Supporting students with visual impairments to access STEM content

Dr Emma Rowlett

Disability Adviser for Postgraduate Students
University of Nottingham

My Background/Experience

- **Aug 2009-present**: Disability Adviser, UoN
- **Sept 2005-July 2011**: PhD student, UoN
  - "Disability equality and discrimination in Higher Education"
  - Special focus on maths-based subjects and VI
- **Oct 2007-Dec 2009**: Researcher, HEA funded mini-project "Accessibility in MSOR"
- **Sept-Nov 2007**: foundation maths course – firsthand experience as student with VI
- **Sept 1995-Aug 1997** – Maths GCSE - prior to developing visual impairment

What I'm NOT going to do:

- Go into a lot of technical detail: I am **NOT** a mathematician or a computer scientist
- Give you a 'one-size-fits-all' method of making STEM content accessible

What I hope to do:

- Provide an overview of the issues students with VI and staff supporting them might face
- Give you some ideas about how you might support students to access course content
- Provide a few suggestions for good practice

‘Content’

- Types of maths-based content:
  - Mathematical notation
  - Graphics (e.g. graphs, diagrams, tables)

- Forms it may take:
  - Slides, OHTs, writing on flipcharts or black/white/smart boards
  - Textbooks, handouts, worksheets, handouts, exam papers
  - Handwritten, printed, electronic, (spoken?)

Methods of Accessing Content

- Visual
  - Large print (various sizes, styles, paper colour)
  - Enlarge on photocopier, optical/electronic magnifiers, screen magnification software
- Non-visual
  - Audio/speech (screen reading software/human reader)
  - Electronic (e.g. web, Word, PowerPoint, PDF)
  - Tactile (e.g. Braille, Moon, tactile diagrams)
- May combine methods depending on:
  - type of content
  - why they need to access it and how quickly
  - situation they are in (e.g. lecture, exam, at home)

The Problem

- Mathematical notation is two-dimensional
- Graphics are visual presentations
- But:
  - Speech/audio and Braille are non-visual and essentially linear
  - 2D Braille does exist but is not widely used
  - Not all Braille readers know mathematical Braille, and different standards exist
  - Large print and magnified images can make it hard to get overview of notation or graphics as can only view small section at a time

Challenges

- Choosing a suitable alternative format
  - What suits the student, their learning style, and the content they need to access?
- Converting content to this format
  - What format is the original? (e.g. LaTeX, Word, PDF)
  - Practical and technological difficulties and very time-consuming
- Accessing content once converted
  - Does it say what it is meant to say?
  - Can students read what it says?
  - Can they understand what it says?
- Manipulating mathematics and showing workings
- Producing content themselves

Notation: Speech/Audio Format

Two volunteers needed...

$$\ln(2)+\sum_{i=1}^{\infty}\frac{(-1)^{i+1}(x-2)^{i}}{n2^{n}}$$

Notation: Large Print Format

- May seem easy, but if enlarging to A3 isn't an option, what then?
- In Word/Powerpoint may be possible to enlarge the font/stretch the image
- LaTeX can be type-set in a larger font

- **BUT** the equation may then not fit on the page, so how to present it in a way that still makes sense and doesn't introduce errors?

Find the following integral by first resolving the integrand into its partial fractions.

$$\int \frac{x^3 + x^2 + x + 2}{(x+1)(x-2)(x+3)}\,dx$$

Find the following integral by first resolving the integrand into its partial fractions.

$$\int \frac{x^3 + x^2 + x +}{(x+1)(x-2)(x}$$

$$\frac{- 2}{+ 3)}\,dx$$

Find the following integral by first resolving the integrand into its partial fractions.

$$\int \frac{x^3 + x^2 +}{(x+1)(x-2)}$$

$$\frac{x+2}{(x+3)}\,dx$$

Find the following integral by first resolving the integrand into its partial fractions.

$$\int \frac{x^3 + x^2 + x + 2}{(x+1)(x-2)(x+3)} dx$$

Find the following integral by first resolving the integrand into its partial fractions.

$$\int \frac{f(x)}{g(x)} dx,$$

where

$$f(x) = x^3 + x^2 + x + 2$$

and

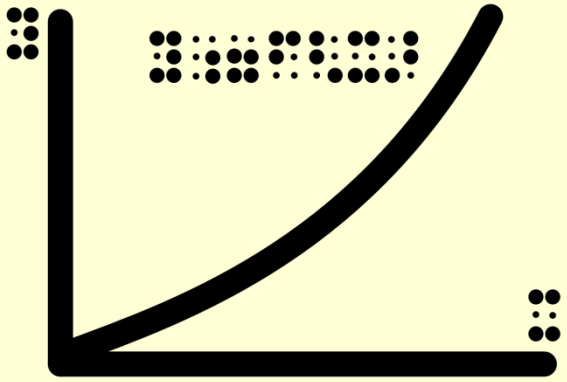
$$g(x) = (x+1) \times (x-2) \times (x+3)$$

```
    Find the following integral by first
resolving the integrand into its partial
fractions.
    $$ \int \frac{x^3+x^2+x+2}{(x+1)(x-2)(x
+3)} \, dx $$
```

```
    Find the following integral by first
resolving the integrand into its partial
fractions.
    $$ \int \frac{f(x)}{g(x)} \, dx \text{,}$$
    where
    \begin{align*}
      f(x)= \, &x^3+x^2\\
      &+x+2
    \end{align*}
    and
    \begin{align*}
      &g(x)=(x+1)\times\\
      &(x-2)\times(x+3)
    \end{align*}
```

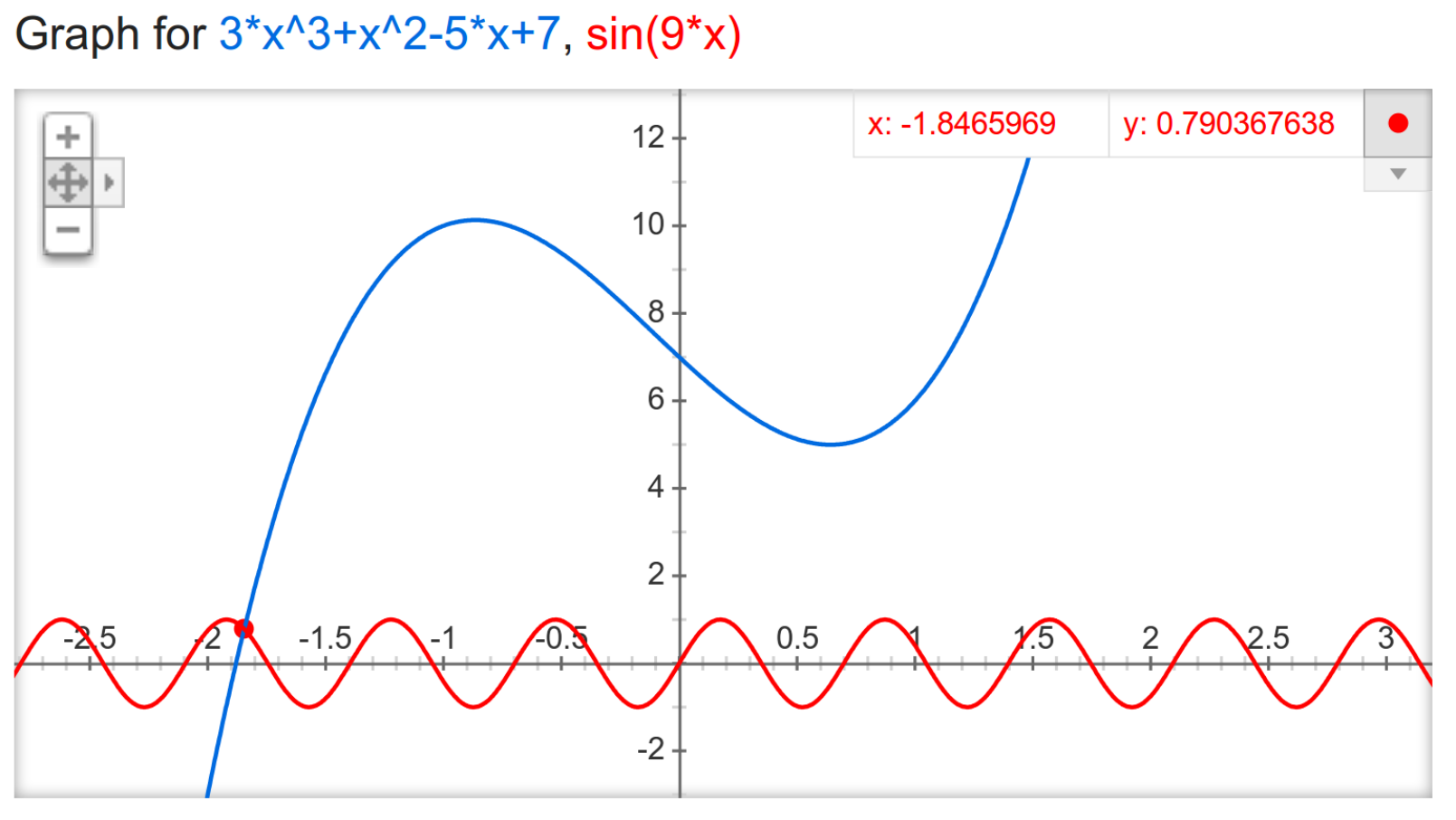
Graphics

- Enlarge or magnify,
  - depends on size of original and complexity
- Describe in words (written or spoken)
  - How do you do this accurately?
  - Will this interfere with the purpose of the graphic (e.g. for a student to read a point on a graph)
- Tactile
  - Often raised lines and Braille labels
  - String, plasticine, lego, etc!
- May need to be simplified to some degree



Graphics: Speech Example

- Two different volunteers...



Good Practice

- Prepare reading lists, handouts, presentations etc as far in advance as possible to allow time for conversion to alternative formats
- Ensure content you produce is available in its original form (e.g. Word, PowerPoint, LaTeX), not just the image (e.g. PDF, photocopy)
- Have handwritten notes converted into more accessible versions (e.g. Word, LaTeX)
- Where possible, produce any materials that include notation in LaTeX (or MathML)
- Think about complexity of graphics and how they might be accessed by students with VI

Most important of all, talk to the student about his/her needs and preferences

Questions?

You can always email me:

emma.rowlett@nottingham.ac.uk