



The educational uses of pencasts in mathematics education.

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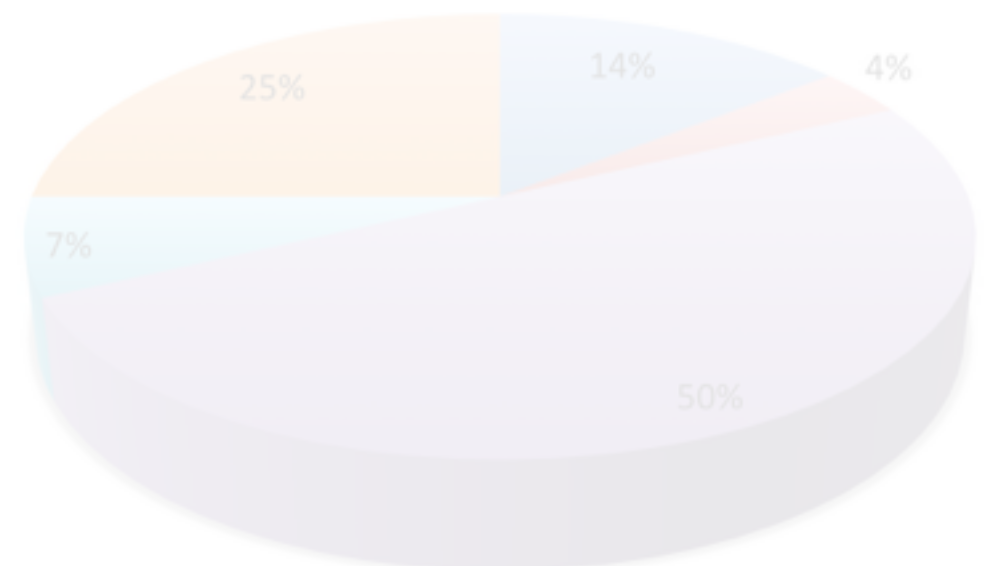
Challenges of teaching and learning mathematics

Diverse mathematical background

Time since last studied maths

Memory and concept difficulties

Fast pace



What is a Pencast?

Interactive
document

digital
notes

synchronised

audio



Why pencasting?

Pen and paper

Portable

Quick setup

Easy to create

Better handwriting



Equipment I started with ...



Livescribe echo™ smartpen

- Owned since Spring 2012
- Funded by MSOR Network
- ~ RRP £130 /€180

To create a pencast:

- Livescribe Paper
- Computer (Mac or PC)
- Livescribe Desktop software
(replaced by Echo Desktop software)

Equipment I now use ...

Livescribe 3 smartpen

Owned since Summer 2015

Funded by Ulster University

as part of its widening and
participation strategy

~ RRP £130 / €180

To create a pencast:

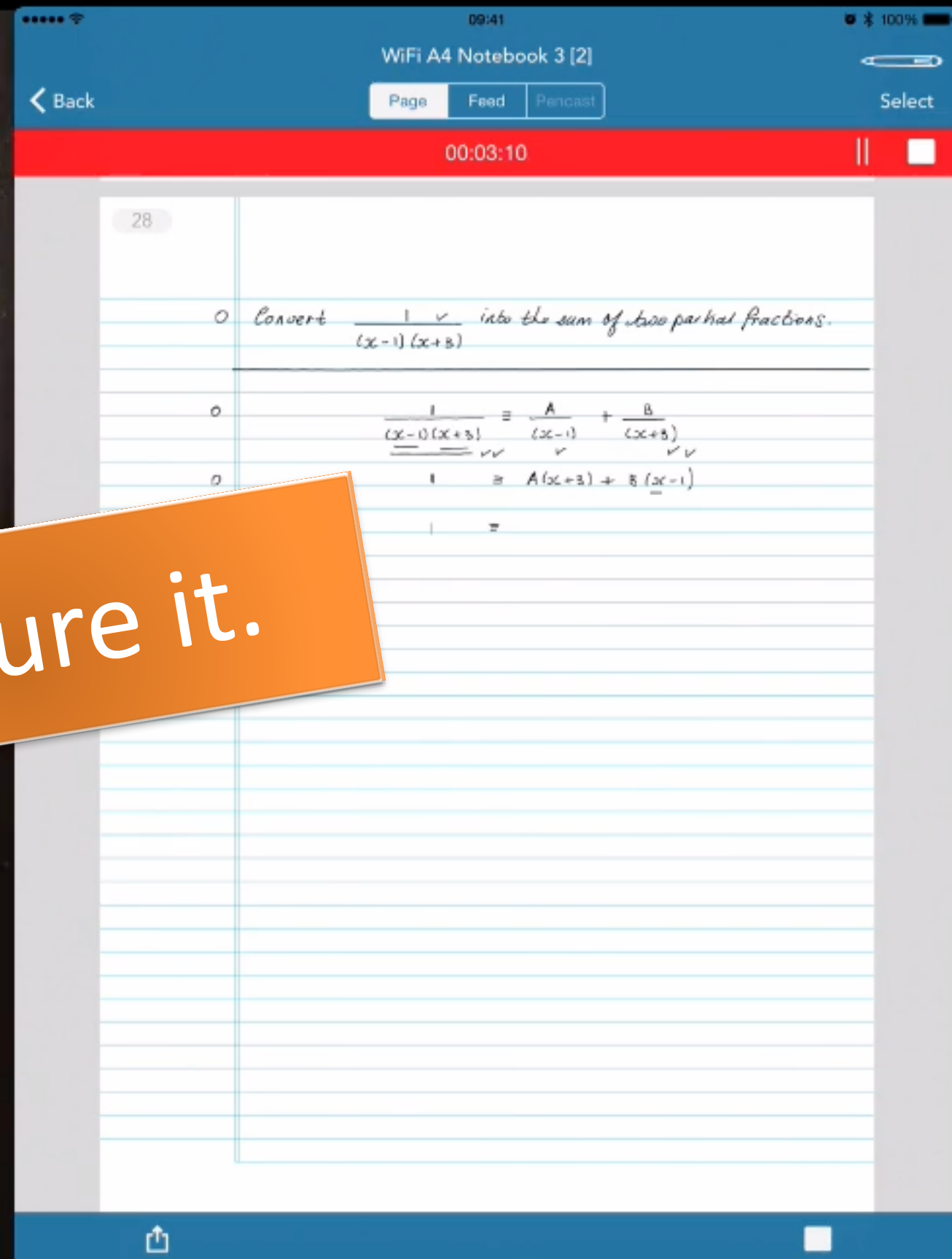
Livescribe Paper

iOS 8+ or Android (KitKat v4.4.2)

Livescribe+ App

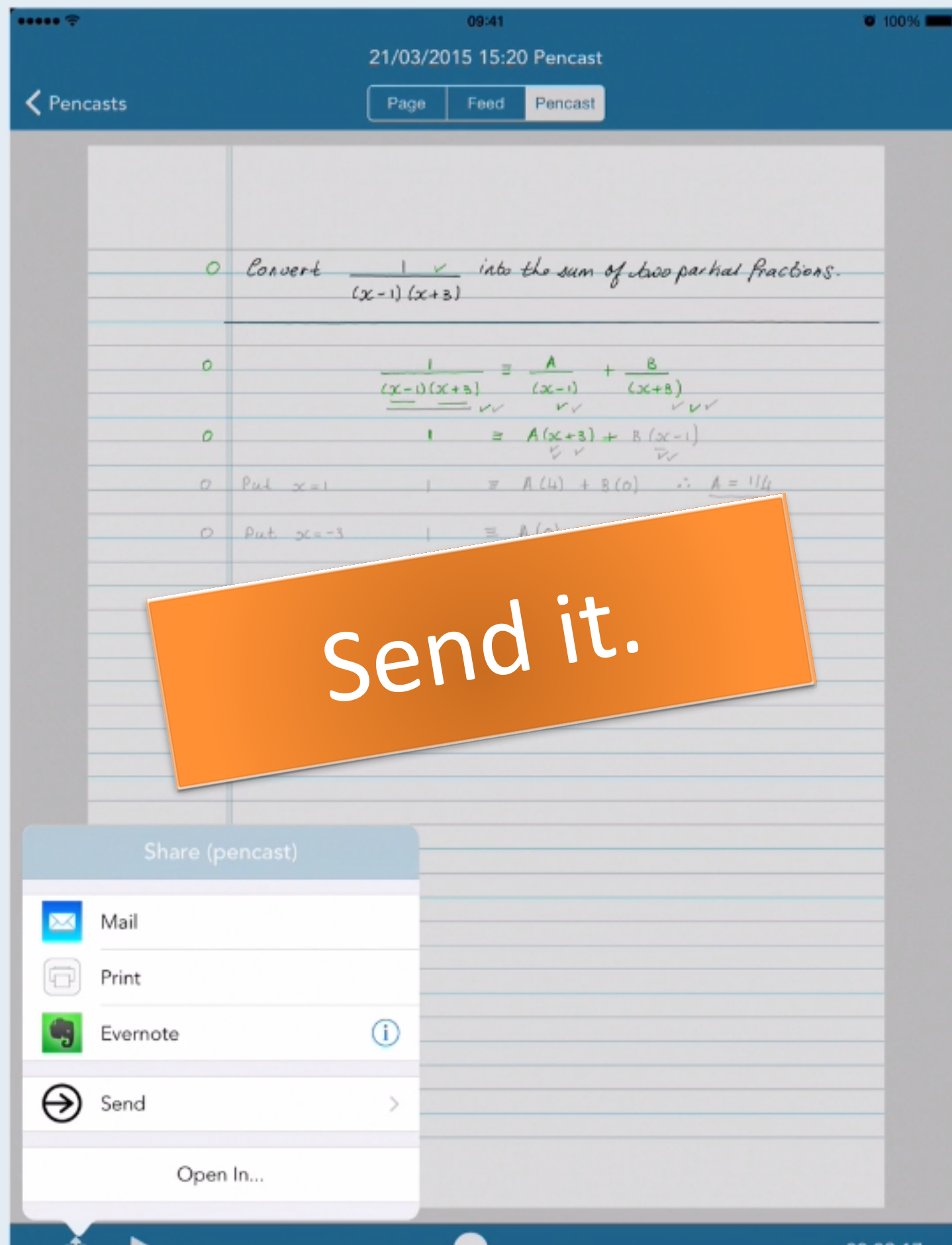
(free on App Store or Play Store)





Capture it.

Screenshot of video on capturing a pencast (mathcast) using Livescribe+ App



Screenshot of video on sending a pencast (mathcast) using Livescribe+ App

Upload to Blackboard VLE.

Coursework 1: Pencast Mark Schemes

Enabled: Statistics Tracking

Student self-assessment process: To help you *judge and improve the quality of your learning* in each of the assessed topics, you are encouraged to *review the pencast mark scheme*, and the *tutor's comments* on your marked solution for each of the questions given in the coursework.

Coursework Learner Score and Reflection quiz: Once you have reviewed and appraised your work should complete the "**Coursework 1: Learner Score and Review Feedback**" quiz.

Pencast marks scheme with worked solution:

Hyperlinks to a pencast mark scheme for each mathematics problem is given below.

Question No	Theme of question	Pencast Version A	Pencast Version B	Marks Offered
1	Matrix operations	MCA1AQ1	MCA1BQ1	20
2	Inverse of a matrix using the adjoint method	MCA1AQ2	MCA1BQ2	20
3	Vector operations on Cartesian vectors.	MCA1AQ3a MCA1AQ3b	MCA1BQ3a MCA1BQ3b	20
4	Application of vectors.	MCA1AQ4	MCA1BQ4	20
5	Algebra of complex numbers.	MCA1AQ5	MCA1BQ5	20

13/05/2015 14:28 Pencast

< Pencasts

Page Feed Pencast

(Support - Revision)

14/ Source: MAT305 MAY 2015 13/5/2015

2)
$$\begin{array}{rcl} 2x - y & = & 8 \quad (1) \\ x + 3y & = & -3 \quad (2) \end{array}$$

$$\begin{array}{rcl} 2x - y & = & 8 \quad (1) \\ -2x - 6y & = & 6 \quad (3) \end{array}$$

$$\begin{array}{rcl} 2x - y & = & 8 \\ -2x - 6y & = & 6 \\ \hline 7y & = & -14 \\ y & = & -2 \end{array}$$

Substitute $y = -2$ into (1)

$$2(3) - 1(-2) = 6 + 2 = 8 = \text{RHS}$$

00:09:22

Educational Uses

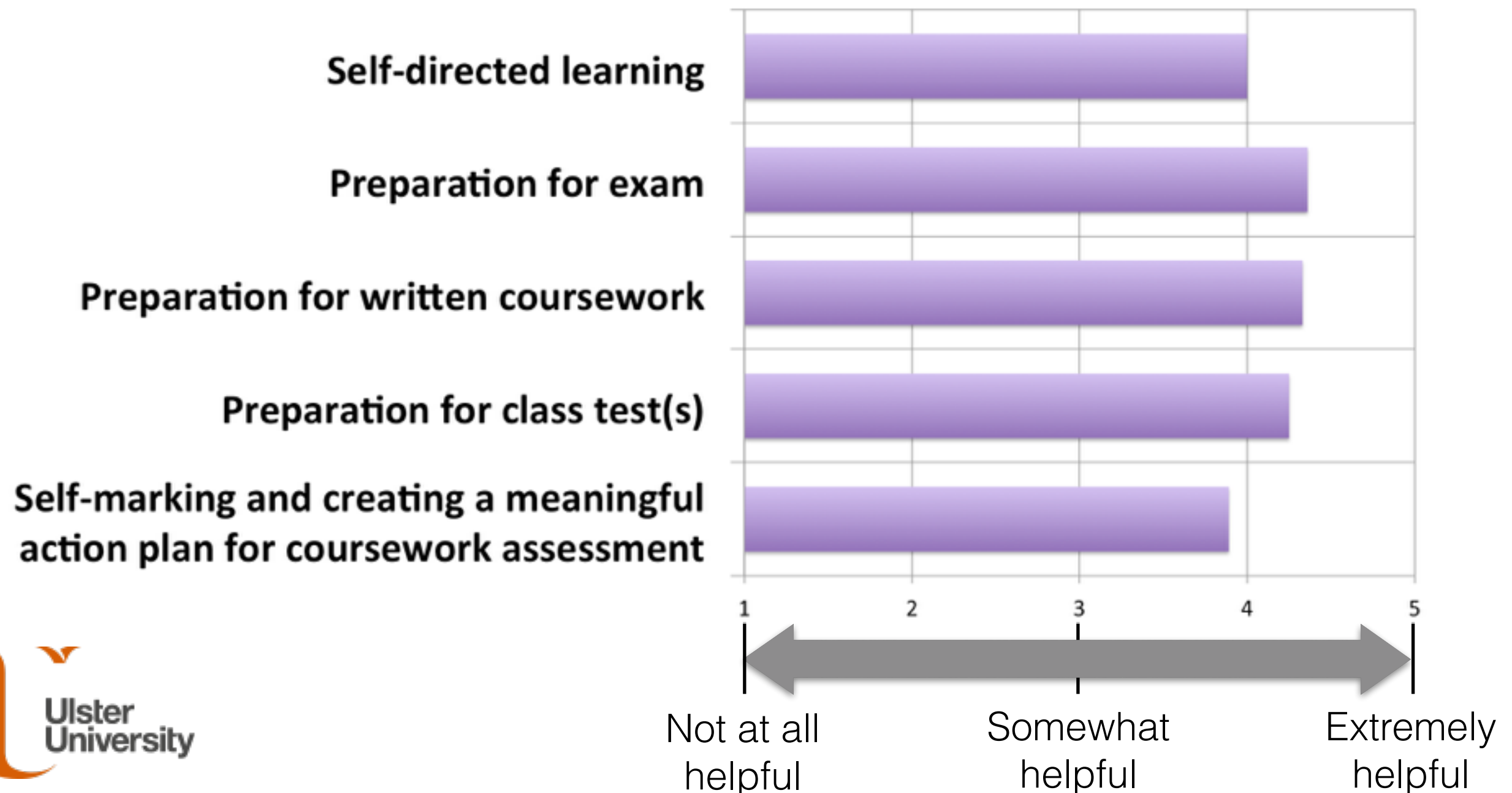
100+ Pencasts.

Playback times: 5 - 30 minutes.

Average size: 4 MB.

Student Survey (May 2015)

If you DID use the pencasts, how helpful did you find them for:



How pencasts are used

How did you use the pencasts over the last academic year?

I fast forward and rewind to concentrate on sections that are most helpful	79%
I usually watch and listen to a complete pencast	36%
I would come back to view a pencast again	57%
I use pencasts regularly	36%
I have watched a few	36%
I have watched and listened to a pencast once	4%
I have never watched and listened to a pencast	0%

How can pencasts be improved?

	About right	Increase	Reduce
The number of pencast examples	41%	59%	0%
The length of a pencast	82%	0%	18%
The detail and number of steps in a pencast	82%	14%	4%
The legibility of handwriting	75%	21%	4%
The presentation of a pencast solution	95%	5%	0%

Solve the quadratic equation

$$x^2 - 3x + 2 = 0$$

 using the quadratic formula. Show your answers correct to 2 d.p.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(1)(2)}}{2(1)}$$

$$x = \frac{3 \pm \sqrt{9 - 8}}{2}$$

$$x = \frac{3 \pm 1}{2}$$

$$x = \frac{3+1}{2} = 2$$

$$x = \frac{3-1}{2} = 1$$

Given $y = 2 + \sqrt{x}$
 find $\frac{dy}{dx}$

$$y = 2 + x^{1/2}$$

$$\frac{dy}{dx} = 0 + \frac{1}{2}x^{-1/2}$$

$$= \frac{1}{2\sqrt{x}}$$

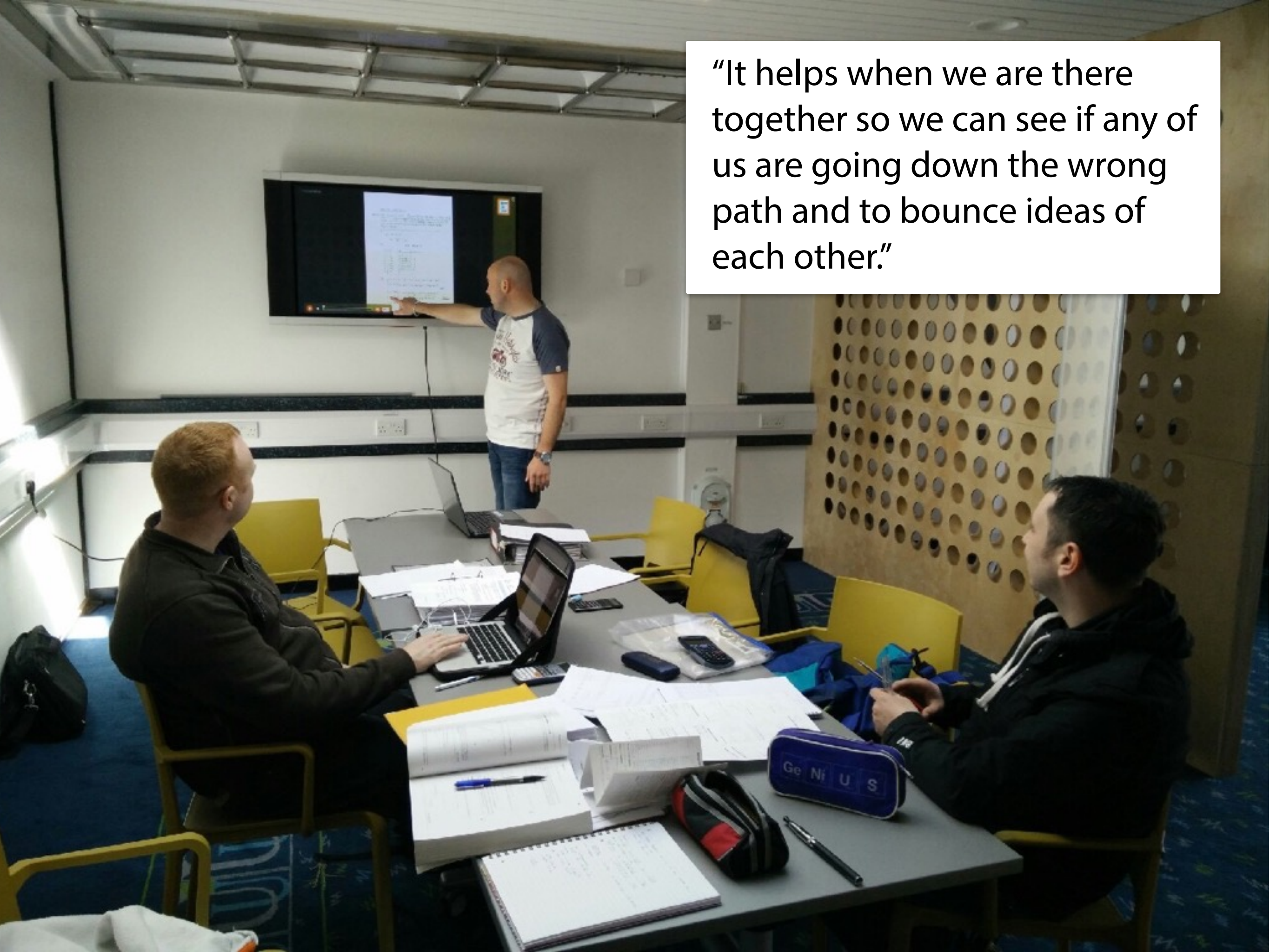
Solve $x^2 - 2x - 8 = 0$

“The pencasts have been extremely helpful because of there direct relevance to the subjects covered in the class.

The pencasts helped prepare me for the class test and the coursework ...”

“The pencasts supply all the steps, for a solution. Its difficult / impossible to understand and note down steps and answers during a tutorial session.”

"It helps when we are there together so we can see if any of us are going down the wrong path and to bounce ideas of each other."

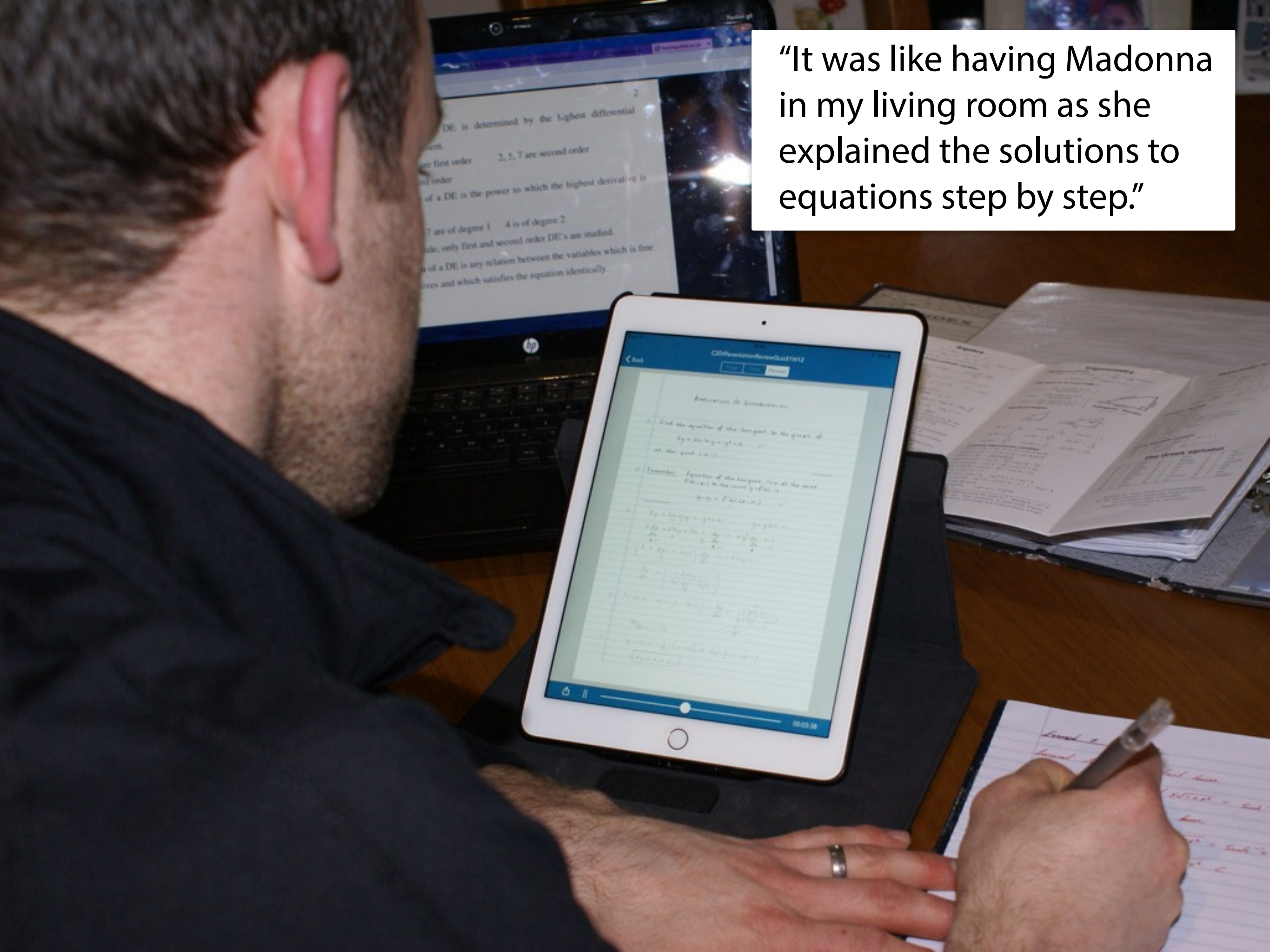


“Without the pencasts I would not have been able to get through my first year.”

“Everyone has **different levels of understanding**. I myself can get some elements of the module right away, but there are parts I can't. With the pencasts I can play it over and over until I get it.”

“Being a **part time student** it was easy to **motivate** myself when coming home from a days work to open the pencasts and work on maybe two and feel that I got something positive out of them.”

"It was like having Madonna in my living room as she explained the solutions to equations step by step."



Solve the quadratic equation

$$x^2 - 3x + 2 = 0$$

 using the quadratic formula. Show your answers correct to 2 d.p.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(1)(2)}}{2(1)}$$

$$x = \frac{3 \pm \sqrt{9 - 8}}{2}$$

$$x = \frac{3 \pm 1}{2}$$

$$x = \frac{3 + 1}{2} = 2$$

$$x = \frac{3 - 1}{2} = 1$$

Solve the system of linear equations

$$x + y = 5$$

$$2x - y = 1$$

 by the elimination method.

$$x + y = 5$$

$$2x - y = 1$$

$$\hline$$

$$3x = 6$$

$$x = 2$$

$$y = 5 - x = 5 - 2 = 3$$

$$x = 2, y = 3$$

Solve the differential equation

$$y' + 2y = 0$$

 by the method of separation of variables.

“They provide extra teaching outside of the class room, it provides more information and is extremely helpful for revision purposes especially.”

“It's just like having your tutor at home guiding you through a problem.”

“The pencasts supply all the steps, for a solution. Its difficult / impossible to understand and note down steps and answers during a tutorial session.”

Solve the quadratic equation
 $3x^2 - 4x - 1 = 0$
 using the quadratic formula. Show your answers correct to 2 d.p.

$ax^2 + bx + c = 0$
 $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$a = 3, b = -4, c = -1$
 $x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(3)(-1)}}{2(3)}$
 $x = \frac{4 \pm \sqrt{16 + 12}}{6}$
 $x = \frac{4 \pm \sqrt{28}}{6}$
 $x = \frac{4 \pm 2\sqrt{7}}{6}$
 $x = \frac{2 \pm \sqrt{7}}{3}$

Either $x = \frac{2 + \sqrt{7}}{3}$ or $x = \frac{2 - \sqrt{7}}{3}$

Solve the system of linear equations
 $2x + 3y = 12$
 $x - y = 2$

$2x + 3y = 12$
 $x - y = 2$
 $2x + 3y = 12$
 $-2x + 2y = 4$
 $5y = 16$
 $y = \frac{16}{5}$
 $x - \frac{16}{5} = 2$
 $x = 2 + \frac{16}{5}$
 $x = \frac{10}{5} + \frac{16}{5}$
 $x = \frac{26}{5}$

The solution is $x = \frac{26}{5}$ and $y = \frac{16}{5}$.

“Are there any limitations? Yes **face to face teaching** is **best**, with these as an add on makes life easier.”

“In class, you could just ask the teacher there and then for help. With pencasts that isn't the case.”

My strategy for effective mathcasts



Storyboard - Create an outline solution.

Script - Create a first draft script.

Rehearse - Read script out aloud.

Storyboard - Plan visual cues and essential facts and formulae.

Script - Revise solution

Rehearse - Speak aloud - Remember who it is for!

Script - Revise - Is its **simple**? Is it **clear**? Is it **concise**?

Repeat until satisfied!

Advantages



Audio synced with digital handwritten notes

Quick and easy to create

Quick and easy to share

Clear sound

Less storage space required c.f. videos

Print as a standard PDF

Disadvantages



Cannot edit mistakes

Visual element limited to recorded ink-strokes

Several pencast formats

Not interactive

Planning takes time

Students access to technology may be limited

Limited ink colours

What now? What next?



Flip Learning!

Thank-you for listening!

Any Questions?

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