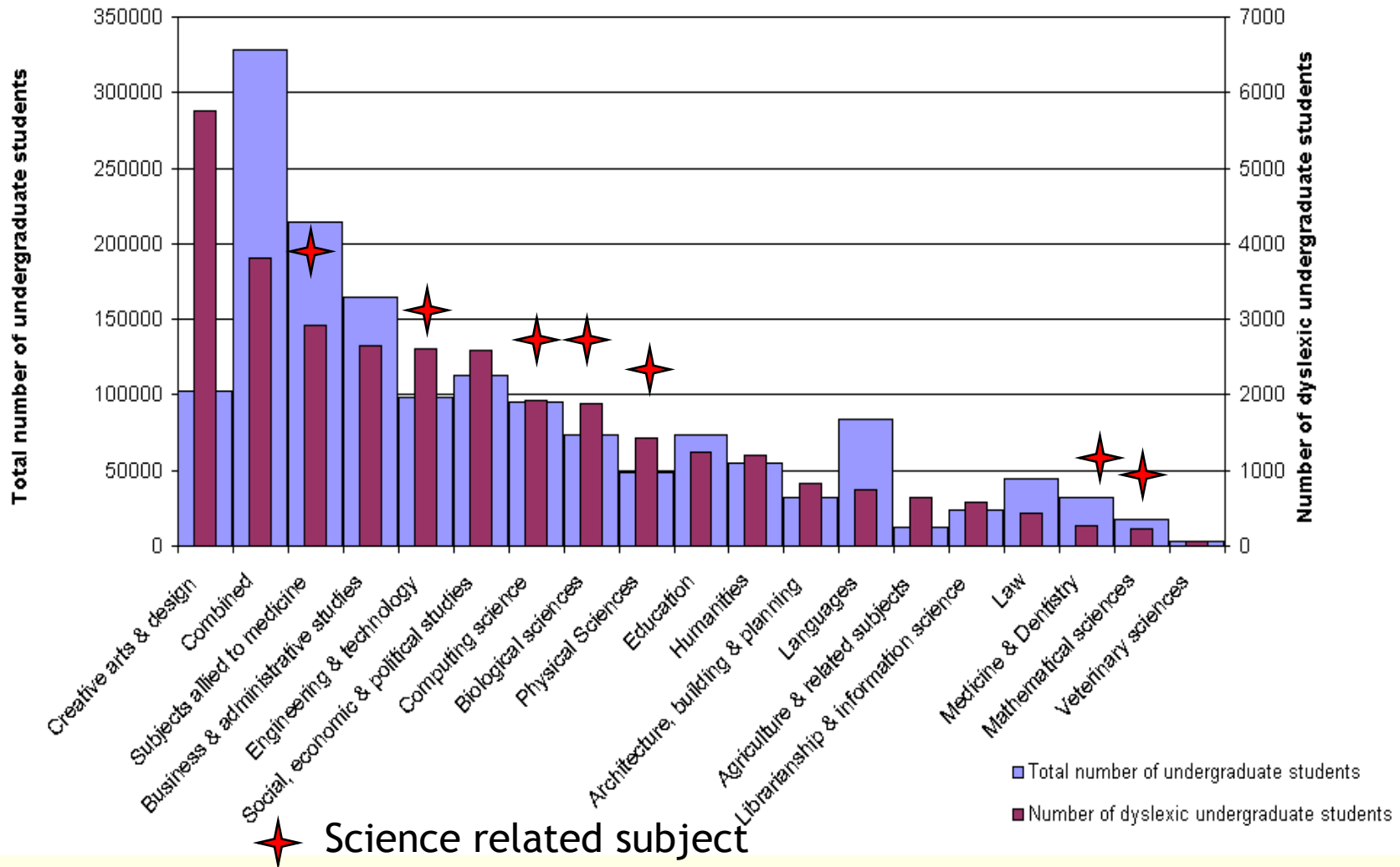


Reading and Writing Mathematical Notation using Assistive technology

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How many dyslexic student's study math or science?

Total Number of Undergraduate Students and Number of Dyslexic Students By Subject Area (2001-2002)



Mathematical language and notation...

- Needs to be **understood and manipulated** by scientists, engineers & mathematicians.
- Symbols & expressions must be **accurately recalled** during lectures, exams, lab sessions and when writing assignments or reports.

Reading Maths: Creating accessible formats

- Most handouts and web based resources are in PDF format
- LaTeX markup language used by journals and academics to typeset maths

— neither approach is accessible without additional tools

Scanning and recognising maths notation

- Standard OCR software can not recognize math equations

$$f(y_i|\theta_i, \phi) = \exp \left[\frac{(y_i\theta_i - b(\theta_i))}{\phi} + c(y_i, \phi) \right].$$

$(y_i\theta_i - b(\theta_i))$

$\exp \left[\frac{(y_i\theta_i - b(\theta_i))}{\phi} + c(y_i, \phi) \right]$

- OCR for maths tool is being developed in Japan: **InftyReader**

Converts image/PDF to LaTeX or MathML

But not yet commercially available

MathML

- Mark-up language for equations on the web
 - Displays correctly with zoom in feature
 - Can be read aloud by text-to-speech engines with highlighting
- Now part of the DAISY accessible format standard

Equivalent plane strain solution

symmetric conditions has gained wide acceptance in geotechnical engineering because of its simplicity. According to this theory, the degree of consolidation U_h at time t and at distance z from the drain may be predicted from

$$\bar{U}_h = 1 - \exp\left(-\frac{8T_h}{\mu}\right)$$

where μ is given by

$$\mu = \ln\left(\frac{n}{s}\right) + \left(\frac{k_h}{k'_h}\right) \ln(s) - 0.75 + \pi(2lz - z^2) \frac{k_h}{q_w}$$

where n is the ratio of the radius of the well to the radius of the drain, s is the ratio of the radius of the well to the radius of the drain, l is the length of the drain, q_w is the discharge capacity of the drain, and k_h and k'_h are the coefficients of horizontal permeability of the soil and the drain, respectively.

Read aloud with highlighting by Texthelp Read & Write Gold or BrowseAloud:

given by

$$\mu = \ln\left(\frac{n}{s}\right) + \left(\frac{k_h}{k'_h}\right) \ln(s) - 0.75 + \pi(2lz - z^2) \frac{k_h}{q_w}$$

Viewing MathML

- MathML appears in web pages
 - Free Internet Explorer plug-in:
www.dessci.com/mathplayer
- Mozilla FireFox native support with maths fonts installed

Creating MathML

- Most scientific publishing programs support MathML through save as/export to html including
 - Scientific Notebook
 - MathType (advanced version of Equation Editor) can convert from Word to MathML or LaTeX

Writing Maths: Need support with...

- Capturing notes accurately
 - Audio recordings difficult with highly visual notes
 - Organisation & accuracy of notes important

→ Investigated use of Tablet PC with hand-writing recognition tools

Tablet PC trial with Maths Learning Support Centre, Loughborough University

- During December 2007, 4 dyslexic students studying maths & engineering were provided with:
 - Tablet PC
 - OneNote 2007
 - InftyEditor, with hand-writing recognition of equations, & InftyReader

What is a Tablet PC?

A computer plus...



Note book

Diary

Pencil case

Folders

Word processor

Drawing pad

Internet access

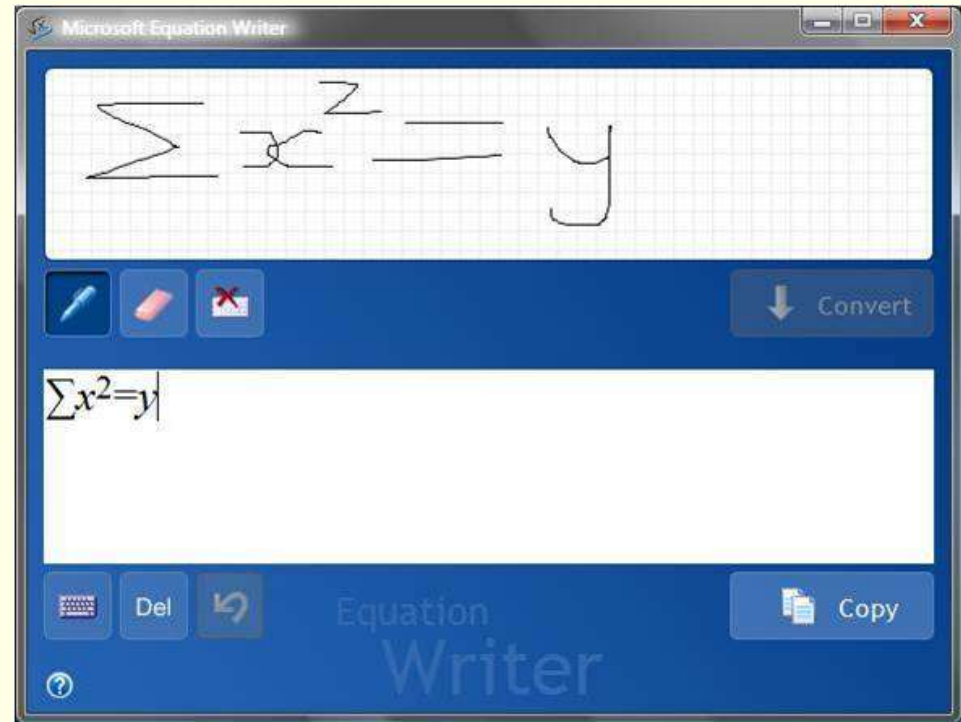
E-books

Using OneNote with a Tablet PC: **Key benefits**

- Gather handwritten & non-textual information in electronic format
- Edit and correct handwritten notes
- Access to accessibility tools for all their work, where ever they are
- Help with organising their notes, tasks and coursework

Conversion of hand written equations to text using a Tablet:

- **Equation Writer** (free) converts handwritten equation to an image.
- **InftyEditor** has beta tool for converting hand-written equation to LaTeX/MathML



Student's experiences with OneNote & a Tablet:

- Used OneNote for Maths assignments & note taking

Found notes & assignments were:

- Much easier to read & neater
- Better organised, easy access to colour pens
- Able to edit and add to afterwards
- Able to paste in diagrams & notes from other applications

Student's experiences with written equation recognition:

- Liked the idea of capturing and converting equations BUT:
 - Recognition not very quick or accurate enough
 - Currently based on Japanese writing of maths symbols
- All wanted to read aloud equations they had written but currently not a joined up process

The future...

- Tablet PCs provide additional support for learners handling mathematical notation
- Tools for creating and reading MathML are continuing to develop

BUT

- Need to educate the academic community on how to produce accessible, mathematical documents

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