

Learning the unlearnable teaching the unteachable

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What do you think of western civilisation?

I think it would be a good idea!

What do you think of technology in education?





building the
unbuildable



some things
have changed





**Pupils from Oakgrove
School, Milton Keynes, try
out the mobile technology
they will use to investigate
micro-climates**

From: **The Personal Inquiry Project**
Technology Enhanced Learning Research Programme, UK

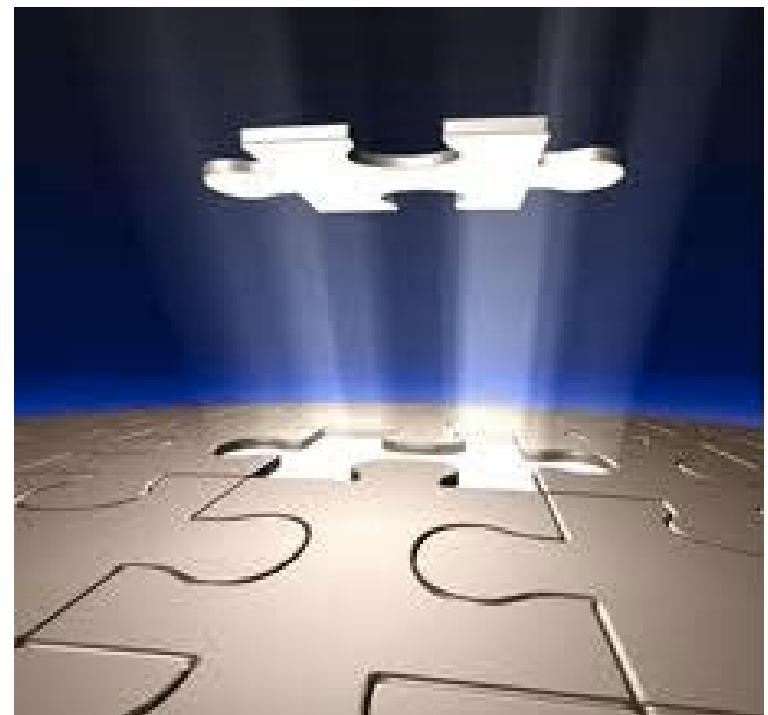


Funded by the
Technology Enhanced
Learning Research
Programme, UK

knowledge

literary knowledge

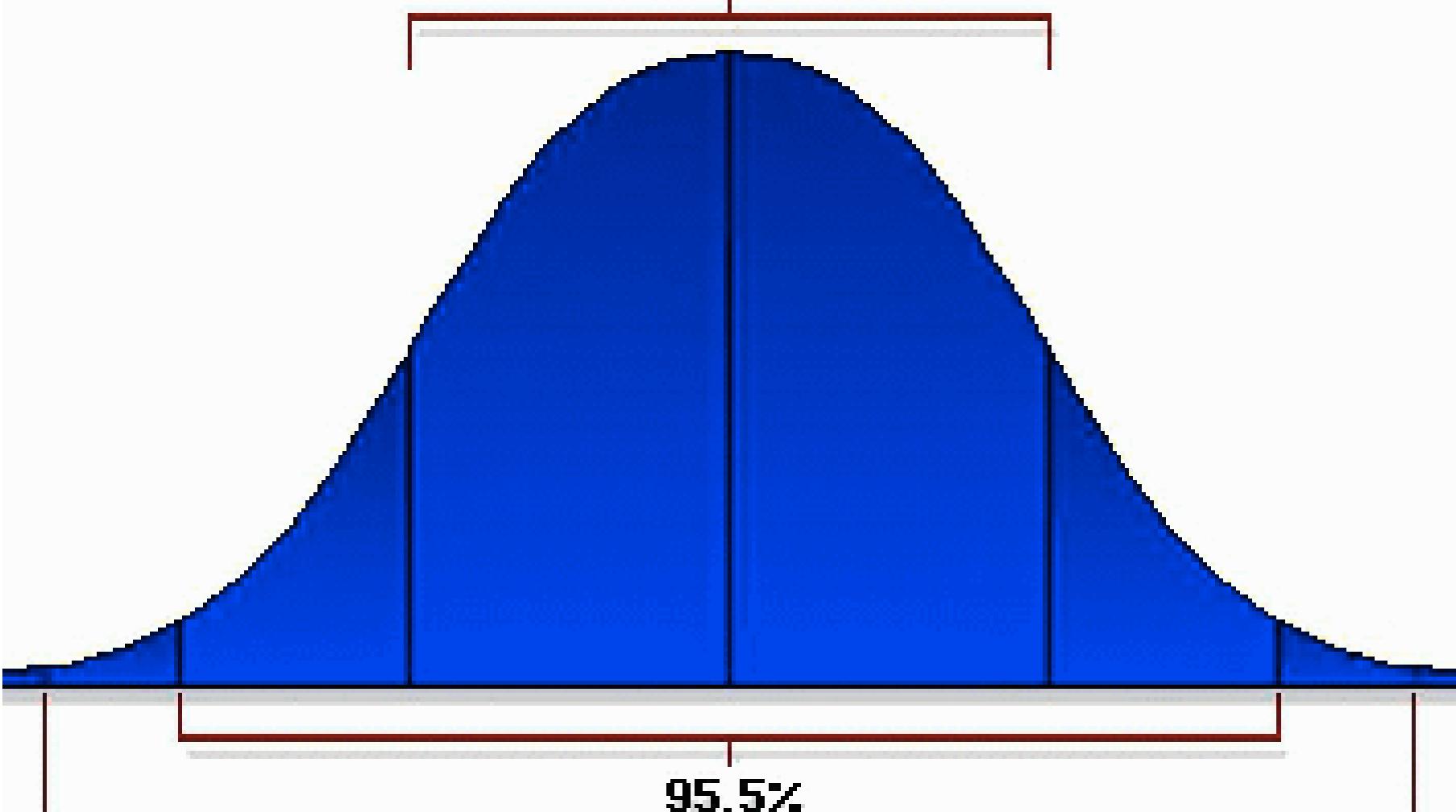
there is new
knowledge to be
learned





Goldman
Sachs

“We were seeing things that were 25-standard deviation moves, **several days in a row**” said GS’s chief financial officer, 2007.



68.3%

95.5%

99.7%



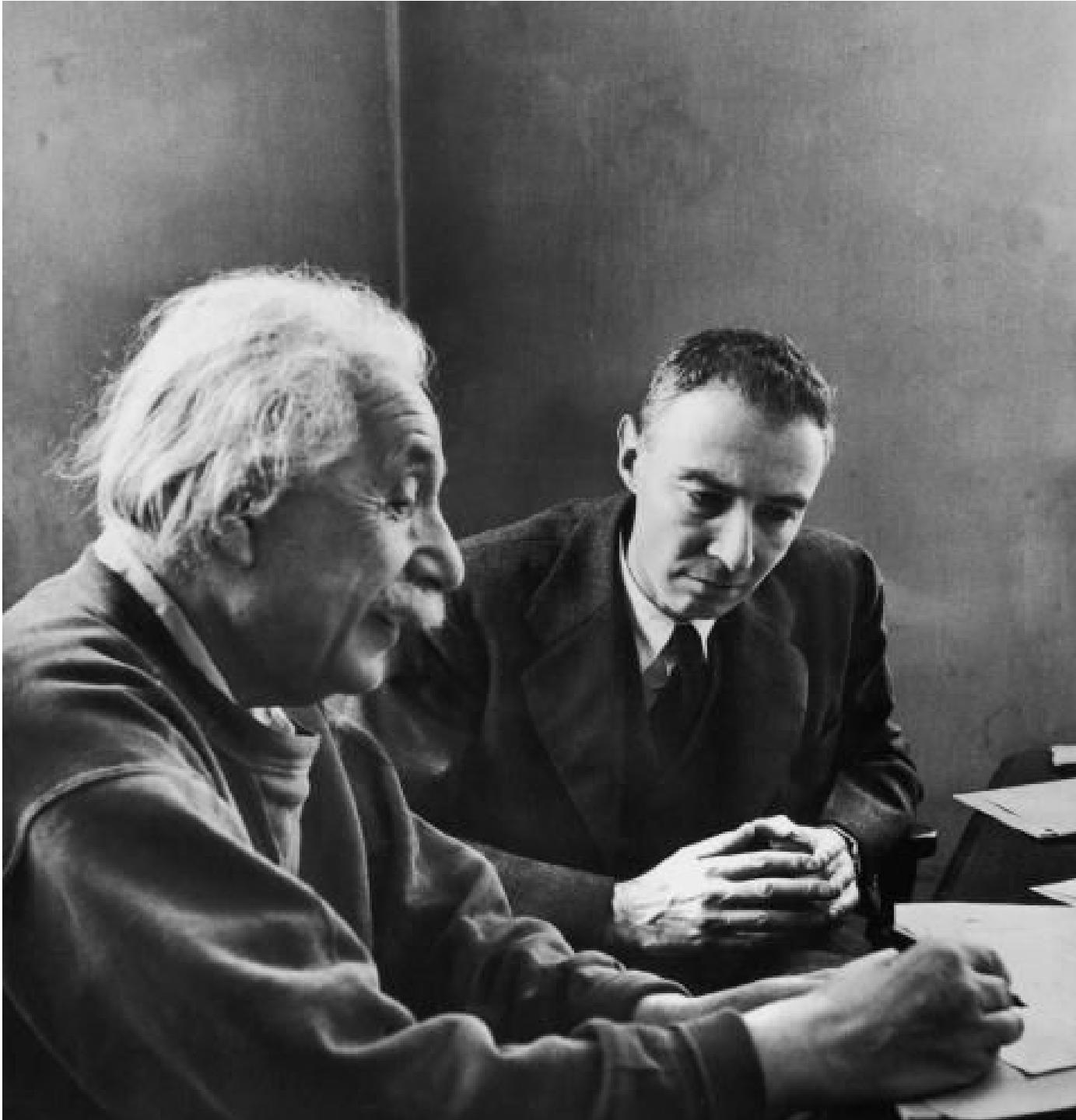
Goldman
Sachs

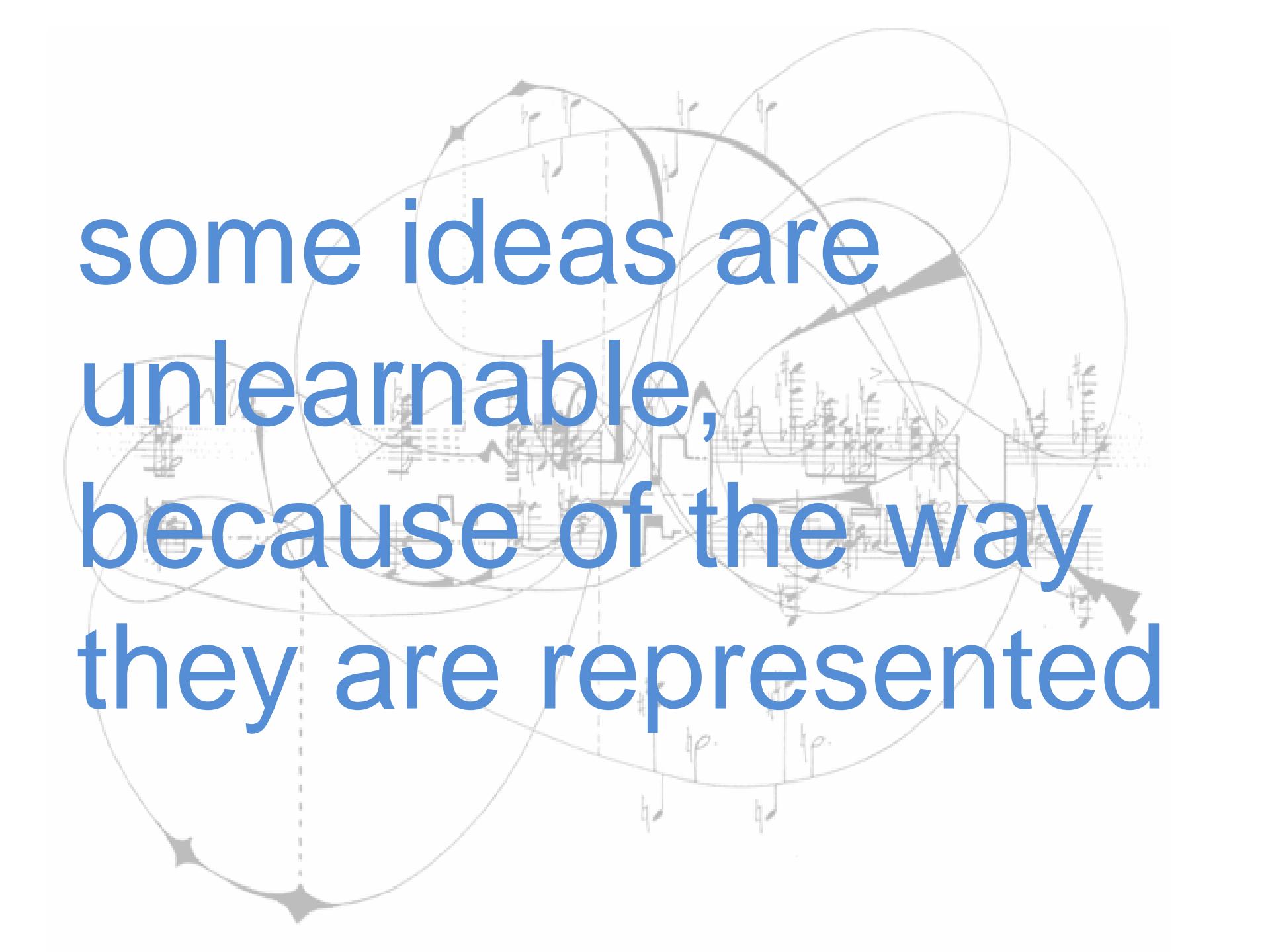
The expected waiting time for this event, 25 s.d., is **6×10^{124} lives of the universe**

3 days in a row!



learning the learnable





some ideas are
unlearnable,
because of the way
they are represented



Let us consider a Taylor expansion of $\psi(\mathbf{v}^*)$ around \mathbf{v}' . Thanks to (23), we get

$$\begin{aligned}\psi(\mathbf{v}^*) &= \psi(\mathbf{v}') + \gamma a(|\mathbf{x} - \mathbf{y}|) \nabla \psi(\mathbf{v}') \cdot (\mathbf{q} \cdot \mathbf{n}) \mathbf{n} + \\ &\quad \frac{1}{2} \gamma^2 a(|\mathbf{x} - \mathbf{y}|)^2 \sum_{i,j} \frac{\partial^2 \psi(\mathbf{v}')}{\partial \mathbf{v}'_i \partial \mathbf{v}'_j} (\mathbf{q} \cdot \mathbf{n})^2 \mathbf{n}_i \mathbf{n}_j + \dots\end{aligned}\tag{24}$$

If the interactions are nearly elastic, so that $\gamma \ll 1$, we can truncate the expansion (24) after the first-order term. Inserting (24) into (21) gives

$$\begin{aligned}\langle \psi, \bar{Q}_P(f, f) \rangle &\approx \frac{1}{\epsilon} \int_{\mathbb{R}^3} \int_{\mathbb{R}^3} \int_{\mathbb{R}^3} B(|\mathbf{x} - \mathbf{y}|) (\psi(\mathbf{v}') - \psi(\mathbf{v})) \\ &\quad + \gamma \nabla \psi(\mathbf{v}') \cdot a(|\mathbf{x} - \mathbf{y}|) (\mathbf{q} \cdot \mathbf{n}) \mathbf{n} f(\mathbf{x}, \mathbf{v}) f(\mathbf{y}, \mathbf{w}) d\mathbf{v} d\mathbf{w} d\mathbf{y} \\ &= \langle \psi, \mathcal{Q}_P(f, f) \rangle + \gamma \langle \psi, \mathcal{I}(f, f) \rangle.\end{aligned}\tag{25}$$

It is a simple matter to recognize that in (25) $\mathcal{Q}_P(f, f)$ is a Povzner collision operator of the type (5), since the post-interaction velocity \mathbf{v}' in (25) is obtained from the pre-interaction velocities (\mathbf{v}, \mathbf{w}) through the elastic interaction (21).

setup

go

population

1

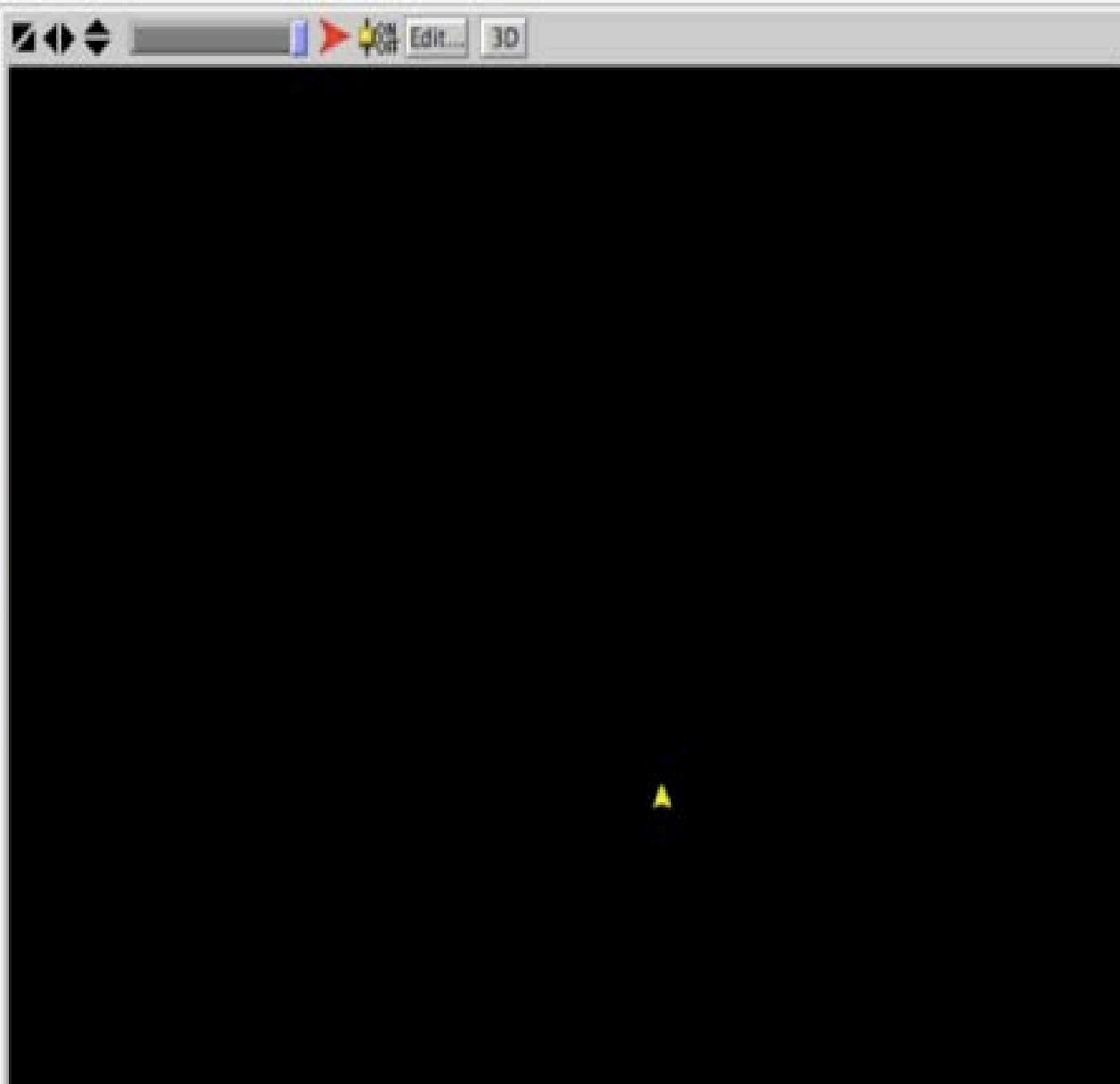
vision 3.0 patches

minimum-separation 1.00 patches

max-align-turn 5.00 degrees

max-cohere-turn 3.00 degrees

max-separate-turn 1.50 degrees



Interface

Information

Procedures













































































































































































































































































































































































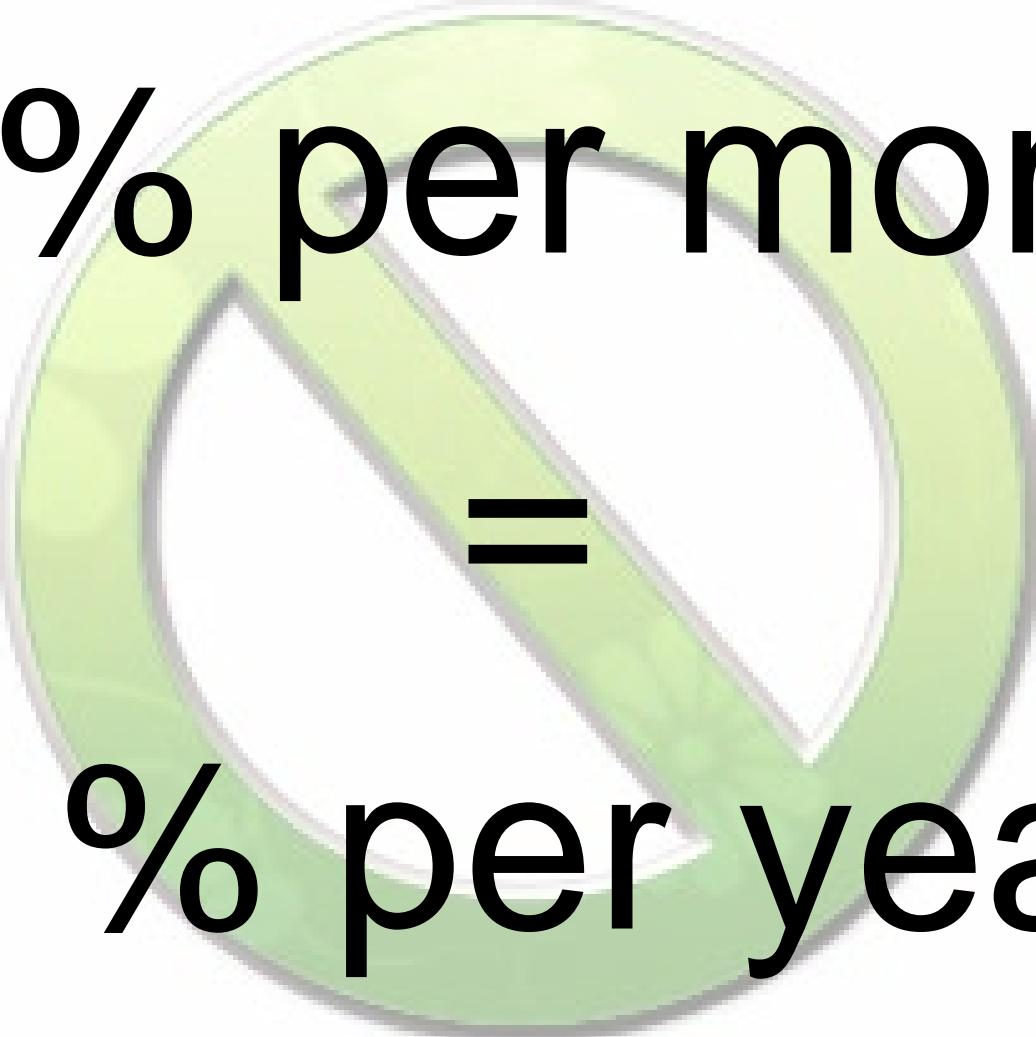





systems are read-only

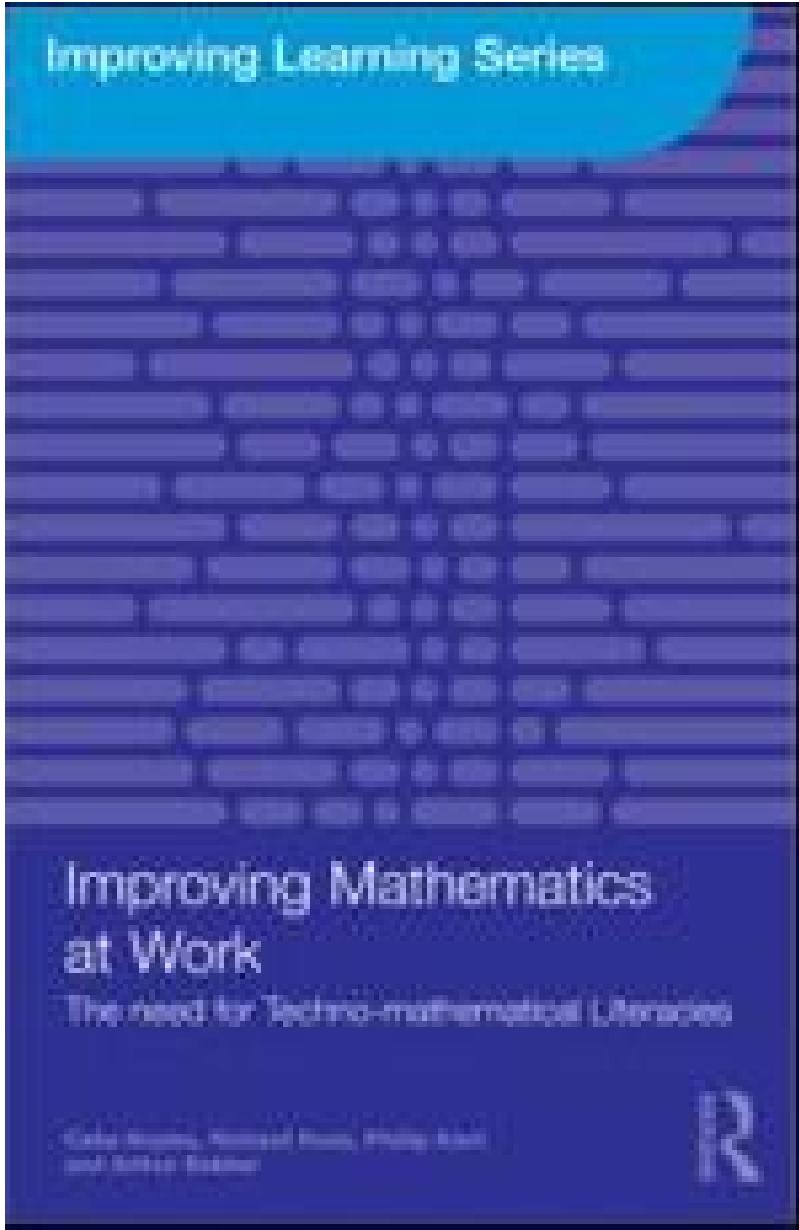


**multiply
by 19**



$\frac{1}{2}\%$ per month

? % per year



shameless advertising

Hoyles, C., Noss, R., Kent, P. & Bakker, A. (2010)
Improving Mathematics at Work: The need for techno-mathematical literacies
Routledge

pseudo-mathematics

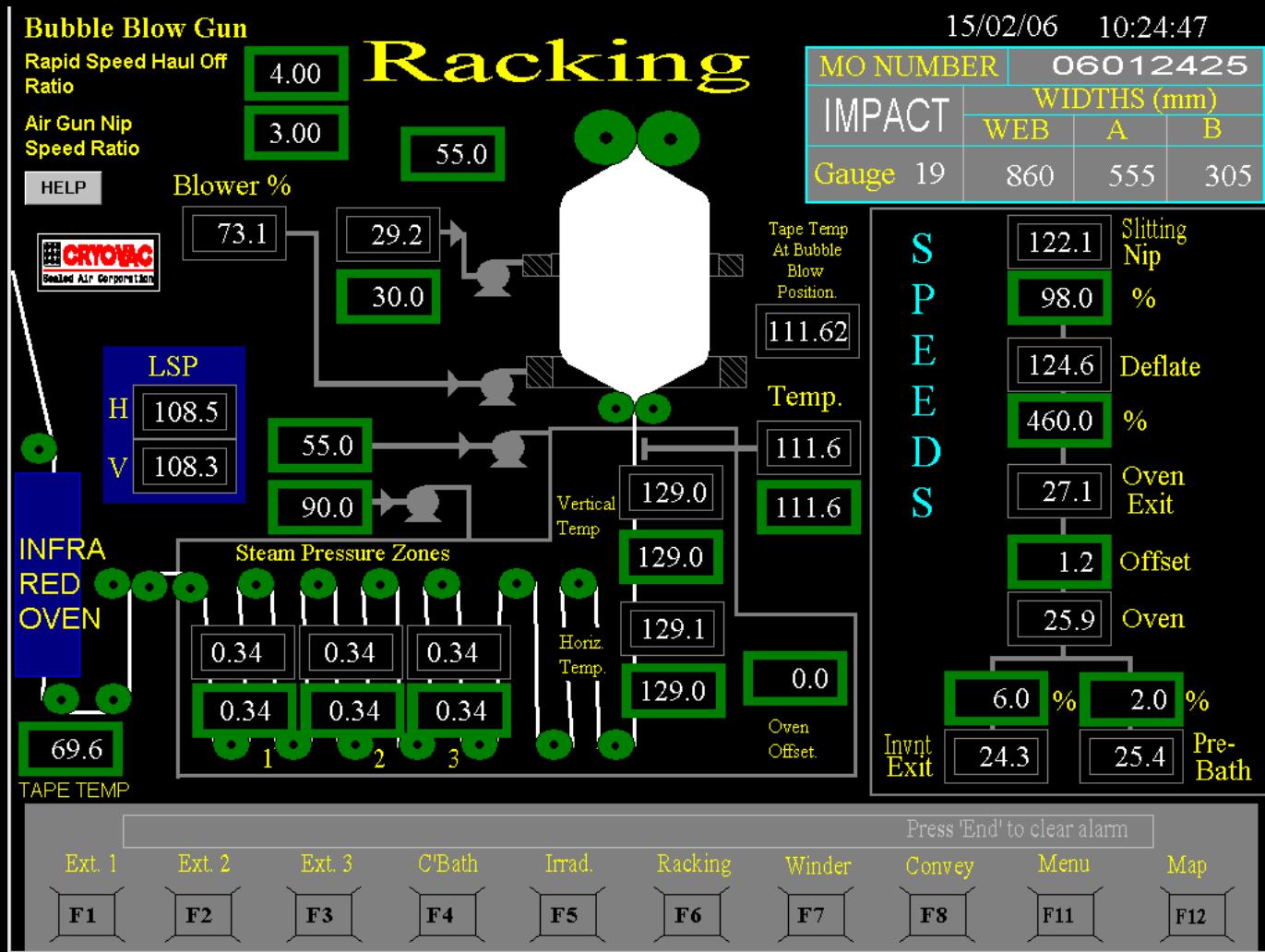


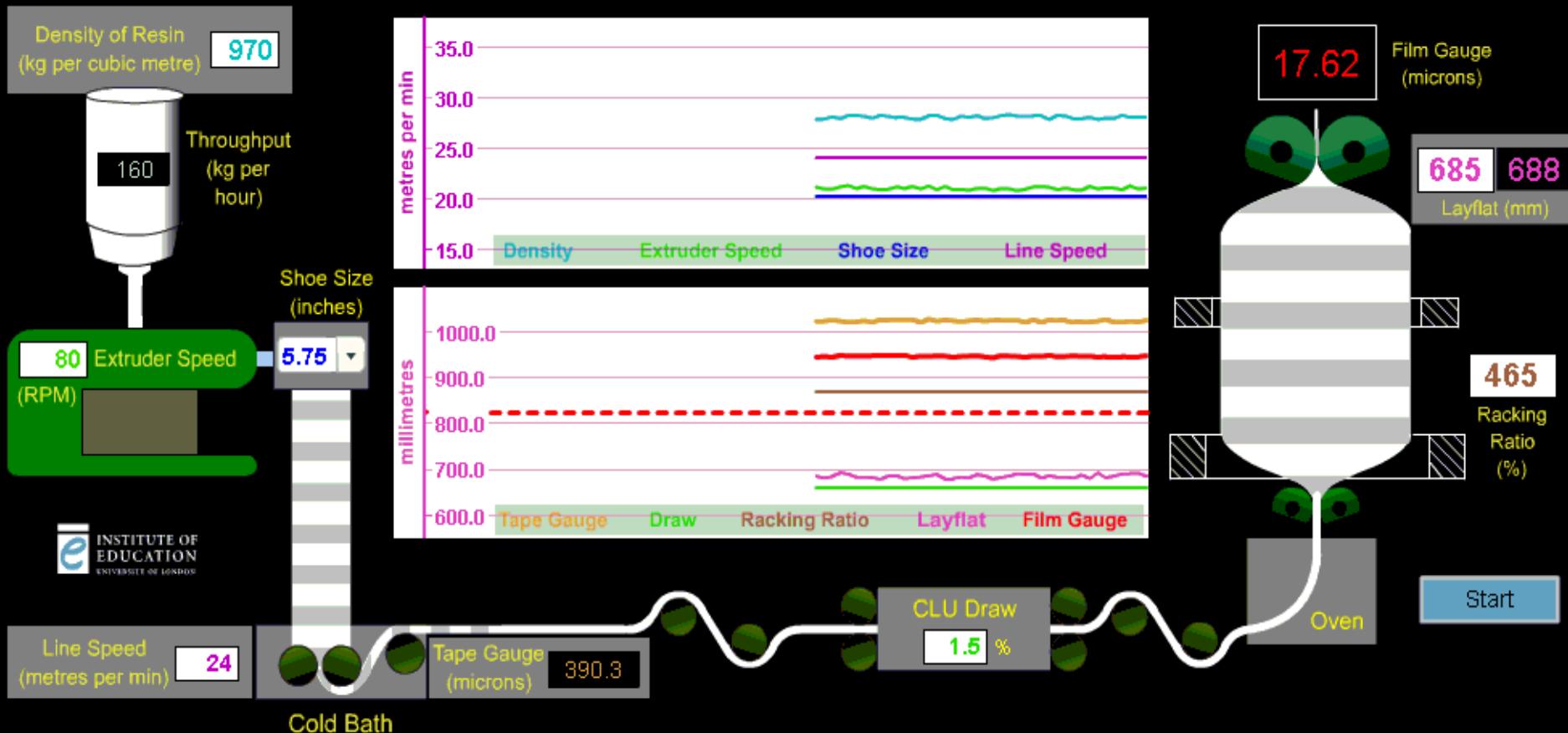
all existing scientific data
are “suppositions,
allegations, predictions.

Numbers prove
nothing”.

Peter Hitchens
Climate Change Denier
Mail on Sunday









A group of people are seated around a large conference table in a professional setting. In the foreground, a man with dark skin and short hair, wearing a light-colored shirt, is looking towards the left. Behind him, another man with a beard and glasses, wearing a white shirt and tie, is also looking in the same direction. Other individuals are visible in the background, some with their heads down or looking at papers. The table is covered with various items, including coffee cups, saucers, and papers.

Andre Stoddart
CEO, Sealed Air, Europe



There is one part of this that goes a **bit beyond the mathematical side** which has been the focus that has been sort of the **soft side** of what the end user gains, the **empowerment** that the end user has, the **knowledge** that the person has ... the **job satisfaction** that the operator has ...

techno-mathematical literacies computational thinking

- splitting problems
- tracing how things work
- finding ‘bugs’
- critiquing models

[children must] understand and play an active role in the digital world that surrounds them, not to be passive consumers of opaque and mysterious technology. *Royal Society, 2012*

making things learnable is too important to pick up the crumbs of technologies designed for other purposes



there are beautiful empowering
technologies



[View In iTunes](#)**\$4.99**

Category: Education

Updated: Jan 31, 2011

Current Version: 1.5

1.5

Size: 3.9 MB

Languages: English, Dutch, French, German, Japanese, Portuguese

Seller: Paul Schmitt

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palasoftware Inc. All rights reserved.

Rated 4+

Requirements: Compatible with iPad. Requires iOS 3.2 or later.

Customer Ratings

Current Version:

★★★★★ 16 Ratings

All Versions:

★★★★★ 195 Ratings

More iPad Apps by palaware

ScoreMate (score and track)

Description

This is the best integer practice app or program I have found in 34 years of teaching math. - Tim Seiber, Math Teacher

[palaware Web Site](#) ▾ [MathBoard Support](#) ▾[...More](#)

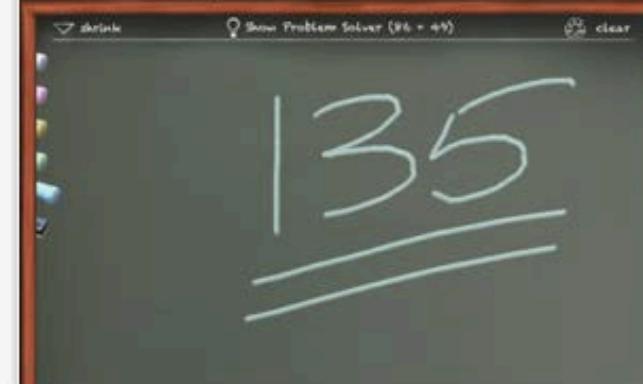
What's New in Version 1.5

- Added landscape support.
- Added support for left handed students.

iPad Screenshots

Results

- ✓ 1) $24 + 38 = 62$
- ✓ 2) $25 + 36 = 61$
- ✓ 3) $40 + 33 = 73$
- ✓ 4) $117 + 49 = 166$
- ✓ 5) $38 + 67 = 105$
- ✓ 6) $94 + 122 = 206$
- ✓ 7) $58 + 92 = 136$
- ✗ 8) $96 + 49 = \underline{\hspace{2cm}}$



Problem Solver

Problem

$$\begin{array}{r} 168 \\ \times 163 \\ \hline \end{array}$$

Step (1)

$$\begin{array}{r} 168 \\ \times 163 \\ \hline \quad \quad 1 \\ \quad 168 \\ \hline \quad 504 \end{array}$$

Start by multiplying the ones ($8 \times 3 = 24$) ($2 + 6 = 8$) ($8 + 1 = 9$). Remember to regroup as needed.

Step (2)

$$\begin{array}{r} 168 \\ \times 163 \\ \hline \quad \quad \quad 4 \\ \quad 168 \\ \hline \quad 1008 \end{array}$$

Now multiply the tens ($8 \times 6 = 48$) ($6 + 6 = 12$) ($12 + 1 = 13$). Remember to regroup as needed.

Step (3)

$$\begin{array}{r} 168 \\ \times 163 \\ \hline \quad \quad \quad 4 \\ \quad 168 \\ \hline \quad 1008 \\ + 168 \quad \quad \quad 1 \\ \hline 27024 \end{array}$$

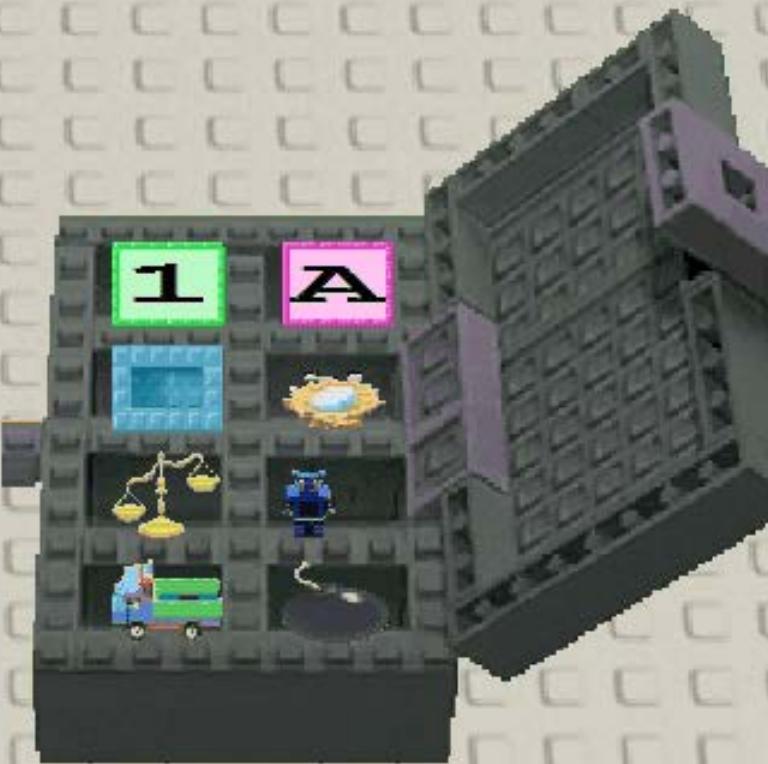
1. what are the unlearnable ideas?
2. how can technology be designed to make them learnable?

3.1415926...

1 A

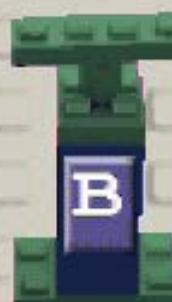
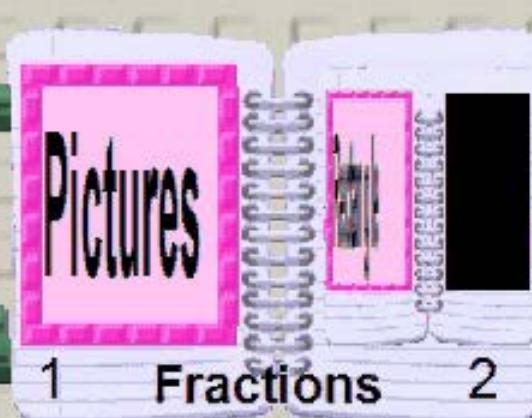


D



1

A



MiGen

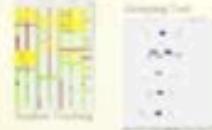
eXpresser



eGeneraliser
& intelligent support



teacher assistance
tools



activity & task
design tool



Funded by the Technology Enhanced Learning Research Programme (UK)

algebra is not a good way to learn algebra

File Edit
Activity

Computer's Model

step Random

Unlocked numbers
Model No. is 7
Rule for total number of tiles:
Model No. \times 2 + Model No. \times 2

Construct
make the model. Use different colours for each pattern to show other people how you made your model. Find a rule for the number of tiles for any unnamed
 Use pattern(s) to construct the model.
 Make sure "My Model" is coloured during animation.
 Check that "My Model" animates without messing-up.
 Make sure the "Computer's Model" is coloured.

Finish

My Model 2

Pattern Maker

4 7 2 ? X Cancel

Model Rule

Model No. 4 \times 2 + Model No. 4 \times 2

See previous

abfrank not logged in

MacBook Pro

The image shows a Scratch-like programming interface on a MacBook Pro screen. In the center, a 'Pattern Maker' dialog box is open, displaying a 4x4 grid with various colored tiles (blue, green, yellow, red) and numerical values (4, 7, 2, ?). Below the grid are 'OK' and 'Cancel' buttons. To the left of the dialog, a 'Computer's Model' window is visible, showing a 2x2 grid of colored tiles and a rule: 'Model No. × 2 + Model No. × 2'. A 'Model Rule' window at the bottom shows the same rule with variables. On the right, a large grid area is available for drawing. The top menu bar includes 'File', 'Edit', and 'Activity'. A status bar at the bottom right says 'abfrank not logged in'.

it's hard to do

AI support for student exploration

The screenshot shows a computer modeling application interface with the following elements:

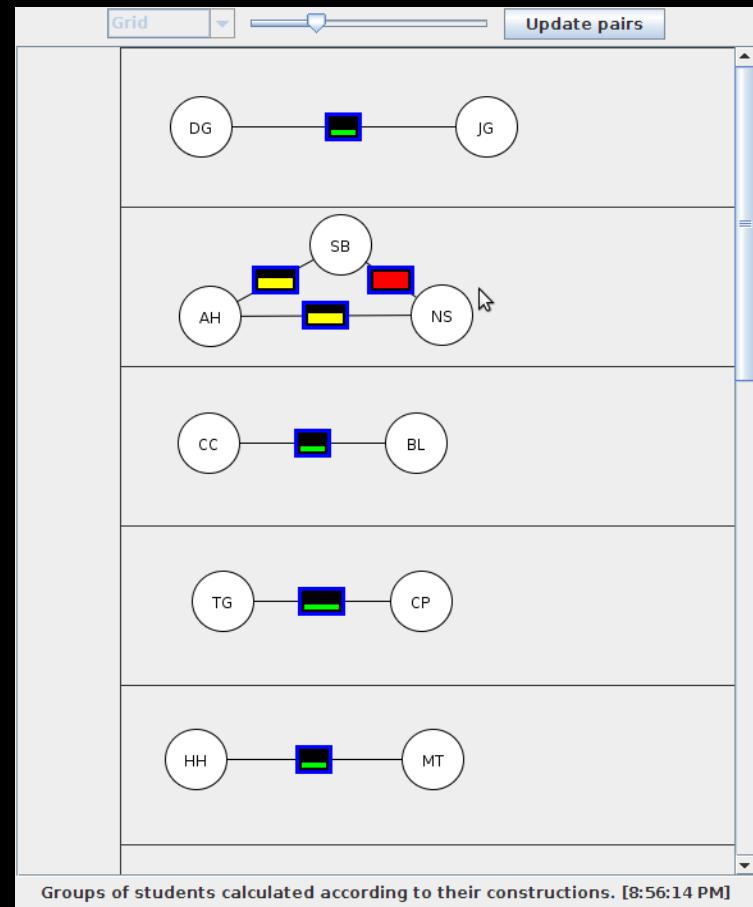
- Top Bar:** Includes "Computer Model", "My Model" (with a color palette), and standard window controls.
- Left Panel:** Shows a grid of green tiles labeled "CODE".
 - Model Rule 7:** Unlocked numbers named "N. of Pots 7".
 - A yellow callout box contains the text: "This is correct. But what is the link between these numbers?" with an "OK" button.
 - Goals:** A list of tasks:
 - Construct the My-Own-Building-Block model. Use more than one pattern to make the model. Use different colours for each pattern to show other people how you made your model. Find a rule for the number of tiles for any
 - Use pattern(s) to construct the model.
 - Make sure "My Model" is always coloured.
 - Check that the "General Model" animates without messing-up.
 - Make sure the "General Model" is coloured always.
 - DONE** button.
- Middle Panel:** Displays the "My Model" workspace with a green tile labeled "CODE".
- Bottom Panel:** Shows two "Properties" windows and a "Model Rule" section.
 - Properties Window (Left):** Shows a pink box labeled "N. of Pots" with value "4". Below it is a "How many tiles?" input field with value "20" and a green tile icon. Buttons for "Add this pattern (+)" and "Remove this pattern (-)" are present.
 - Properties Window (Right):** Shows a green tile labeled "CODE" followed by the equation $= 5 \times 4$.
 - Model Rule:** A table with columns "Pattern" and "Count". It lists "N. of Pots" with a count of "4".

AI powertools for teachers

track students

Time Zoom:		20	Width:	174
Ann Smith	1/1	Lisa Smith	1/1	Angela Lefevre
Tile placed		Pattern animated		1/1
Tile placed		Unlock number		Pattern cr Goal 1 acc
Tile placed				Local rule
Tile placed				Local rule
Feedback: Rhythm		Pattern animated		Local rule
B Block created				Local rule
				Local rule
Pattern created		Pattern animated		Local rule
Goal 1 accomplished		Pattern animated		Local rule
				Local rule
Unlock number		Pattern animated	Goal 2 accomplished	Pattern an
				Unlock nu
Local rule created				Pattern an
Pattern animated				Unlock nu
Feedback: Mess-up		World rule created		Pattern an
		Pattern animated		Pattern an
Pattern animated		World rule created		Pattern an
Feedback: Mess-up		Pattern animated		Pattern an
		World rule created		Pattern an
Goal 3 accomplished		Tile placed		Goal 2 acc
		Tile placed		
Local rule created		Tile placed		
Pattern animated		Tile placed		
Goal 2 accomplished		Tile placed		
		B Block created		
Local rule created		Pattern created		
Pattern animated		Goal 1 accomplished		
Goal 2 accomplished				

group students

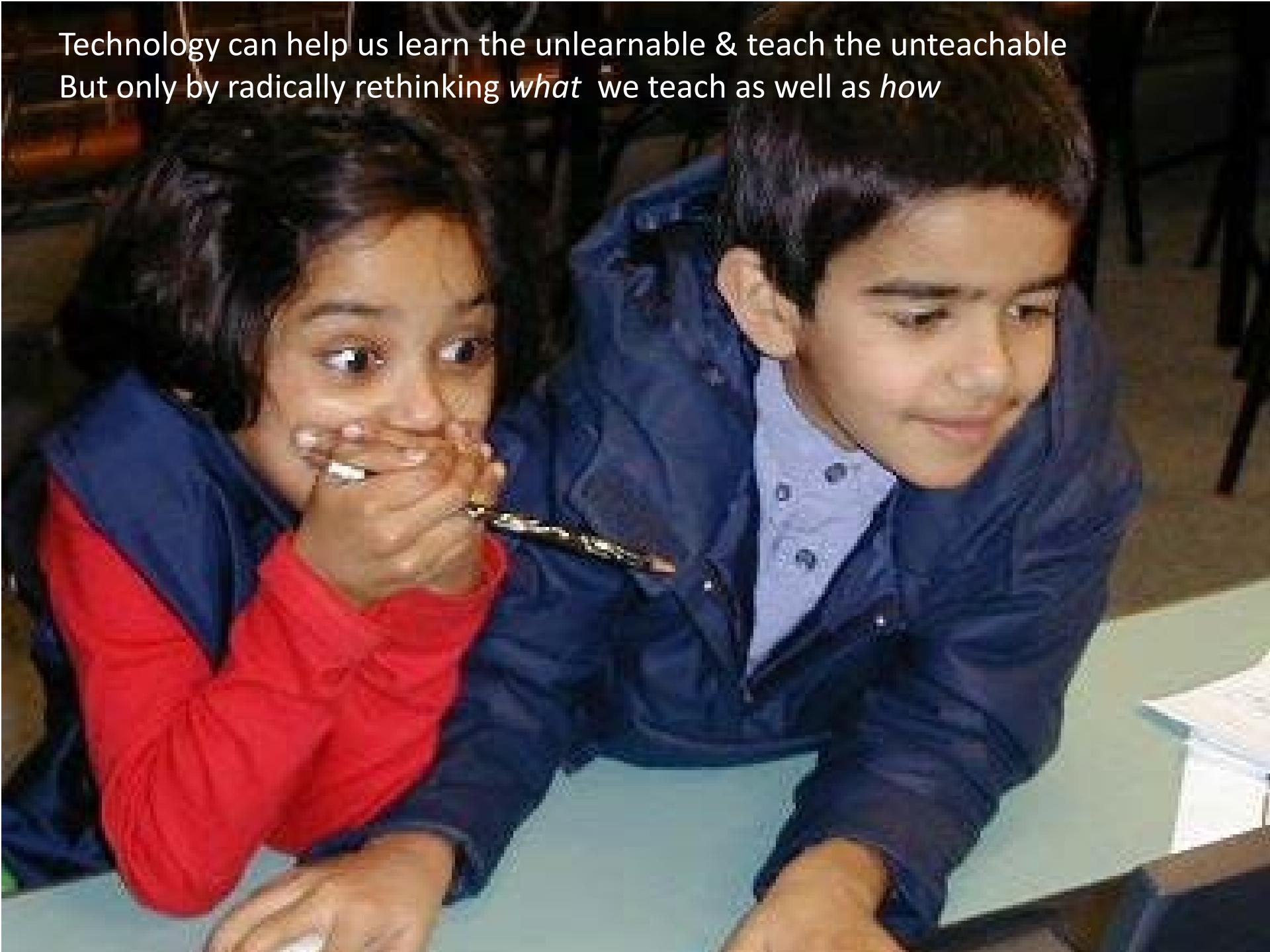


**building learning
technologies**

**building learnable
curricula**



Technology can help us learn the unlearnable & teach the unteachable
But only by radically rethinking *what* we teach as well as *how*



london knowledge lab

london knowledge lab

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Profile 12 Jan 12
Live online debate between Diana Laurillard and Stephen Downes

LKL's Diana Laurillard and Canadian researcher Stephen Downes will present contrasting responses to the question: To what extent should learning technologies support the development of critical thinking skills? The Association for Learning Technology has a free webinar on 22 February 2012.

Research 24 Jan 12
Professor Andrew Burn has succeeded in two bids

Professor Andrew Burn has succeeded in a bid to the Arts and Humanities Digital Media and Technology Fund and a grant funding application to the British Film Institute for a project called 'Shakespeare's Globe and Immersive Education'.

Also the British Film Institute, the IQE (Professor Andrew Burn) and Film London have secured a £1.2m grant from the Economic and Social Research Council to study the state of film education across all member states.

Study 17 Jan 12
First Light funding for young people's film

Professor Andrew Burn and Dr John Palmer have won £25k from First Light to develop a new series of short courses in Media and ICT Education at the University of Derby, based at the Derbyshire Film School in Derby.

The project is a collaboration with the BFI, the National Film Development Corporation, and the Cambridge-based animation company, 3D Animation Ltd.

Research 24 Jan 12
Media and ICT Education: Specialised Professional Development Courses - Springummer 2012

We are pleased to announce an exciting new series of specialised professional development short courses in Media and ICT Education, all taking place at the University of Derby during the spring semester from 6 March 2012.

These specialised courses offer unique and developmental opportunities drawn from the range of practice and research.

Study 17 Jan 12
TEL feature TEL's PI project

The Institute of Engineering and Technology's (IET) autumn issue of Engineering and Technology Education (ETE) features an article on the work of the London Knowledge Lab's Personal Inquiry/Inquire project led by Professor Mike Sharples.

The project author describes how inquiry makes students fully aware of inquiry as being crucial to students' engagement with science. The project team's work entailed providing children with their own kits to conduct their own experiments beyond the classroom which often involved parents and carers.

- Read the article ['Inquiry: kind permission of E&TE'](#)
- Download the full magazine
- More on [PI/Inquire](#)

Projects

Bolus Ensemble Haydal Identify Echoes Ensemble HayTEL InterLife Learning Design Midas Personal Inquiry SynergyNet Resources Associate Members TEL Programme iGenda Venues Press releases Funding opportunities Guide to impact Journals in TEL

Programme themes

Flexibility | Inclusion | Personalisation | Productivity | Research Community

Highlighted downloads

NEWT Mobile and Ubiquitous Technologies (MUT) [NEWT Technology Briefing on Interdisciplinarity](#)
Research Briefing on Interdisciplinarity

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Home About the programme themes | Flexibility | Inclusion | Personalisation | Productivity | Research Community

SEARCH

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Research Briefing on Interdisciplinarity

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