Does HE teaching skill matter?

A search for common lessons, and a selection of big and surprising effects in teaching innovations

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For the slides, references, etc. see:
http://www.psy.gla.ac.uk/~steve/talks/troles2.html

Part A:

Applied research should focus on the bottlenecks

Work only on the bottlenecks

In the 1970s some Unix guru said as a dictum that if you wanted your code to run faster it was no good polishing it all: you had to find the 10% of the code which accounted for 90% of the execution time and focus effort only on that.

Nobody who loves theory, good practice, principles, or standards would ever say that. But applied scientists, who want things actually to work better, should take this as their first commandment.

It is actually a principle that is widely relevant to applied fields.
e.g. Parisitology, Business, Medicine
   and Education.

Bloom's 2 sigma paper (1984)

When I finally, rather recently, came across an education paper that was reasoning like this, I woke up. His outline argument:

A) Proof of attainable benefit: skilled 1:1 (or 1:3) tutoring showed a 2 sigma (standard deviation) improvement relative to a school classroom.
B) But the cost is unaffordable for wide applicability
C) Bloom's Mastery Learning (ML) gets 1 sigma improvement
D) => he asks what additional intervention could get the 2nd SD?

Sigma == standard deviation == "effect size"
(effect size = the diff. in the means divided by the SD of the control group)

2 SDs means the average tutored learner achieved more than 98% of standard classroom learners.
(Normal distb.: 68.2% within +- 1 SD of mean;   15.8% above 1 SD;   2.2% above 2 SD.)

In search of what makes a difference

Much of the time I've spent looking at theories of the LTP (Learning and Teaching Process). Now I'm trying to apply the Unix rule and Bloom's paradigm for educational research seriously. Where are the big gains to be had?

To advance theory, finding unexpected effects and working to explain them is the way to go. For example …

An example of a non-priority

The mind-boggling papers showing that where a student sits in a lecture theatre <u>causes</u> a difference in their final course mark.
Perkins & Wieman (2005). Random assignment of seat position.
Mean final grade of each group "on the edge of significance" but bigger effect on top 20% and bottom 10% of marks; and on attendance.
Griffith (1921) is similar. About 10% mark difference between back and middle of the room.
(But Kalinowski & Taper, 2007 found no such effect.)

This is amazing, worrying, and interesting. But the effects are not very big: this is not a bottleneck, significant as it may be for theory.

In search of what makes a difference (2)

So: never mind advancing theory: what is most likely to <u>make</u> a difference, rather than to describe and explain what goes on?

So a first clue is to scan the literature for the biggest demonstrated effects (improvements in learning outcomes). The bulk of this talk is a tour of some truly big effects in education, starting with the least and working up.

But first: do teachers even make any difference anyway?

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Part B:

Do Teachers make a difference at all?

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Effect no.1:
Learning not organised by teachers

Allen Tough, a Canadian researcher active in the 1970s, (http://allentough.com/) looked into:

How much learning adults did:
90% had done at least one project in the last year
Average 5 projects per year
Average hours per week: 10

How much of it was independent of courses and teachers (about 4 out of 5 projects).

But also notable is that almost no-one at first said this: they actually didn't realise that this was serious learning, and largely self-directed and self-managed.

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Allen Tough's Adult learning projects (2)

Definition: any period of time in which your primary motivation (over 50% of the motive) is to gain and retain knowledge and skill.

(N.B. very many of these are for practical reasons, but you pursue the eventual practical end through spending time first directed at learning.)

Spend a few minutes writing this down (then we'll do some sharing):

How many such projects have you done in the last year? Start writing down the ones you can remember; and if possible, a guesstimate at how many hours altogether you spent at it.

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Allen Tough (3)

Tough and his followers have found a similar pattern in samples from age 16 to 60.

Clearly people have no trouble doing learning, nor in managing their own learning, and more often than not do not find organised teaching (courses) the most useful for their purposes. LifeLong Learning is not new, and doesn't seem to need help.

Most of the literature turns its back on this;
Just as drug companies might prefer you not to compare the effect of their drug with the effect of giving no treatment at all.

=> Theme A: Learners learn a lot without teachers. And we want them to, don't we?

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Aronson's Jigsaw classroom

The basic idea is student-generated content applied in a big way. Teachers do NOT play the role of subject matter expert, but focus on teaching how to learn.

Many have applied this e.g. Betty Collis
Ann Brown has applied it in US middle schools to great effect
Ann Brown's work inspired me to do something similar in my PosPsy L4 option.

A class with 70 people digging their bit of the mine, and sharing it, is going to learn a lot more than when only one person does that.

So Teachers do still have a central role, but not the traditional one. Still, back to more traditional views …

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Part C:

Role 3 for Teachers:
Delivery / implementation / execution

The "Dr.Fox" experiments

There have been experiments on whether lecture delivery skill made a difference to learning.
Hired an actor; fixed the script; had it delivered with high or low "expressiveness".
But also, tried it on 2 groups: students who expected to be tested, and students who did not.

If they thought they had to learn it, it made a difference to their ratings of the lecture but not to their learning (test scores);
If they thought they didn't have to learn it, then the well delivered lecture caused higher learning.

So in HE, student will power overrides teacher delivery lack of skill. Good delivery is good professional practice, but it isn't a bottleneck to learning.

Neo-Vygotskian arguments

There is another type of "delivery" that may be important, but I haven't seen direct evidence about it: being interactive, shaping what you do in response to the learner's last action.

The real role of a tutor: not marking work nor being a walking FAQ repository, but doing pair programming with a student, …

Delivery type 1: Exposition
Delivery type 2: Contingent tutoring: doing something different depending on the learner's response. *[Theme B]*

Kinds of "delivery"

In interacting with the two founders (one of them an ex-schoolteacher) of a young company producing EVS equipment, I got two shocks to my tacit assumptions about EVS, talks, …

A. (When we said they must support powerpoint for HE customers) "Why would you want to give a slideshow?"

B. How teachers actually really do re-use of colleagues' good teaching.

Challenge A: Slideshows

People use ppt to pre-plan the sequence of their talk
The worst just read out their slides
Most use the slides as planning prompts and then ad-lib from their heads about them.

For workshops, people plan say 3 activities; produce paper materials for the activity e.g. discussion, and report.
They have a plan, but ppt is useless for representing it.

What is the same is:
•The existence of a plan;
•The preparation of some materials
•But much remains only in the head of the presenter.

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Slideshow

Narrative

Transmission

Telling

HE

Slideshow	Palette
Narrative	Learning by Exploration
Transmission	Constructivism
Telling	Teaching
HE	Schools

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Challenge B: re-use

How teachers actually re-use colleagues' good teaching.

Do they want to borrow:
- The slides? No, they want to steal the …
- Learning activity? But actually even that doesn't do it ..
- The stored resource: Yes.

They want the general idea/resource, but to set their own activity and questions based on it.

N.B. This is after all how HE people re-use textbooks.

⇒ This implies that good teaching is not just exposition; it may not even be designing activities; but the dynamic deployment of activities depending on the audience's responses.
⇒ (Theme B: contingent tutoring.)

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Plan   **Action**

Decisions

Presentation   Delivery

External storage → Human memory

Storage

N.B. in HE → facts in the head, activities carefully pre-frozen.

In schools → activities/occasion dynamic, facts and visuals frozen

So "delivery" may include dynamic replanning of the "activity design" ….

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Part D:

Role 2 for Teachers:

Learning activity design

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Learning activities

Most of the education literature is about the effect of differently designed activities on learning. Designing these is a second, different role for teachers (than delivery / execution of these activities).

Here are some massive published gains from changing the design of the learning activity.

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Hake

Hake (1991): "The results [course feedback] showed quite clearly that my brilliant lectures and exciting demonstrations on Newtonian mechanics had passed through the students' minds leaving no measurable trace. To make matters worse, in a student evaluation given shortly after the exam, some students rated me as among the worst instructors they had ever experienced at our university. Knowing something of the teaching effectiveness of my colleagues, I was severely shaken."

So he went looking for better ways to teach physics …..

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Hake's survey

Hake (1998) published a survey of 62 courses (6,542 students) all studying the same subject, all using the same standardised test, and using it both pre- and post-.

He graphed the mean gain on each course against whether or not it had used the method of "Interactive engagement".
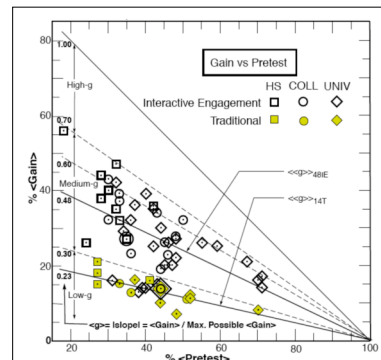
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Hake's results

Fig. 1. %<Gain> vs %<Pretest> score on the conceptual Mechanics Diagnostic (MD) or Force Concept Inventory (FCI) tests for 62 courses enrolling a total N = 6542 students: 14 traditional (T) courses (N = 2084) which made little or no use of interactive engagement (IE) methods, and 48 IE courses (N = 4458) which made considerable use of IE methods. Slope lines for the average of the 14 T courses <<g>>14T and 48 IE courses <<g>>48IE are shown, as explained in the text.
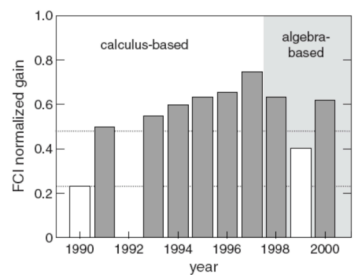
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Mazur

Crouch & Mazur (2001) published an analysis of 10 years of Mazur's MIT course.

Again, the standardised pre- and post-test.

He concludes he has doubled the amount of learning, but the graph suggests that really, he tripled it.

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Mazur's gains

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The learning design

So more effective teaching can be achieved.

"Interactive engagement" and "peer instruction" revolve around asking students questions. These may be presented using Electronic Voting Systems (EVS).

But what kind of questions? Brain teasers.

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Brain teaser questions

The point is to provoke debate, internal and between peers.
Cf. Socratic questioning, and "catalytic assessment"

Remember the old logo or advert for Levi's jeans that showed a pair of jeans being pulled apart by two teams of mules pulling in opposite directions. If one of the mule teams was sent away, and their leg of the jeans tied to a big tree instead, would the force (tension) in the jeans be:

- half
- the same
- or twice what it was with two mule teams?

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Mastery learning scores

Summative achievement scores   Mastery learning scores
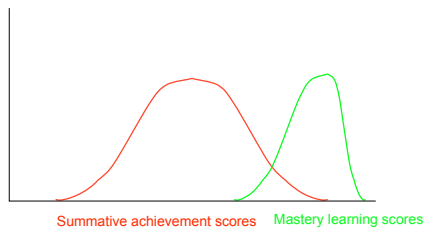
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Mastery Learning: the method

- Telling the students not to interpret formative tests as ability measures
- Giving them highly specific suggestions about how to improve, and the occasions to act on this.
- Showing confidence in them, based on most of the class succeeding
- Giving them the experience of success on objective tests
- I.e. basing assertions on evidence not empty words

One feature was that the first and original aim was to change the mindset teachers have about learners: to convince them that almost all learners can succeed, and that exams are NOT there to label student performance as a measure of capability.

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Part E:

Role 1 for Teachers:

Learning content design / Curriculum design

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The final case from the literature has the biggest effect.

It isn't about delivery or a clever activity, it is about a change in <u>what</u> the learner is given.

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Creating knowledge: Chick sexing

To be learned: sexing day old chicks (for the egg industry)
Viewed as an implicit skill: some people could do it, but couldn't tell you how to do it yourself.
Training used to take 6-12 weeks to get a person up to speed and accuracy for useful employment. Method was loads of practice, feedback from an expert.
Then researchers worked on creating an instruction leaflet (pictures, some text). Trainees learned more in 1 minute from the leaflet than in the previous 6-12 weeks.
This is an improvement of about 26,000 times.

So discovering the knowledge, articulating it, and expressing it in a leaflet can be very valuable: one role of a "teacher".

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Chick sexing

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Interpretation

When I presented this to my education option class, they said it was training not education and they didn't see it as relevant for HE. But …

- It is about representation: and about articulating what was tacit
- A minimal manual for chick sexing
- The leaflet turned out to be more powerful than hands-on practice and personal tutoring.
- I've started to have some success with exercises of my own that try to make explicit the skills our graduates need e.g. critical thinking.
- Our culture, science generally, fails to give credit to improved representations of knowledge even when very important:
  - Calculus notation
  - Maxwell's equations in Cartesian notation vs. div and curl

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Part F:

Selective teaching

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Intro

This section is about:

1. How explicit teaching of traditionally implicit disciplinary practice may cause big gains (one possible generalisation of the chick-sexing case?)

2. How a highly selective allocation of teaching effort (to material) may pay off. This is curriculum design of a kind.

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Outline argument

- Psychology's **anomalous 2009 NSS result**: 5th best of 107 in the UK on overall course satisfaction, 101st on feedback.

- Most of the value of feedback is in helping learners to understand **core assessment criteria** e.g. critical thinking. These difficult criteria are core to, and definitive of, the specific discipline. ("CDCs")
- **The dept.'s course** gives little feedback, but much feedforward, focussed on procedures, and specifically on CDCs.
- **A 2nd course design** in another discipline has outstanding results, appears different, but actually has similar features.

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Rank	Qu.	Qu.text
1	14	Any changes in the course or teaching have been communicated effectively.
2	15	The course is well organised and is running smoothly.
5	22	Overall, I am satisfied with the quality of the course.
8	6	Assessment arrangements and marking have been fair.
8	11	I have been able to contact staff when I needed to.
8	16	The library resources and services are good enough for my needs.
11	13	The timetable works efficiently as far as my activities are concerned.
16	1	Staff are good at explaining things.
		<other question items>
35	5	The criteria used in marking have been clear in advance.
		<other question items>
54	7	Feedback on my work has been prompt.
79	9	Feedback on my work has helped me clarify things I did not understand.
101	8	I have received detailed comments on my work.

Core disciplinary assessment criteria

In my dept. by having major coursework focussed on the most difficult criterion ("being critical") was part of this. And by having them spend 3 months, rather than the 60 minutes of an exam essay, allowed more focus too.

But I've had promising results from a 5 minute version too: I.e. the radical change in time scale can also help focus on the criterion by changing context.

Reciprocal peer critiquing using the "criticality" criterion also may help here: I.e. exercising the same criterion as a reader-critic as well as as an author.

All of this could be done for other criteria e.g. spelling, reading recent not old literature, etc. But you wouldn't expect the same rewards. This is about focus, not universal tips/approaches to feedback.

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CDC (2)

The conclusion I'm coming to is that feedback effort on a course should NOT be evenly distributed (as you would expect if you believe that feedback is generally necessary for learning), BUT should be extremely selectively targeted on:

a) Procedural knowledge (not declarative, conceptual knowledge)

b) Core disciplinary assessment criteria (CDC) e.g. critical thinking

I.e. CT is a criterion in the exams (in all assessment); it is crucial to "being a psychologist" I.e. demonstrating thinking like a psychologist; it is the hardest thing for a student to learn; it is where the bulk of both student and staff time is invested.

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Part G:

Conclusion

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Teachers making a difference

Teachers clearly can make a big difference to learning;
but not in the way almost everyone automatically thinks almost all the time. It is mostly not the face to face contact ….
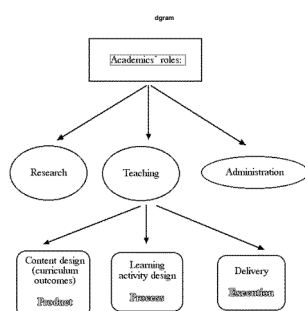
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3 roles of teaching

(Academic jobs are typically expressed as having 3 kinds of work: Research, teaching, administration.)

But in fact, teaching has 3 facets.
And a person might be excellent at one, yet rubbish at another.
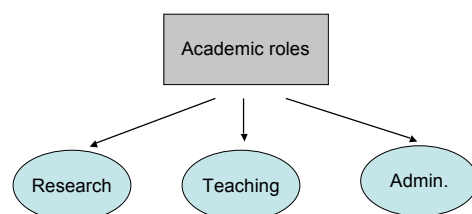I.e. good teaching is not a single thing

1. Knowledge selection and expression. (The biggest recorded effect; but not easy to see how to generalise it.)
2. Designing learning activities. (The most published research; some of it with big effects.)
3. Delivery e.g. lecturing, facilitating discussions. (Not a bottleneck in practice.)
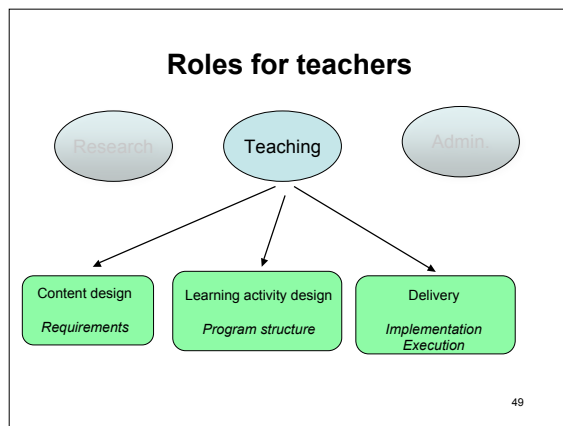
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Academics' roles:
Research — Teaching — Administration
Content design (curriculum outcomes) Product — Learning activity design Process — Delivery Execution

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Roles for teachers

Academic roles
Research — Teaching — Admin.

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Roles for teachers

Research

Teaching

Admin.

Content design

Requirements

Learning activity design

Program structure

Delivery

Implementation
Execution

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A place to stop

For the slides, references, etc. see:
http://www.psy.gla.ac.uk/~steve/talks/troles2.html

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