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

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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

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

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

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

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

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?



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How do we improve teaching?



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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

Except that...

For some process quality assurance is more efficient than quality control

- e.g., automobile manufacture

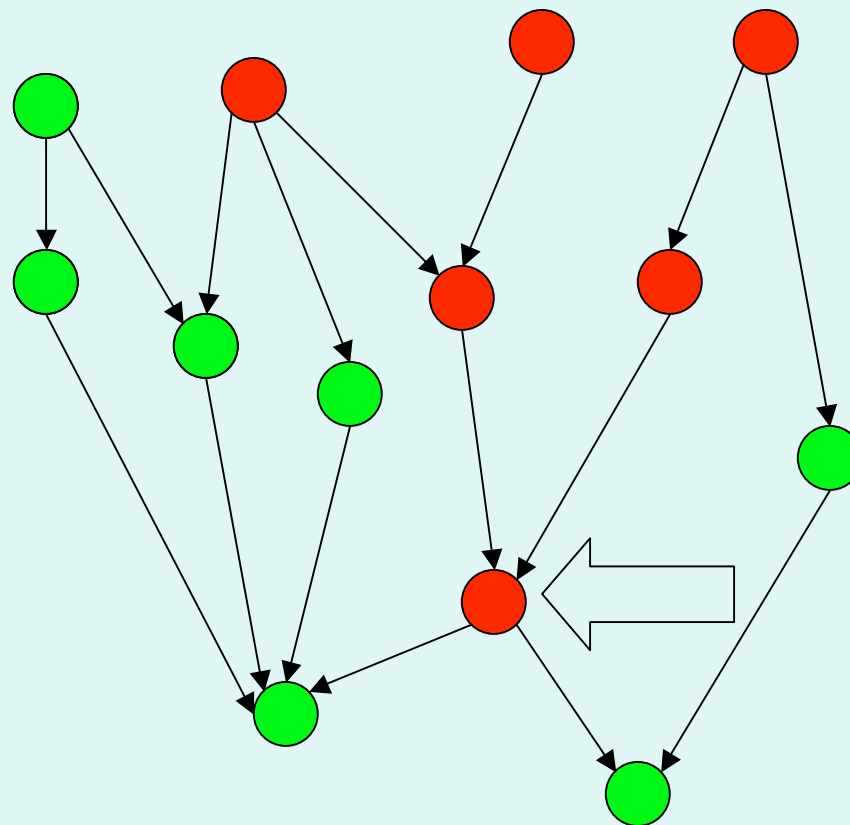
For some process quality control is more efficient than quality assurance

- e.g., silicon chip manufacture

Crucial trade-offs: testability vs complexity vs predictability

Where does learning fit?

What gets learnt?



(Denvir & Brown, 1986)

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?

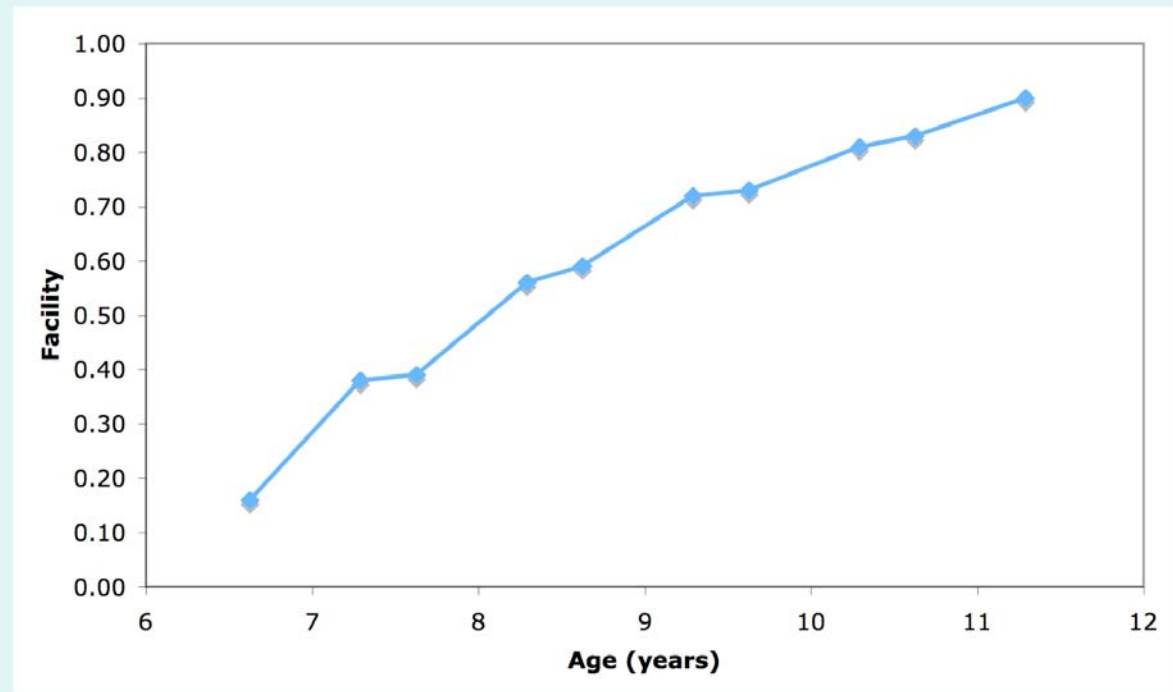
a) $\frac{4}{5}$, b) $\frac{3}{4}$, c) $\frac{5}{8}$, d) $\frac{7}{10}$.

Success rate 46%; 39% chose (b)

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

What gets learned (3)?

860 + 570 =



(Leverhulme Numeracy Research Programme)

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

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

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)

Why pedagogies of engagement?

Intelligence is partly inherited

- So what?

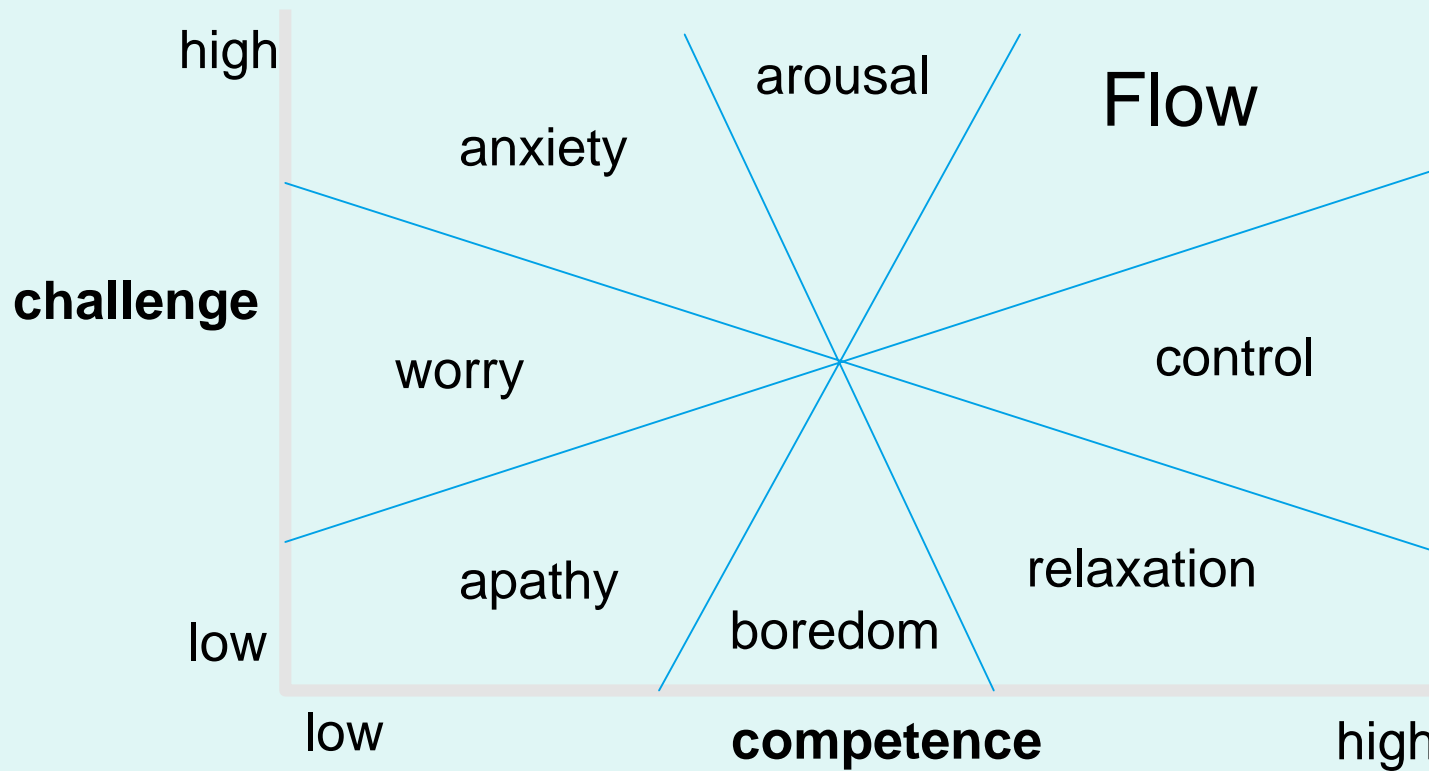
Intelligence is partly environmental

- Environment creates intelligence
- Intelligence creates environment

Learning environments

- High cognitive demand
- Inclusive
- Obligatory

Motivation: cause or effect?



(Csikszentmihalyi, 1990)

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

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

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

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)

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

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



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Four-process architecture

Task selection

Task presentation

Evidence identification

Evidence accumulation

Almond, Steinberg and Mislevy (2002)



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Task selection/ Task presentation



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Questioning in math: discussion

Look at the following sequence:

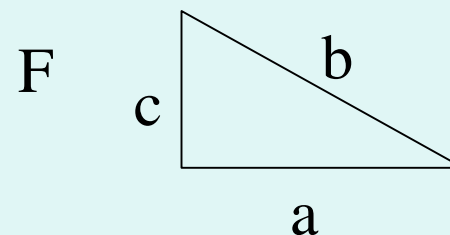
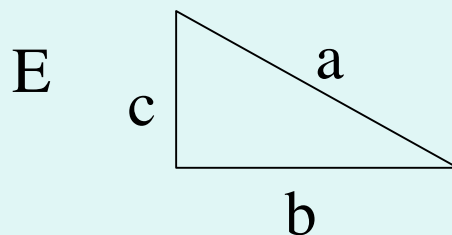
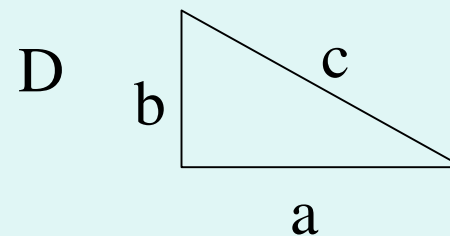
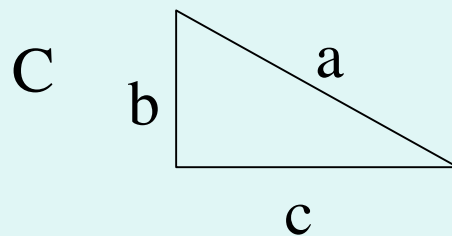
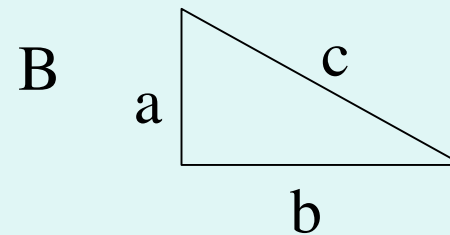
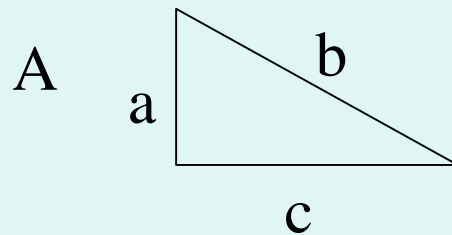
3, 7, 11, 15, 19,

Which is the best rule to describe the sequence?

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

Questioning in maths: diagnosis

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

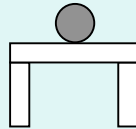


Questioning in science: discussion

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

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)

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



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Questioning in English: discussion

Macbeth: mad or bad?

Questioning in English: diagnosis

Where is the verb in this sentence?

The dog ran across the road

↑ ↑ ↑ ↑
A B C D

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

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

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.



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Evidence identification



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Evidence identification

Single student response systems

All-student response systems

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



Anoto pen



Wireless pen

Special coated paper

Pen 'knows where it is'

Palm with wireless keyboard

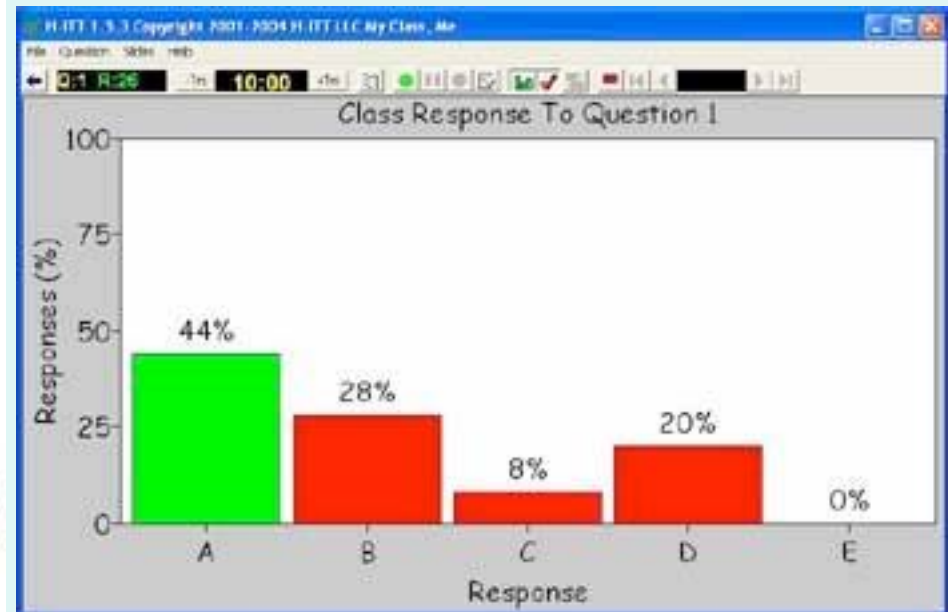


Text-based input

**Limited task-presentation
capability**

Portable

Classroom 'clickers'





Discourse[®]

The screenshot displays the Discourse software interface, which is used for classroom discussions. It features a central question, a list of student responses, and a detailed view of a specific student's answer.

Question: Why did the dinosaurs disappear?

Response Table:

Info	OK	Time	Response
Angela, Oliver	✓	2	postal service
Dan, Wakeman	0	1	postal
Davis, Nicole	0	2	
Erdosy, Judi	0	1	USPS
Maggie, Fischer	0	3	distribution
Markham, Carolyn	✓	1	postal service
Nancy, Ferryok	✓	2	postal service
Rita, Chehade	0	1	The New York Times
Val, Shute	0	1	"which" refers back to "postal service" (btw=this is a very poorly phrased sentence...)

Student Answer (Beth Chery): A big meteor from space hit the Earth. It threw a great cloud of dust that covered the sun worldwide. Plants died and dinosaurs starved. Earth's climate or the weather changed which affected what they ate. Their brains were so small so they could not adapt and they died.

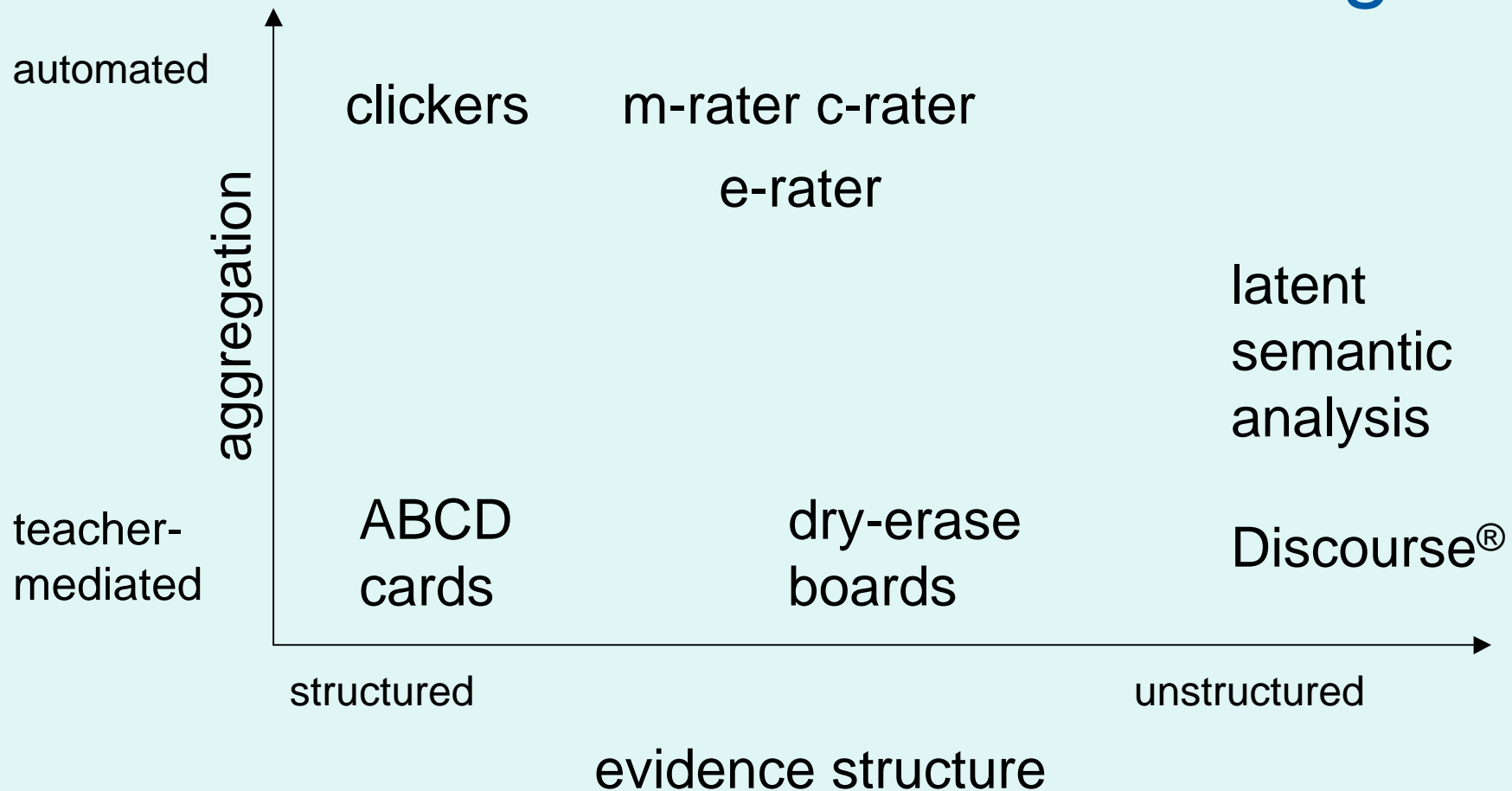
Evidence identification

Automated essay scoring (e-rater)

Paraphrase analysers (c-rater)

Graphical and equation analysers (m-rater)

Evidence identification technologies



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

Evidence utilization

Whole-class

Sub-groups

- Homogenous
- Heterogenous

Individualization

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