27th February 2013) - which is summarised below. The links to videos and resources at the end will better illustrate how this can revolutionise your teaching.

The fundamentals of Autograph

The first decision that the user has to make is, which level to open the software up with? The simplest guidelines for this are to use 'Standard Level' up until the point when you are going to introduce calculus, or require switching angles between degrees and radians. There are plenty of key differences between Standard and Advanced levels when using the separate Statistics or 3-D pages but I won't attempt to go into these here. There are 3 types of Autograph page:



New Statistics page



New 2-D Graph page (also used when investigating scatter graphs, correlation, regressions etc.)



New 3-D Graph page

My advice to any new user of Autograph is to spend some time familiarising yourself with two often overlooked but extremely useful features:

Preferences – you will find this under the 'View' menu. Here the user can decide on things such as the speed of the slow plot, what significant figure accuracy to display, whether to shade the 'accept' or 'reject' region when graphing inequalities (the default is the 'reject' region) and many more. In earlier versions of Autograph I always used the 'preference' to keep the 'Whiteboard Theme' on permanently and also 'Display Keyboard' each time Autograph is opened up. In version 3.3 'Whiteboard Theme' is now on by default. The on-screen keyboard is very versatile as it contains many common mathematical symbols and it can also be used in other applications such as Word, Powerpoint, and Excel.



Edit Axes – There are so many useful options that I couldn't begin to explain them all here. Top Tip!... set the 'Appearance' of Autograph so that it looks how YOU want it to look then 'Save' this file (named e.g. Blank 2-D) to your Desktop. Next time you want to use Autograph just open this file (you may also find it useful to prepare similar templates for a Statistics Page and a blank 3-D Page). I also find that when using some projectors the grid lines appear too faint – this is easily overcome by choosing a darker grey for the grid (again under the 'Appearance' tab)

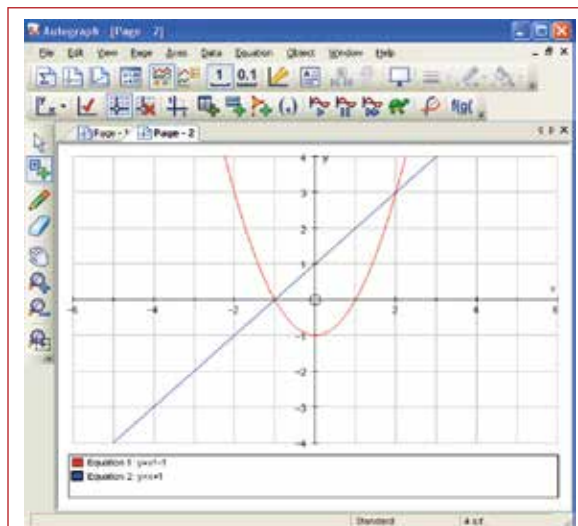


Figure 1 – Display for an individual PC

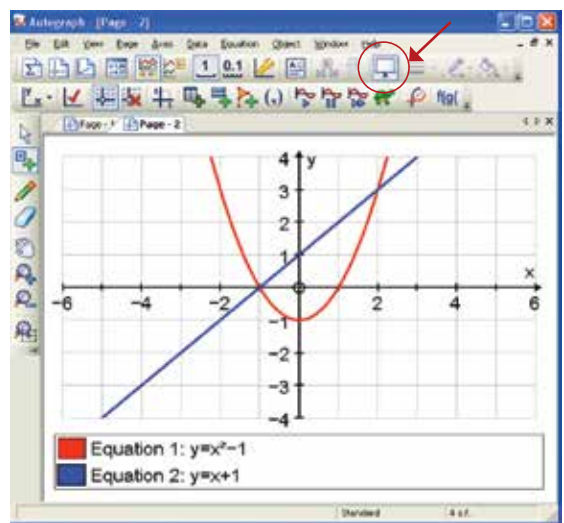


Figure 2 – Display when using 'Whiteboard Theme'

Moving on to applications in the classroom let's start with some algebra of the quadratic function.

A 'Right Click' allows the option to 'Insert Image'. A 'time lapse' photo of a ball being bounced across a table is shown here and positioned so that the first bounce is at the origin.

Tip - a double click on the inserted image allows for changing the transparency and also whether or not to scale the image when using the Autograph 'zoom' functions.

This and many more images along with other resources are available to download from:

www.tsm-resources.com/autograph

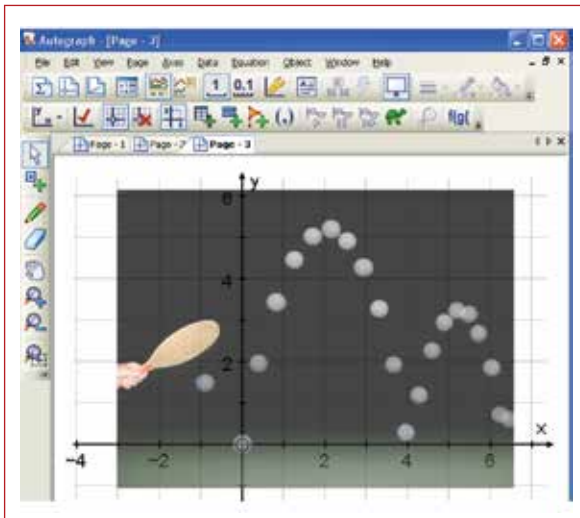




Figure 3

 'Add Point' mode has been used to place 3 points at strategic positions on the image – the vertex and the start and end points of the first bounce.

 Having 'selected' these 3 points the 'Object' menu allows a quadratic function to be fitted through the points as shown here.

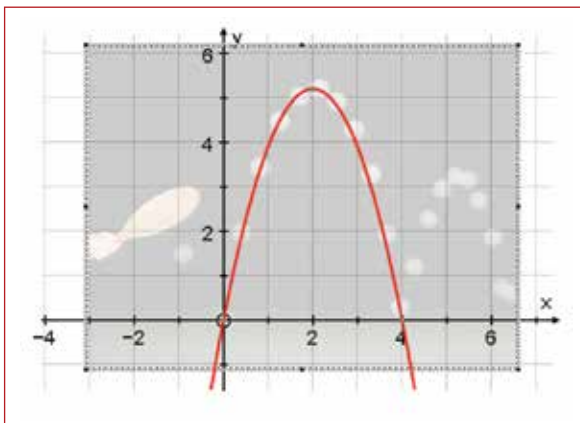





Figure 4

 An equation in factorised form has been added along with appropriate text boxes.

 The incredibly useful (particularly when asking the class questions along the lines of "what if . . . ?") Constant Controller, can now be used to adjust the values of 'k' and 'a' until a good fit to the original function is established.

 The task for the class would be to find, using their algebra skills and not the software, a suitable model to describe the second bounce. Using Slow Plot invite them to enter their equation!

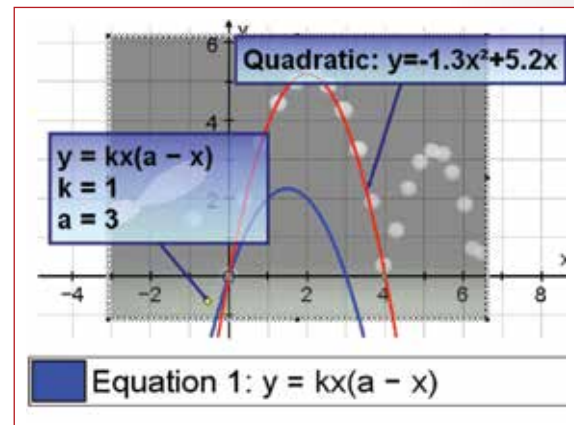


Figure 5

Dynamically change 'a' and 'k' using the Constant Controller.

Tip – check out the 'Options' available!



Figure 6

This is just one brief example of many applications in algebra and graphing. I have chosen this example to try to demonstrate that there are ways of using the features of Autograph to enhance understanding of all sorts of algebraic techniques and skills that feature in the mathematics curriculum.

Applications in calculus.

Rather than give a detailed account of how Autograph can be used for everything including introducing differentiation and integration, solving first and second order differential equations, introducing radians for trig functions by, for example, considering the gradient function of $y = \sin x$ in using both degrees and radians, here are a few selected images from worksheets that I have made available.

These worksheets also contain step-by-step instructions to guide students through investigational approaches to understanding what this branch of mathematics is all about. It is helpful to point out here that I have tended to adopt an approach, which involves students discovering rules for themselves, such as differentiating the general cubic function, **before** we discuss the results in class. This is achieved by directing students to work through suitable activities, in advance of the lesson, using these carefully designed worksheets. This has proved to be far more effective than the more traditional approach of teaching a topic in class when the students have no previous experience of what I am talking about!

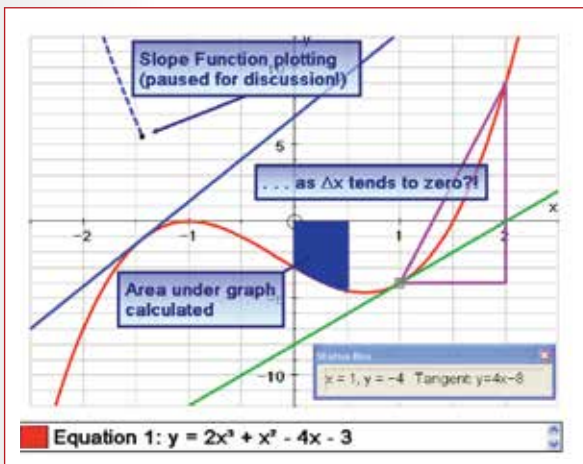


Figure 8 – many features, shown here in **one** diagram, that are used in a series of worksheets on basic differentiation and integration

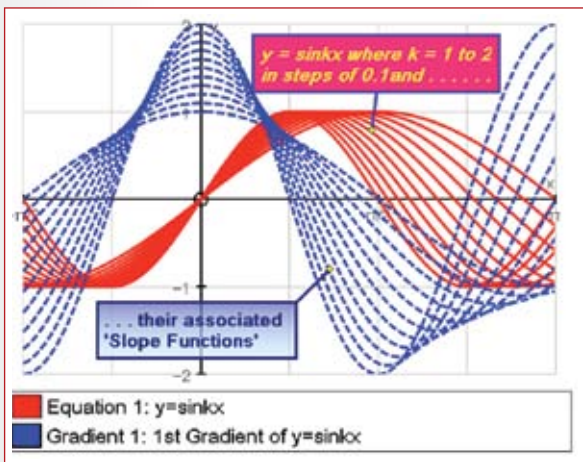
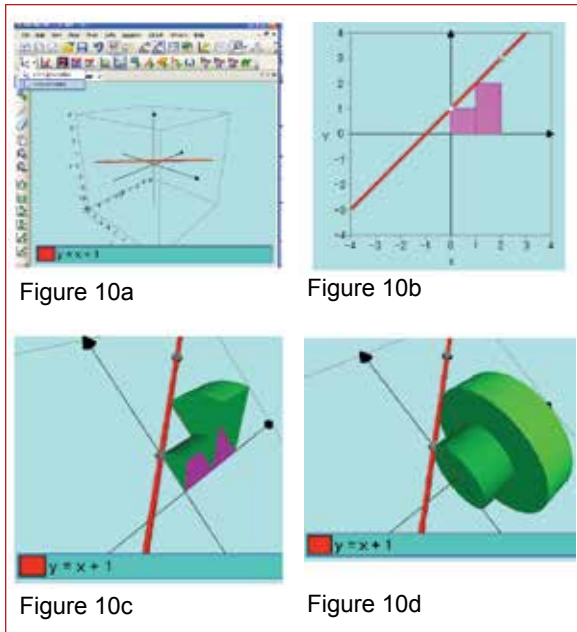


Figure 9 – an attempt to demonstrate how it is possible to animate the Chain Rule. When asked “what if I change k to 2?” very few students **predict** that the gradient graph will become $\frac{dy}{dx} = 2\cos 2x$

Figure 10 here shows a series of images from an introductory worksheet that students would be expected to complete **in advance** of a lesson on Volumes of Revolution. My experience is that students have no problems with using the software.

My concern is to ensure that students fully understand the mathematical concepts being studied. By seeing the mathematics come to life in this way their understanding is greatly enhanced and this is the case no matter whether they are being introduced to basic linear graphs, algebraic solution of simultaneous equations or the multitude of topics right across the spectrum and into the wonders of more advanced calculus and 3-D vectors etc.

If you would like to see these worksheets in full detail then they are available to download from: www.tsm-resources.com/autograph



The talk in London went on to give a very brief taste of similar applications of Autograph in:

- Trigonometry
- Vectors (in 2-D and 3-D)
- Data Handling, Statistics and Probability
- Circle properties and 3-figure Bearings
- Geometrical Transformations

These are fully documented in the worksheets and lesson plans mentioned above. Many of the ideas for these resources that I have used with my own students came from viewing the excellent video clips of ‘Autograph in Action’ available through www.autograph-maths.com



Alan Catley is an Independent Consultant and INSET provider

If you would like a CD of all my resources, worksheets, lesson plans etc. on the use of Autograph in the classroom then get in touch with alan@catley.org

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