A9 The Sciences of Learning and the Practice of Teaching

- guyclaxton
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There is much argument about learning, the practice of teaching and the purposes of education. Here is a handy "crib-sheet" of some of the areas of contention and misunderstanding.

1. There is no single agreed 'science of learning': that's why senior academics in the field like myself are typically styled Professors of the *Learning Sciences* plural. The Learning Sciences constitute a hybrid discipline comprising experimental psychology, social and affective neuroscience, cognitive anthropology, developmental psychology, robotics and AI, neurology, systems theory, sociocultural studies, embodied cognition, philosophy of ethics and epistemology, school-based research and many others. Empirical studies of schools constitute one small corner of this territory. What is broadly termed 'cognitive science' comes in many shapes and forms: there is no generally accepted core of knowledge that is 'the science of learning'.

2. The subfield of cognitive science called 'information processing', which sees learning as a purely intellectual activity framed in a language that talks about the *storage* in *memory* of *information* in the form of *propositions*, is on the way out as a field of academic study because it takes no account of the neurodynamic, attitudinal, social, emotional, embodied and cultural factors that play a major, if often invisible and unsung, role in every moment in every classroom. Its root metaphor of the mind as computer is flawed and misleading. The simple computer-based model of Working Memory and Long-Term Memory was formulated in the late 1960s and is long past its sell-by date (except apparently in dwindling bubbles of cognitive and educational psychology). Much of relevance to education has happened since then, and it opens up quite different lines of thought about teaching and learning.

3. Science cannot tell you what you *should* do; that is the realm of philosophy and ethics. It can only tell you what is possible *given certain values and aims*. To claim to deduce an *Ought* from an *Is* is a schoolchild error. Cognitive science steadily improves on common-sense assumptions about the mind and the way it learns.

4. A particular case in point is the idea of 'cognitive load theory' (CLT) which derives from information processing psychology. The primary aim of CLT is to explain why some students find learning some things hard, and to derive teacher actions from this explanation. There are a host of reasons why a child is apparently struggling with a particular learning task, that may reflect preoccupations with emotional matters in or out of school, lack of interest, the 'work' being too easy and boring, or its difficulty (for a particular class) being misjudged, the desire to appear rebellious to peers, and so on. To leap to narrow cognitive explanations without taking account of these and many other possible factors, is unjustified and unhelpful.

5. It follows that there is no such thing as 'good teaching', only teaching that is good for certain purposes or outcomes. For example, if all you are concerned about is scores on relatively superficial tests of understanding , then there is a good deal of research that

shows that explicit or didactic teaching – that which maximises Explanation (by teachers) and minimises opportunities for Exploration (by students) on the grounds of 'efficiency' – is perfectly good. If, however, you also value (note: in addition to, not instead of, 'knowledge') the cultivation of essential character strengths such as curiosity, independence of mind, mental agility, imagination, judicious scepticism, skilful collaboration, or intellectual humility, then different kinds of teaching are needed. Indeed, relentless 'explicit teaching' may well stunt the development of such valuable strengths.

6. Any kind of teaching can be done 'badly'. Explicit teaching can be dull and disengaging, just as inquiry-based teaching can be unfocused or pitched inappropriately. As Karl Popper pointed out long ago, it is intellectually lazy to promote a 'good' version of one by attacking a 'weak' or caricatured version of the other. In reality, the craft of teaching mostly involves a shifting mixture of both explanation and exploration, depending on a whole variety of factors (prior knowledge, subject, purpose, age, aptitude, mood etc) to which good teachers are sensitive and responsive (see John Hattie's work). To try to mandate a single template is bad education and bad science.

7. The distinctions between "biologically primary and secondary knowledge" and "novices and experts", which are often used to justify a didactic approach to high-school teaching, are specious and betray an extraordinarily simplistic view of teaching and learning. Different kinds of learning abound and differ in a host of ways. Learning how to drive a car, sing a Mozart aria or bamboozle parliament are not "biologically primary" but cannot be achieved by didactic teaching. Deeply understanding differential calculus is not the same as being able to perform certain calculations correctly and neither of these simply depends on having "stored information in long-term memory". Novice and expert are not distinct categories but denote different stages along multiple dimensions of learning. To try to base whole systems of education on such binary nonsense is profoundly misleading.

8. In general, polarising and opposing Black and White versions of teaching simply betrays a lack of familiarity with the vast amount of high-quality hybrid and nuanced "dispositional teaching" that is already happening in many states and many countries. To attempt to trash these innovations through dogmatism, cherry-picked research, and wilful ignorance is sheer vandalism.

9. Part of the problem is that some of those who peddle these oversimplifications have no training and little standing in the wider world of cognitive science. (When I spoke to my old friend Alan Baddeley FRS, CBE, godfather of "working memory" research five years ago, he had not heard of "cognitive load theory" and didn't much like the sound of it. The model often relied on by CLT proponents is a travesty of the research-based complexity of Alan's current model.) A little knowledge is indeed a dangerous thing.

10. Much CLT research derives from work on high school maths and science teaching. These subjects are not valid prototypes for other subjects on the curriculum nor indeed for the many wider forms of out-of-school learning.

11. Another part of the problem is the gullibility of educators in the face of authoritative claims to scientific warrant. Teaching is a subtle, complex, intuitive and responsive craft, and it is entirely understandable that teachers may often feel a little insecure about their own styles and methods, and therefore hungry for a solid-sounding rationale on which to pin their practice. To exploit this vulnerability is despicable.

For further reading see:

- Guy Claxton, *The Future of Teaching and the Myths that Hold It Back*
- Stanislas Dehaene, *How We Learn*
- Alison Gopnik, *The Gardener and the Carpenter*
- Bill Lucas and Guy Claxton, *New Kinds of Smart*
- Kirke Olson, *The Invisible classroom*
- David Perkins, *Making Learning Whole,* and *Future Wise*
- Ron Ritchhart et al, *Making Thinking Visible*
- Yong Zhao, *What Works May Hurt*