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Methods and Modalities of Engineering Education

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Factors affecting performance

- Scio-economic background
- Previous education
- Family background
 - Involved in engineering
 - Education level
 - Motivation
- Learning environment

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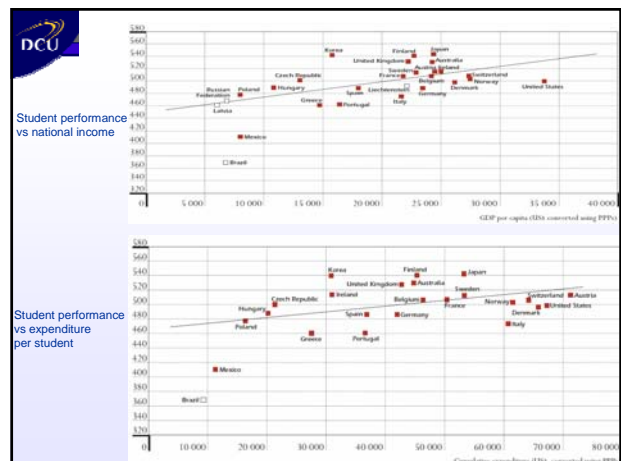
Mathematics literacy

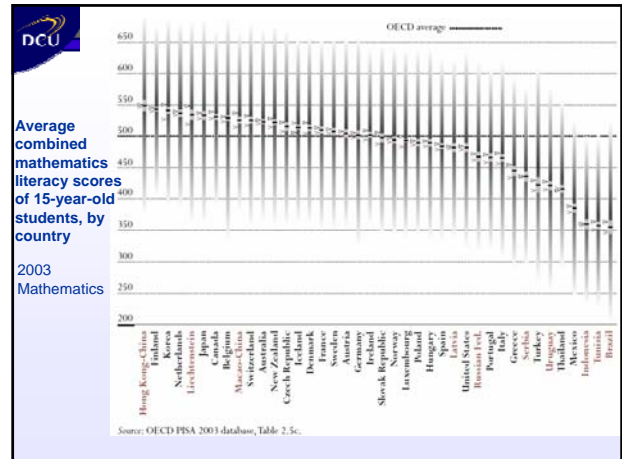
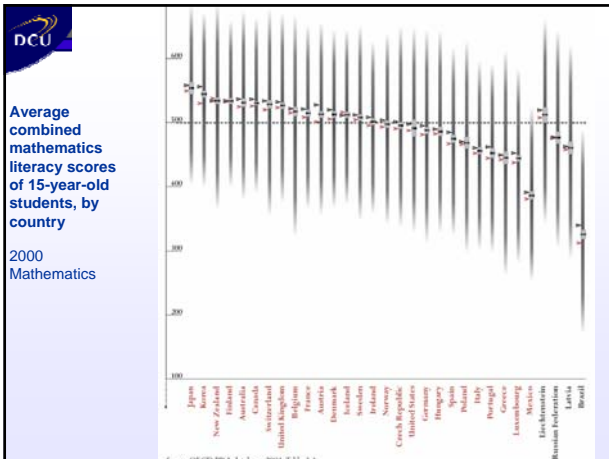
- Mathematics literacy defined as:
...an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned, and reflective citizen. (OECD 2003, p.24)

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Combined mathematics literacy

- *Space and shape*
- *Change and relationships*
- *Quantity focuses*
- *Uncertainty*





Mathematics - PISA

Significance levels	2008 higher than 2000		2008 lower than 2000		No statistically significant difference		
	90 % confidence level	95 % confidence level	99 % confidence level	+	+	+	o
Differences observed in the mean and percentiles							
	5th	10th	25th	Mean	75th	90th	95th
OECD country							
Australia	o	o	o	o	o	o	o
Austria	o	o	o	o	o	o	o
Belgium	+++	+	+	+++	+++	+++	+
Canada	++	++	++	+++	+++	+++	+++
Czech Republic	+++	+++	+++	+++	+++	+++	+
Denmark	++	+	o	o	o	o	o
Finland	o	+	o	++	+++	+++	+++
France	o	o	o	o	+	+	o
Germany	++	+	+++	+++	+++	+++	+++
Greece	+++	++	o	o	+	+	---
Hungary	+++	+++	+++	++	o	o	o
Iceland	o	o	o	o	o	o	o
Ireland	o	o	o	o	+	+	o
Italy	o	o	o	o	+	+++	+++
Japan	o	o	o	o	o	o	o
Korea	o	o	o	+++	+++	+++	+++
Mexico	o	o	o	o	o	o	o
New Zealand	o	o	o	o	o	o	o
Norway	o	o	o	o	o	o	o
Poland	+++	+++	+++	+++	o	o	o
Portugal	+	+	+	+++	+++	+++	+++
Spain	+	+	++	++	+	o	o
Sweden	o	o	o	o	+	+++	+++
Switzerland	+++	+++	++	+	o	o	o
United States	o	o	o	o	o	o	o
OECD total	o	o	o	o	o	o	o
OECD average	+++	+++	+	++	++	++	++

Science - PISA

Significance levels	2008 higher than 2000		2008 lower than 2000		No statistically significant difference		
	90 % confidence level	95 % confidence level	99 % confidence level	+	+	+	o
Differences observed in the mean and percentiles							
	5th	10th	25th	Mean	75th	90th	95th
OECD country							
Australia	---	o	o	o	o	o	o
Austria	---	---	---	---	---	---	---
Belgium	+	o	o	++	++	++	++
Canada	---	---	---	---	---	---	---
Czech Republic	o	o	o	++	+++	+++	+++
Denmark	o	o	o	o	o	o	o
Finland	o	o	o	++	+++	+++	+++
France	o	o	o	++	+++	+++	+++
Germany	o	o	o	+++	+++	+++	+++
Greece	o	o	++	+++	+++	+++	+++
Hungary	o	++	+	+	+	+	+
Iceland	o	o	o	o	o	o	o
Ireland	o	o	o	o	+	+	o
Italy	o	o	o	o	+	+++	+++
Japan	o	o	o	o	+	+++	+++
Korea	---	---	---	---	o	o	++
Mexico	---	---	---	---	o	o	o
New Zealand	o	o	o	o	o	o	o
Norway	---	---	---	---	---	---	---
Poland	o	o	o	++	++	++	+++
Portugal	o	o	o	o	+	+	+
Spain	o	o	o	o	o	o	o
Sweden	---	---	---	---	o	o	++
Switzerland	o	o	+	+++	+++	+++	+++
United States	o	o	o	o	o	o	o
OECD total	---	---	---	---	o	o	o
OECD average	---	---	o	o	o	++	+++

- Learning environment**
- Conceiving, Designing, Implementing and Operating (CDIO)
 - Problem Based Learning (PBL) / Concept teaching
 - Kolb cycle – using learning style to direct environment
 - Continuous assessment
 - laboratories, review reports, group projects, MCQs
 - Virtual Learning Environment (VLE)

- Learning environment**
- Lecture rooms / staff student ratio
 - Laboratory 'hands on' work
 - students develop the skills of observation, inquiry, and problem-solving
 - Research linked with teaching
 - Motivated lecturers / motivated classmates
 - Gaming / Virtual Simulations

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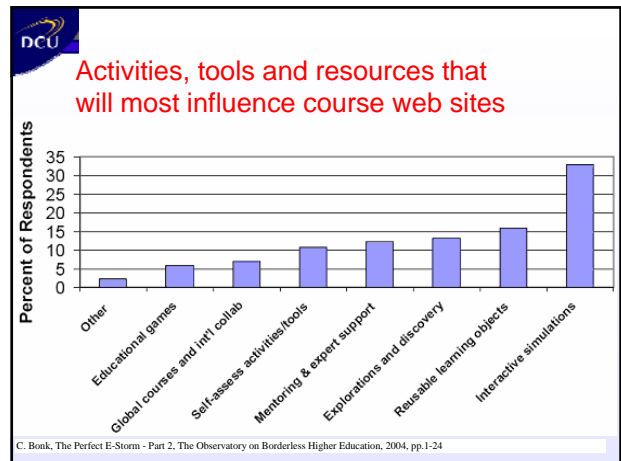
Computer Based Learning (CBL)

Factors affecting peoples opinions

55 %	Visual impact
38 %	Tone
7 %	Content

27 times more connections between the brain and the eyes than between the brain and the ears.

A. Mehrabian, Silent Messages, 1971



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Experiments assessed

- **Moment of inertia** laboratory (1st year UG)
- **Simple harmonic motion** evaluation (1st year UG)
- **Centrifugal force** investigation (1st year UG)
- **Load cell** examination and application (3rd year UG)
- **LVDT and accelerometer** examination (3rd year UG)
- Determination of **beam shear mechanics** (1st year PG)
- Control and measurement of **automated capillary viscometer** (1st year PG)
- **Ultrasonic viscosity measurement** (1st year PG)

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Results

Multiple choice questions

Heart rate monitoring

Lecturer feedback

Demonstrator feedback

Result analysis

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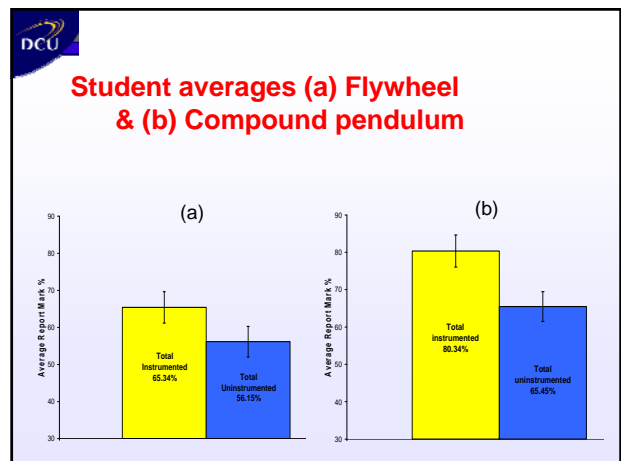
Moment of Inertia

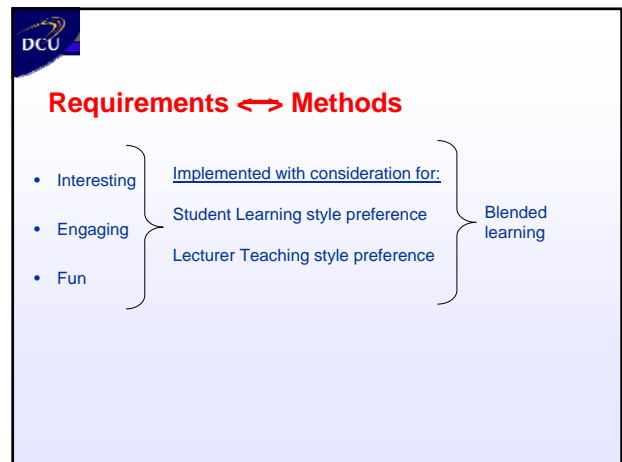
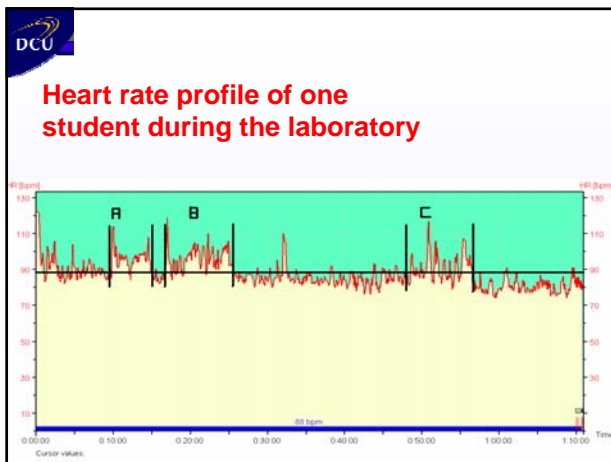
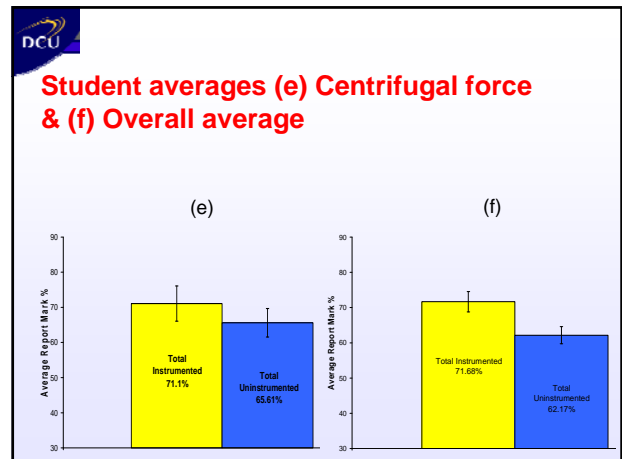
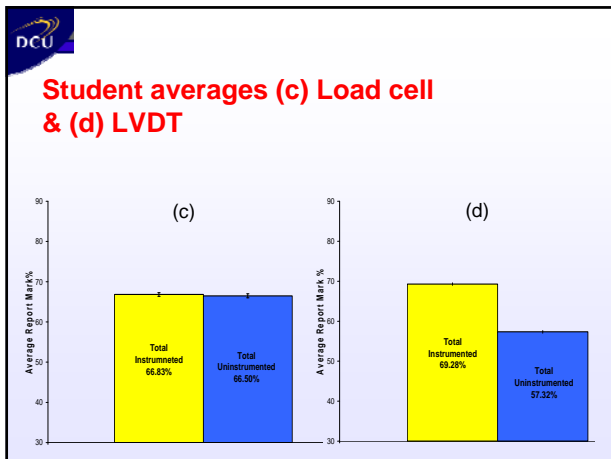
Flywheel Experiment

Rotational Sensor

Data Acquisition Box

PC





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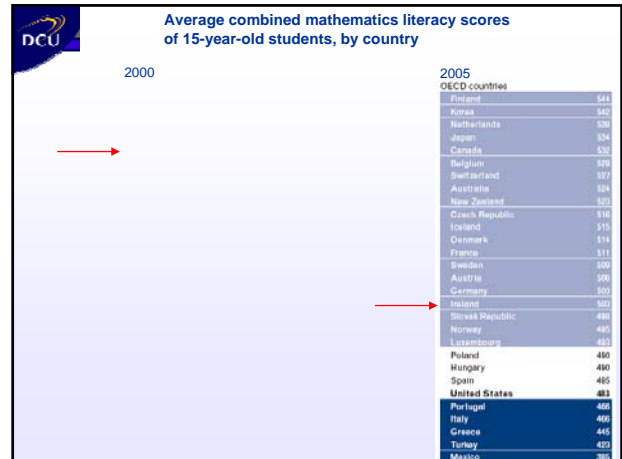
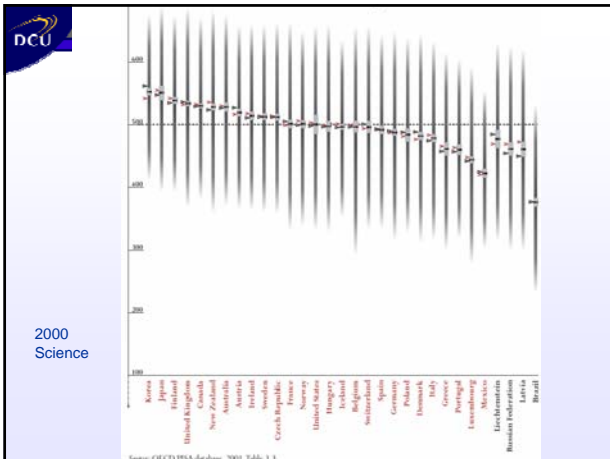
Further Information

- Acknowledgements
 - Funding for this work from the Teaching and Learning Committee, DCU and National Instruments Fellowship schemes
 - Philip Smyth; Pat McElroy - MEng students and Dr. Eilish McLoughlin, School of Physical Sciences, for co-supervising the work
- Useful links
 - <http://webpages.dcu.ie/~brabazod/T&L.html>
 - <http://www.ndlr.ie>
- E-mail: dermot.brabazon@dcu.ie

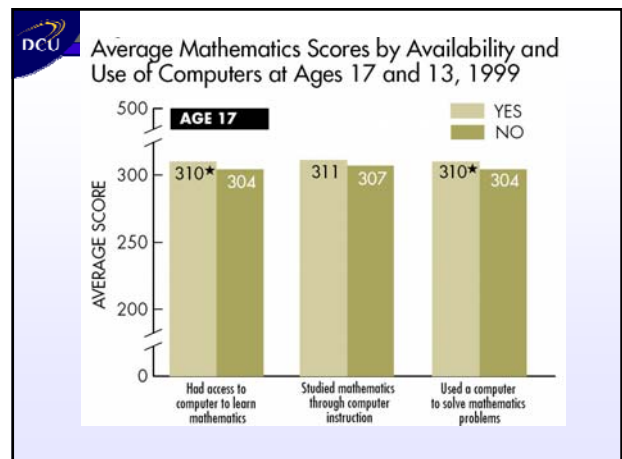
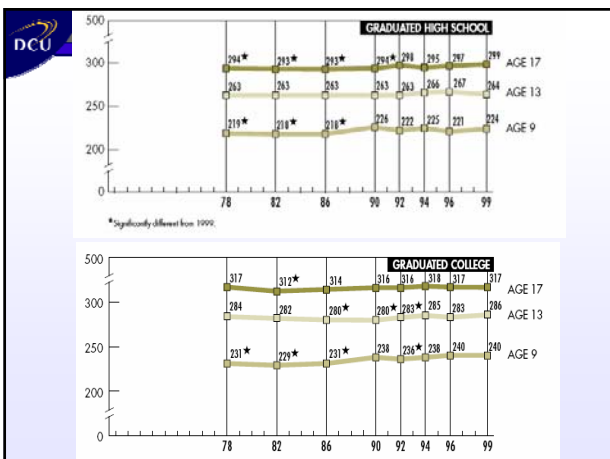
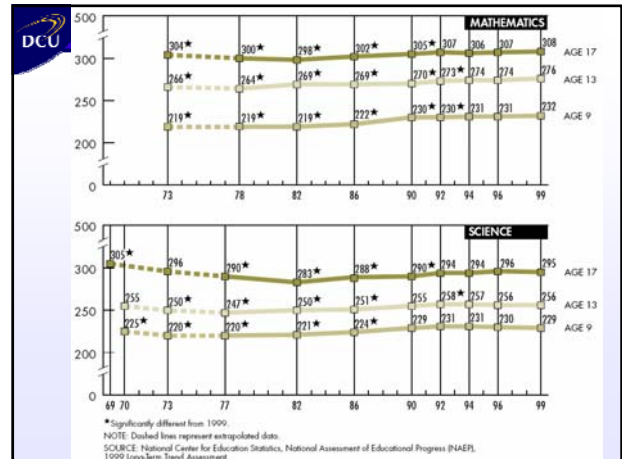
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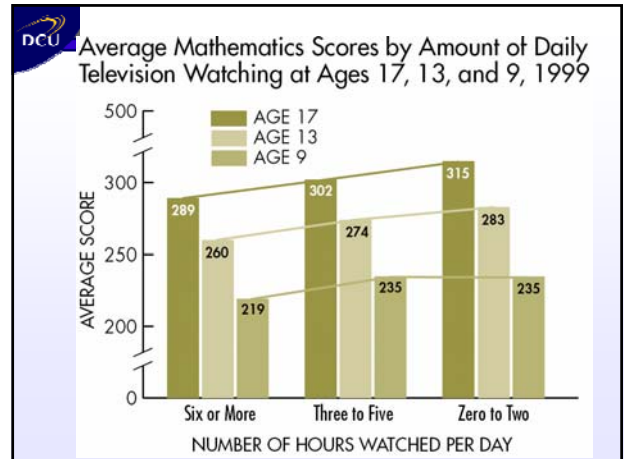
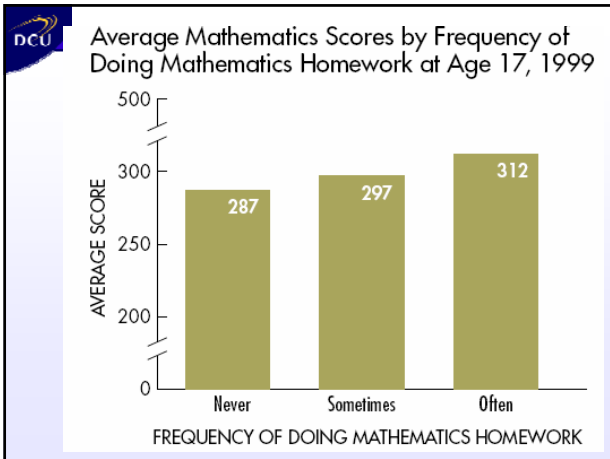
References

- ME CoP Coordinator: Dermot.brabazon@dcu.ie
- NDLR Coordinator: Muireann.okeeffe@dcu.ie
- NDLR: <http://www.ndlr.ie>
- ME CoP: <http://www.ndlr.ie/mecheng/blog>
- Links in this presentation: <http://webpages.dcu.ie/~brabazod/IMC07.html>
- http://en.wikipedia.org/wiki/Community_of_practice, accessed 10/04/2007
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- Downes, Stephen. <http://www.downes.ca/cgi-bin/page.cgi?topic=146> accessed 19/07/2007
- Holden, Colin. "From Local challenges to a Local Community: Learning and Repositories and the Global Learning Repositories Summit, 2003"



- *Space and shape* includes recognizing shapes and patterns, describing, encoding, and decoding visual information, understanding dynamic changes to shapes, understanding similarities and differences and relative positions, and understanding the relationship between visual representations and real shapes and images.
- *Change and relationships* covers the representation of change, including mathematical functions such as linear, exponential, or logistic, as well as data analysis needed to specify relationships or translate between representations.
- *Quantity* focuses on quantitative reasoning (including number sense, estimating, mental arithmetic, understanding meaning of operations, having a feel for the magnitude of numbers, and computations) and understanding of numerical patterns, counts, and measures.
- *Uncertainty* includes the two related topics of data and chance, or statistics and probability, including data analysis and graphic and numeric representations of data.





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