Leading education and social research
Institute of Education
University of London

Assessment, learning and technology: prospects at the periphery of control

Keynote address to ALT-C
September 2007; Nottingham, UK

Dylan Wiliam
Institute of Education,
University of London

www.dylanwiliam.net

www.ioe.ac.uk

Leading education and social research
Institute of Education
University of London

Overview of presentation

Theoretical precepts

- About learning
- About teaching
  - Pedagogies of engagement
  - Pedagogies of contingency

The role of technology

- Supporting, rather than replacing, teachers
- Classroom aggregation technologies

Leading education and social research
Institute of Education
University of London

Raising achievement matters

For individuals

- Increased lifetime salary
- Improved health
- Longer life

For society

- Lower criminal justice costs
- Lower health-care costs
- Increased economic growth

Leading education and social research
Institute of Education
University of London

Where's the solution?

Structure

- Smaller high schools
- Larger high schools
- K-8 schools

Alignment

- Curriculum reform
- Textbook replacement

Governance

- Charter schools
- Vouchers

Technology

- Computers
- Interactive white-boards

Leading education and social research
Institute of Education
University of London

School effectiveness

Three generations of school effectiveness research

- Raw results approaches
  - Different schools get different results
  - Conclusion: Schools make a difference
- Demographic-based approaches
  - Demographic factors account for most of the variation
  - Conclusion: Schools don't make a difference
- Value-added approaches
  - School-level differences in value-added are relatively small
  - Classroom-level differences in value-added are large
  - Conclusion: An effective school is a school full of effective classrooms

Leading education and social research
Institute of Education
University of London

It’s the classroom

Variability at the classroom level is up to 4 times that at school level

It’s not class size

It’s not the between-class grouping strategy

It’s not the within-class grouping strategy

It’s the teacher

Leading education and social research
Institute of Education
University of London

Teacher quality

A labour force issue with 2 solutions

- Replace existing teachers with better ones?
  - No evidence that more pay brings in better teachers
  - No evidence that there are better teachers out there deterred by burdensome certification requirements
- Improve the effectiveness of existing teachers
  - The “love the one you’re with” strategy
  - It can be done
  - We know how to do it, but at scale? Quickly? Sustainably?

Leading education and social research
Institute of Education
University of London

How do we improve teaching?

www.ioe.ac.uk

Leading education and social research
Institute of Education
University of London

Quality control and quality assurance

Quality control

- Bolt-on
- Determines need for re-processing
- Quality is “inspected in”
- Bad

Quality assurance

- Built-in
- Obviates the need for re-processing
- Quality is “designed in”
- Good

Leading education and social research
Institute of Education
University of London

Except that…

For some process quality assurance is more efficient than quality control

- e.g., automobile manufacture

For some process quality control is more efficient than quality assurance

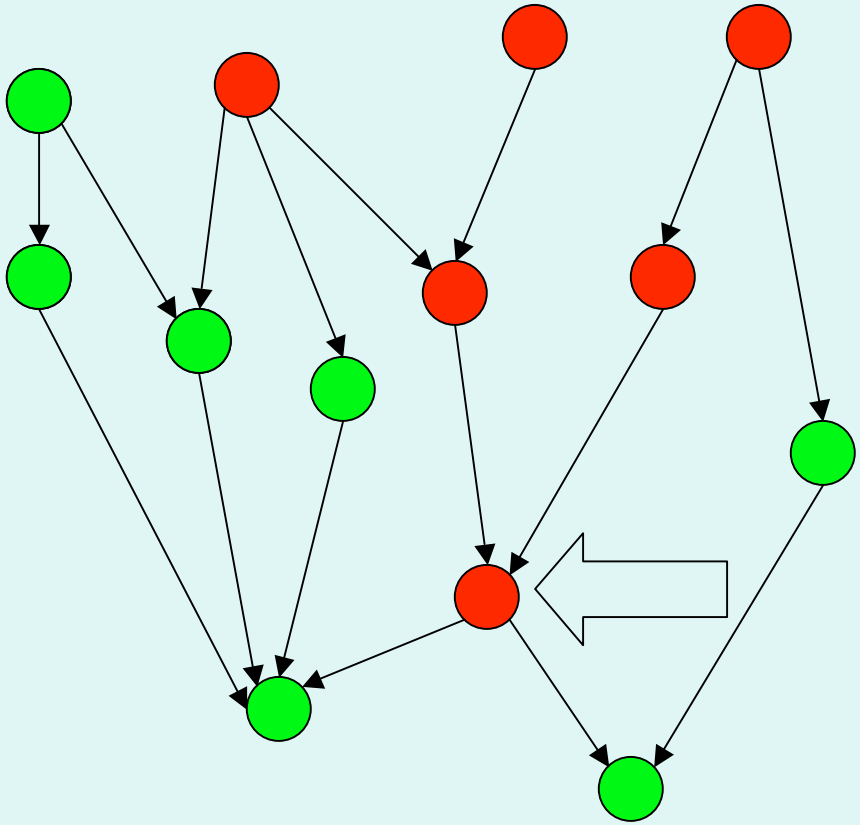
- e.g., silicon chip manufacture

Crucial trade-offs: testability vs complexity vs predictability

Where does learning fit?

Leading education and social research
Institute of Education
University of London

What gets learnt?



(Denvir & Brown, 1986)

Leading education and social research
Institute of Education
University of London

What gets learned (2)?

Which fraction is the smallest?

a) $\frac{1}{6}$, b) $\frac{2}{3}$, c) $\frac{1}{3}$, d) $\frac{1}{2}$.

Success rate 88%

Which fraction is the largest?

a) $\frac{4}{5}$, b) $\frac{3}{4}$, c) $\frac{5}{8}$, d) $\frac{7}{10}$.

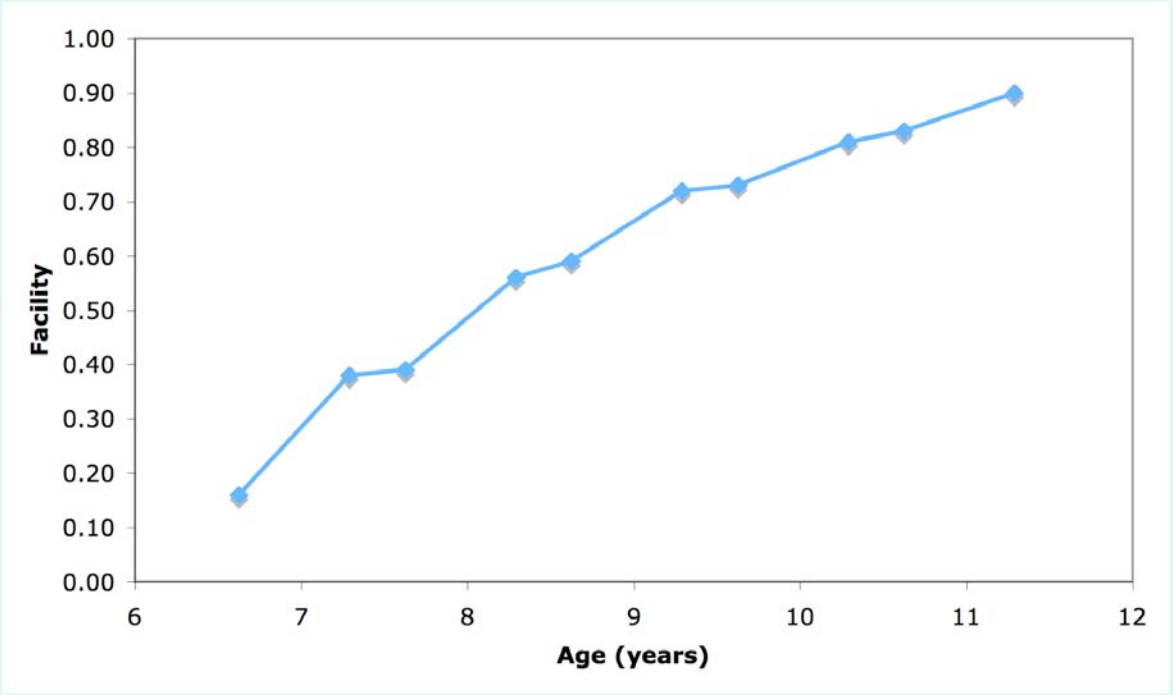
Success rate 46%; 39% chose (b)

(Vinner, PME conference, Lahti, Finland, 1997)

Leading education and social research
Institute of Education
University of London

What gets learned (3)?

860 +570=



(Leverhulme Numeracy Research Programme)

Leading education and social research
Institute of Education
University of London

What gets learned (4)?

Strategies & errors in secondary mathematics (Booth; 1984; Hart, 1984)

- One-third knew the content at the beginning
- One-third didn't know the content at the end
- One-third learnt the content
- But, half of these had forgotten the content six weeks later
- However, some did better on the delayed post-test than on the immediate post-test

Leading education and social research
Institute of Education
University of London

Key insights from C20th psychology

1. **What gets learned as a result of a particular sequence of instructional activities is impossible to predict, but**
2. **Student errors are not random**

Conclusion: teaching is interesting because learners are so different, but only possible because they are so similar

Learning is a liminal process, at the boundary between control and chaos

Leading education and social research
Institute of Education
University of London

Learning power environments

Key concept:

- Teachers do not create learning
- Learners create learning

Teaching as engineering learning environments

Key features:

- Create student engagement (pedagogies of engagement)
- Well-regulated (pedagogies of contingency)

Leading education and social research
Institute of Education
University of London

Why pedagogies of engagement?

Intelligence is partly inherited

- So what?

Intelligence is partly environmental

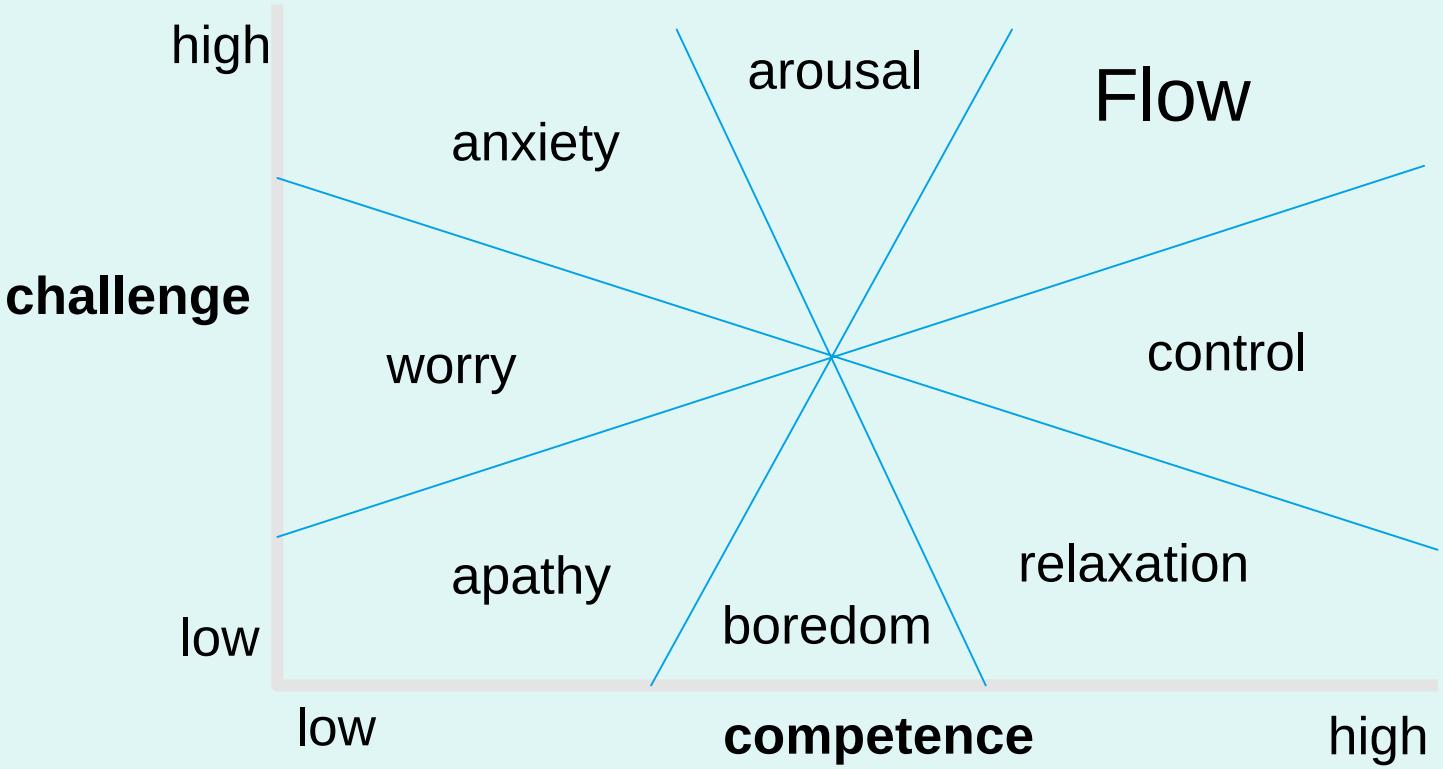
- Environment creates intelligence
- Intelligence creates environment

Learning environments

- High cognitive demand
- Inclusive
- Obligatory

Leading education and social research
Institute of Education
University of London

Motivation: cause or effect?



(Csikszentmihalyi, 1990)

Leading education and social research
Institute of Education
University of London

Why pedagogies of contingency?

For evaluating institutions

For describing individuals

For supporting learning

- Monitoring learning
  - Whether learning is taking place
- Diagnosing (informing) learning
  - What is not being learnt
- Forming learning
  - What to do about it

Leading education and social research
Institute of Education
University of London

Effects of formative assessment

Several major reviews of the research

- Natriello (1987)
- Crooks (1988)
- Kluger & DeNisi (1996)
- Black & Wiliam (1998)
- Nyquist (2003)

All find consistent, substantial effects

Leading education and social research
Institute of Education
University of London

Kinds of feedback (Nyquist, 2003)

Weaker feedback only

- Knowledge of results (KoR)

Feedback only

- KoR + clear goals or knowledge of correct results (KCR)

Weak formative assessment

- KCR+ explanation (KCR+e)

Moderate formative assessment

- (KCR+e) + specific actions for gap reduction

Strong formative assessment

- (KCR+e) + activity

Leading education and social research
Institute of Education
University of London

Effect of formative assessment (HE)

	N	Effect
Weaker feedback only	31	0.14
Feedback only	48	0.36
Weaker formative assessment	49	0.26
Moderate formative assessment	41	0.39
Strong formative assessment	16	0.56

(Nyquist, 2003; revised values)

Leading education and social research
Institute of Education
University of London

Cost/effect comparisons

Intervention	Extra learning	Cost/yr/ classroom
Class-size reduction (by 30%)	20%	£20k
Increase teacher content knowledge by 1 sd	5%	?
Formative assessment/ Assessment for learning	75%	£2k

Leading education and social research
Institute of Education
University of London

Three generations of pedagogy

First generation

- Traditional pedagogy
- Negligible contingency

Second generation

- All student response systems
- Contingency dependent entirely on teacher skill

Third generation

- Automated aggregation technologies
- Contingency supported by technology

Leading education and social research
Institute of Education
University of London

Four-process architecture

Task selection
Task presentation
Evidence identification
Evidence accumulation

Almond, Steinberg and Mislevy (2002)

Leading education and social research
Institute of Education
University of London

Task selection/ Task presentation

www.ioe.ac.uk

Leading education and social research
Institute of Education
University of London

Questioning in math: discussion

Look at the following sequence:
3, 7, 11, 15, 19, ….

Which is the best rule to describe the sequence?

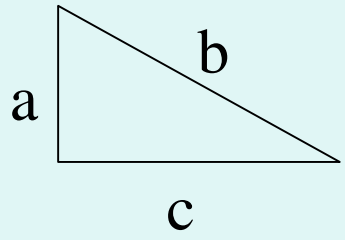
A. n + 4
B. 3 + n
C. 4n - 1
D. 4n + 3

Leading education and social research
Institute of Education
University of London

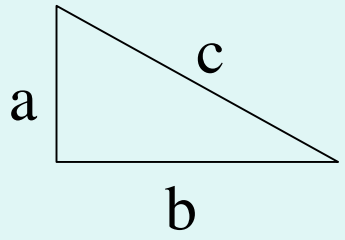
Questioning in maths: diagnosis

In which of these right triangles is $a^2 + b^2 = c^2$?

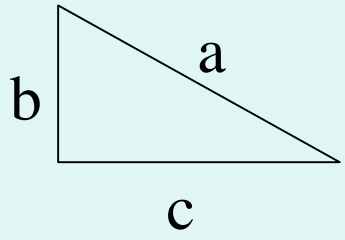
A



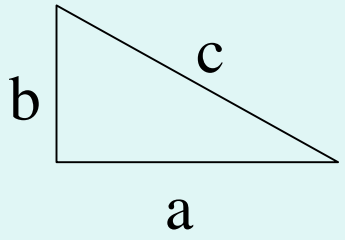
B



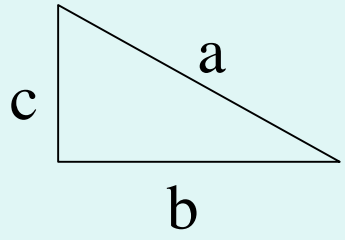
C



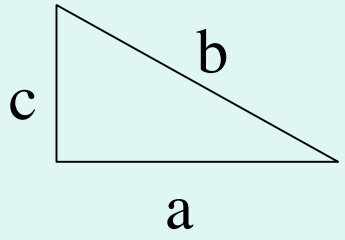
D



E



F



Leading education and social research
Institute of Education
University of London

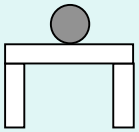
Questioning in science: discussion

Ice-cubes are added to a glass of water. What happens to the level of the water as the ice-cubes melt?

A. The level of the water drops
B. The level of the water stays the same
C. The level of the water increases
D. You need more information to be sure

Leading education and social research
Institute of Education
University of London

Questioning in science: diagnosis



The ball sitting on the table is not moving. It is not moving because:

A. no forces are pushing or pulling on the ball.
B. gravity is pulling down, but the table is in the way.
C. the table pushes up with the same force that gravity pulls down
D. gravity is holding it onto the table.
E. there is a force inside the ball keeping it from rolling off the table

(Wilson & Draney, 2004)

Leading education and social research
Institute of Education
University of London

Save the ozone layer

What can we do to preserve the ozone layer?

A. Reduce the amount of carbon dioxide produced by cars and factories
B. Reduce the greenhouse effect
C. Stop cutting down the rainforests
D. Limit the numbers of cars that can be used when the level of ozone is high
E. Properly dispose of air-conditioners and fridges

Leading education and social research
Institute of Education
University of London

Questioning in English: discussion

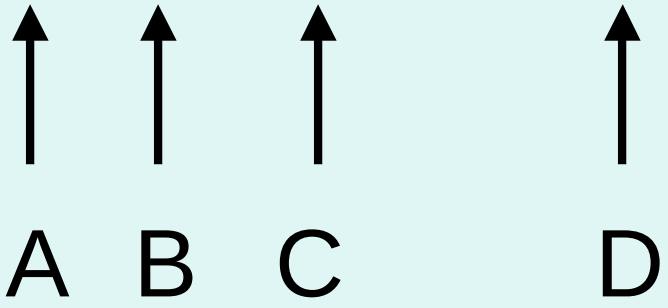
Macbeth: mad or bad?

Leading education and social research
Institute of Education
University of London

Questioning in English: diagnosis

Where is the verb in this sentence?

The dog ran across the road



Leading education and social research
Institute of Education
University of London

Questioning in English: diagnosis

Which of these is the best thesis statement?

A. The typical TV show has 9 violent incidents
B. There is a lot of violence on TV
C. The amount of violence on TV should be reduced
D. Some programs are more violent than others
E. Violence is included in programs to boost ratings
F. Violence on TV is interesting
G. I don't like the violence on TV
H. The essay I am going to write is about violence on TV

Leading education and social research
Institute of Education
University of London

Hinge Questions

A hinge question is based on the important concept in a lesson that is critical for students to understand before you move on in the lesson.

The question should fall about midway during the lesson.

Every student must respond to the question within two minutes.

You must be able to collect and interpret the responses from all students in 30 seconds

Leading education and social research
Institute of Education
University of London

Figurative language

A. Alliteration
B. Hyperbole
C. Irony
D. Metaphor
E. Onomatopoeia
F. Personification
G. Simile
H. None of the above

1. He was a bull in a china shop.
2. May I have a drop of water?
3. This backpack weighs a ton.
4. The sweetly smiling sunshine…
5. He honked his horn at the cyclist.
6. I've told you a million times already.
7. The Redcoats are coming!
8. "They in the sea being burnt, they in the burnt ship drown'd."
9. He was as tall as a house.

Leading education and social research
Institute of Education
University of London

Evidence identification

www.ioe.ac.uk

Leading education and social research
Institute of Education
University of London

Evidence identification

Single student response systems

All-student response systems

- Flash-cards/dry erase boards
- Classroom ‘clickers’
- Traditional keyboards (wired/wireless)
- Anoto pens


A

Leading education and social research
Institute of Education
University of London

Anoto pen

Wireless pen

Special coated paper

Pen ‘knows where it is’

Leading education and social research
Institute of Education
University of London

Palm with wireless keyboard

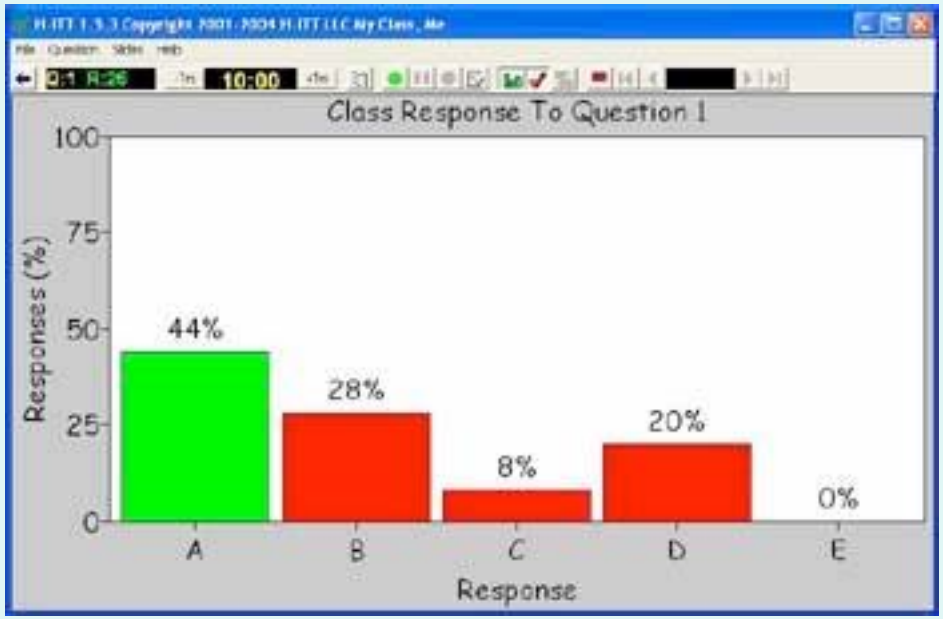
Text-based input

Limited task-presentation capability

Portable

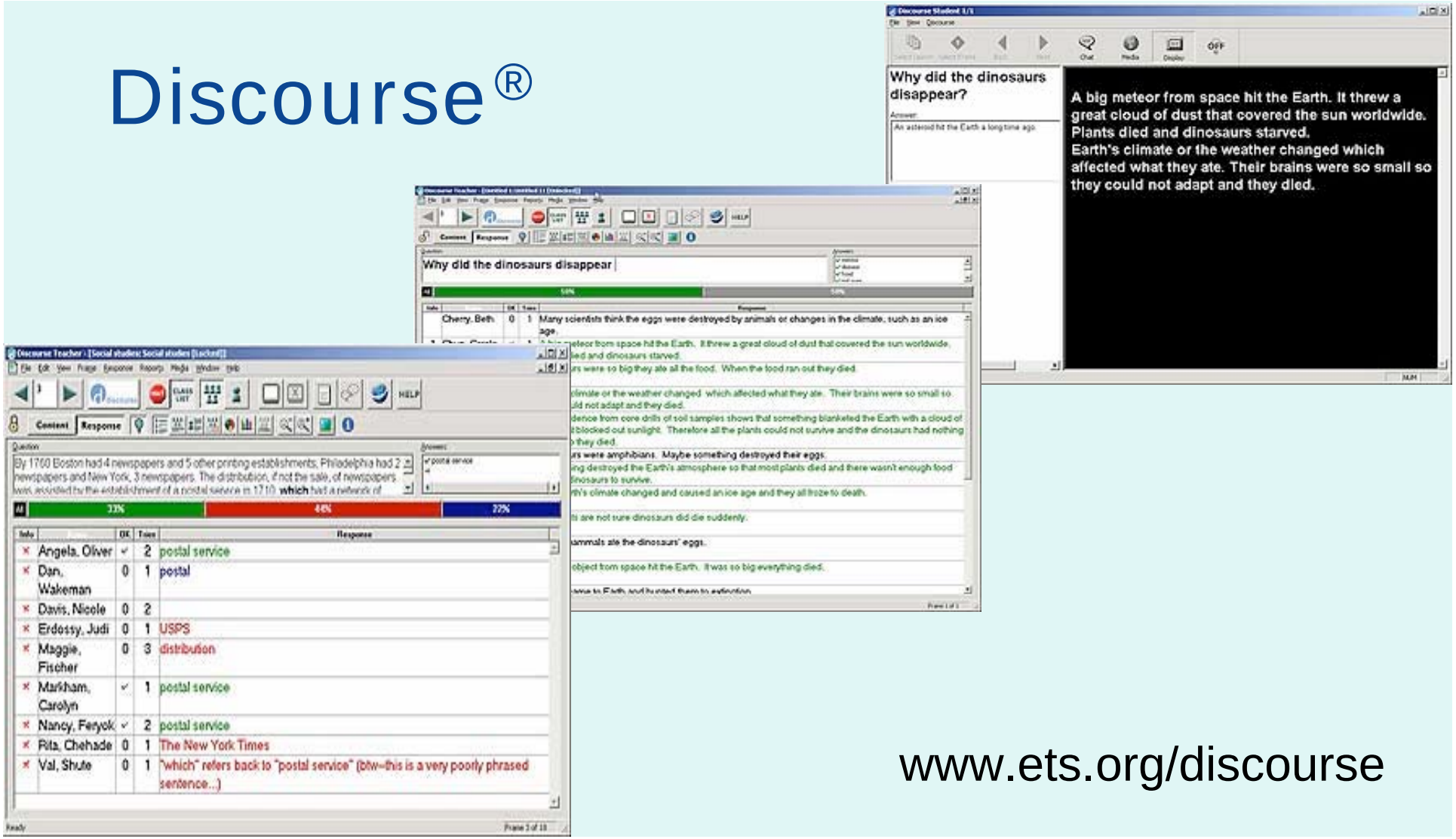
Leading education and social research
Institute of Education
University of London

Classroom ‘clickers’



Leading education and social research
Institute of Education
University of London

Discourse®



www.ets.org/discourse

Leading education and social research
Institute of Education
University of London

Evidence identification

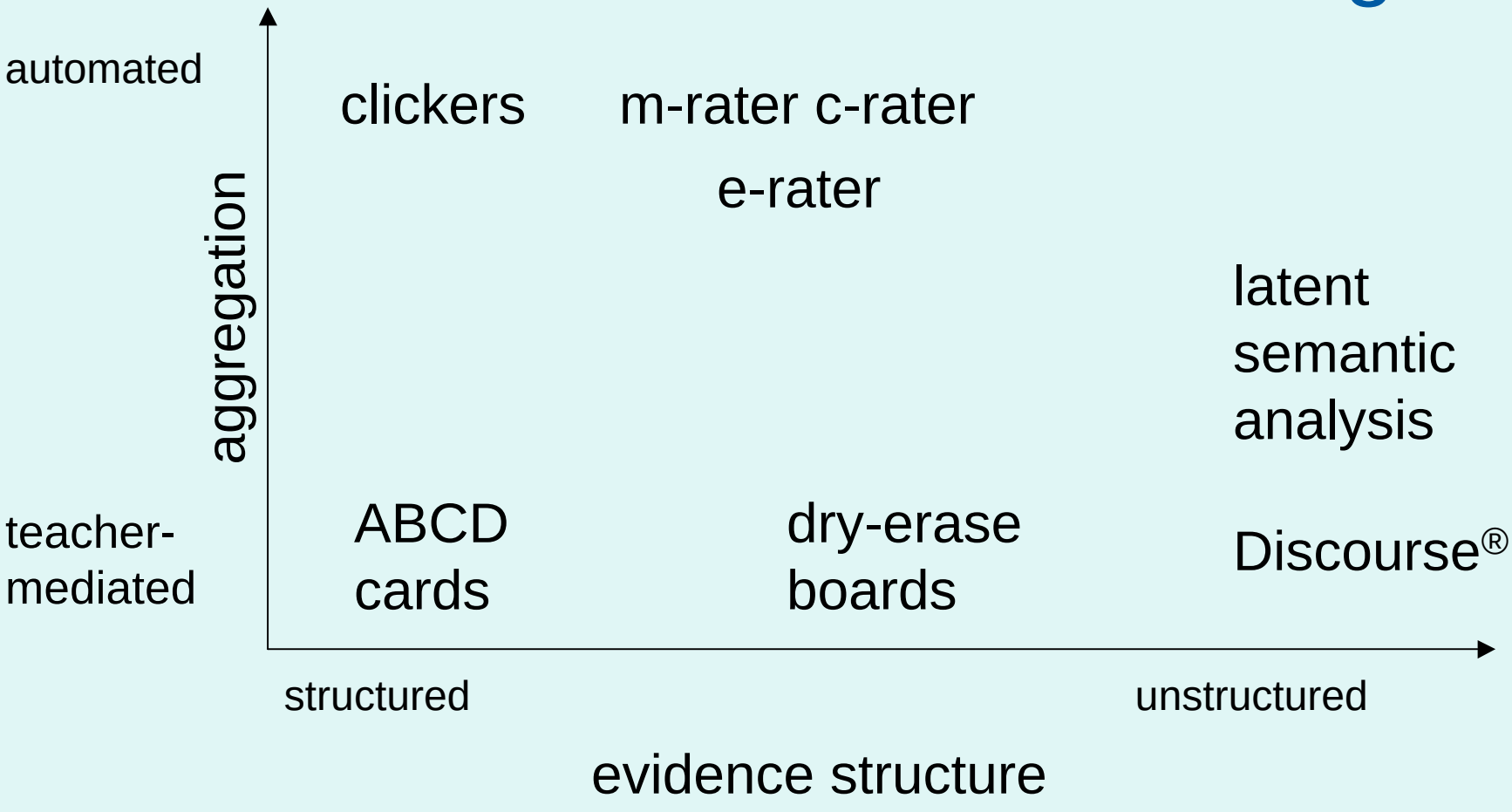
Automated essay scoring (e-rater)

Paraphrase analysers (c-rater)

Graphical and equation analysers (m-rater)

Leading education and social research
Institute of Education
University of London

Evidence identification technologies



Leading education and social research
Institute of Education
University of London

Evidence accumulation

Unidimensional student models

- Useful for summative purposes
- Almost useless for formative purposes

Multidimensional student models

Evidence-centred design

- Bayesian inference networks
  - Proficiency model
  - Task model
  - Evidence model
  - Student model

Leading education and social research
Institute of Education
University of London

Evidence utilization

Whole-class

Sub-groups

- Homogenous
- Heterogenous

Individualization

Leading education and social research
Institute of Education
University of London

Summary

Raising achievement is important

To do so, we have to change what happens in classrooms

We have to work with, rather than replace teachers

Specifically, it is more important to improve pedagogy than subject matter knowledge

- Pedagogies of engagement
- Pedagogies of contingency
  - Single-student response systems
  - All-student response systems
  - Classroom aggregation technologies