Learning from Experience and Teaching by Example: Reflecting Upon Personal Learning Experience to Inform Teaching Practice

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ABSTRACT: Part of the folk wisdom of teaching is that one only really comes to understand a subject when one has to teach it to others. This article considers the ramifications of such a 'simple truth'. Three key questions are explored: Why should preparing to teach provide such effective learning?, What does this suggest about the way teachers should organise learning in classrooms?, and Why does school learning not seem to reflect the conditions of learning that teachers found so effective? It is suggested that teachers should do more to recreate the circumstances surrounding their own intensive learning experiences for their students. A motto might be: 'teacher, teach thyself, and then teach others by your example'.

KEY WORDS: teaching, learning, teacher development, autodidactism, metacognition

Teaching is a contrary business. It can be a source of intense satisfaction and also of deep frustration. Good teachers are highly skilled - and yet teaching is one of the most natural human activities in the world. Teaching is an interactive process: which requires great sensitivity and flexibility from its practitioners so that they can respond to their pupils in real-time: yet we also expect teachers to have prepared highly structured and detailed advanced plans for their lessons.

Perhaps it should not be surprising then that this contradictory vocation is both highly complex and yet often reduced by practitioners to 'simple truths'. Teachers' craft knowledge includes simple heuristic rules (such as 'tell them what you are going to tell them, then tell them, and then tell them what you have told them', and 'be firm for the first few lessons, then when you've established the ground rules you can ease up'). One of those 'simple truths' that many teachers acknowledge is that *they only <u>really</u> learnt their subject, when they had to teach it.* Yet, although most teachers seem to accept this to a greater or lesser extent, it does not generally seem to have much influence on how they set out to help others learn.

Perhaps a cynic would explain this in terms of *the perceived purpose* of learning. This argument would be that different purposes require different types of learning: the teacher needs to

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understand the subject matter in case a pupil asks a difficult question, but the pupils only have to know how to answer in the test. However, most teachers do want their pupils to *understand* the central ideas of their subject. Indeed not only teachers, but many learners will acknowledge that understanding the material is a useful way of producing the 'right' answers in the test, as well as being a valuable goal *in its own right*.

So I would like to explore the possible consequences of the two propositions, that:

a) *teachers want to help pupils to understand their subject*;

and

b) *in many teachers' own experiences, deep understanding did not derive from learning in class, but from preparing to teach a class.*

The logical next stage would seem to be something like:

c) teachers need to create for their pupils a similar learning context to that they themselves experienced when preparing to teach a subject.

Yet when we observe what actually happens in most classrooms (or lecture rooms) there is limited evidence that most teachers take this step. As I am confident in proposition (a), and know from personal experience that (b) contains *at least* a kernel of truth, I feel it is worth asking why we see so little teaching which tries to recreate the conditions that the teacher herself found so fruitful in her own learning.

THE REALITIES OF CLASSROOM TEACHING

There are at least three potential *key* reasons why teachers may find it difficult to follow such an approach. Firstly, teachers have to manage and control a relatively large group of learners, and this aspect of 'teaching' puts severe constraints upon what practitioners can try to do. (Of course this is a more significant obstacle to a creative approach in some schools than others, and with some teaching groups than others.)

Secondly, there are the expectations of other teachers: being inducted into the profession, or into a new school, may be seen to be - at least in part - about fitting in with the norms of that social situation. A new teacher has to appear to behave in the ways that both pupils and other teachers expect a teacher to behave. The model for what is expected will not *only* be based on the limited knowledge of the particular school, or on the more extensive experience of undertaking teacher preparation courses, but to a large extent on the many formative years the teacher herself spent in school learning what it meant to be a pupil and to be taught.

Finally, and quite rightly, the teacher will recognise that the pupils to be taught are at a different level of maturity than the teacher preparing to teach a topic. This is true in terms of intellectual development, as well as in a more general sense (e.g. Donaldson, 1897).

Now these factors are very significant, but they do not exclude the possibility of the teacher analysing her own experiences of learning, and seeing whether there are 'lessons to be learnt': to see if there are features of those intense periods of effective personal learning that can be transferred into a classroom teaching context.

Now undoubtedly one of the central factors to be considered must be motivation. There is surely no greater motivation for mastering a topic, than the thought that one might be caught out by a class of cheeky 14 year-olds who ask some questions that the teacher was not expecting - unless it is perhaps the exhilaration of recognising success in moving a class towards greater understanding by a carefully crafted exposition! The teacher cannot automatically expect *the*

pupils to have this level of motivation. Indeed, the teacher is clearly someone who values schooling, where some of the pupils may not. The specialist teacher also has a particular interest in the subject being taught, whereas in most classes there will be a range of interest levels. However, it is part of the teacher's role to motivate the pupils and inspire their interest, and - as many teachers will recognise - that often has as much to do with the teacher's relationship with the class and individual pupils, and with *their* interactions with each other, as with the subject matter itself. (The teacher's job has always included a certain amount of coercion and sleight-of-hand.) Perhaps more significantly, the classroom *activity* is at least as important in maintaining interest as any inherent fascination of the subject.

Activity is indeed a central issue. One of the main characteristics of effective learning is the active engagement *of the learner's mind*. This may sometimes be accompanied by obvious external signs of activity: but there is no necessary correlation. Many very enjoyable science practical sessions involving a great deal of physical industry lead to *minimal* learning of the scientific principles that the teacher thought were the target of the activity! Often the pupils are busy, industrious and engaged in the practical activity without any clear conception that the activity is meant to illustrate some key scientific idea.

Conversely, pupils sitting quietly and listening to their teacher *could* be actively and effectively processing the teacher's explanations, and expanding their conceptual horizons (cf. Millar, 1989). Of course, it is also possible that they are thinking about something totally different, as the words just stream past them like some sermon attended out of obligation rather than interest.

The key to conceptual learning, then, is active and effective processing of information, regardless of the classroom activity during which it occurs. However, in order for the teacher to know whether such processing is occurring, she needs a window into the pupil's mind. Although the common public conception of assessment in schools is in terms of tests and examinations, most teacher assessment of pupils' understanding takes place through everyday classroom work. In particular, teachers habitually question their pupils. Some teachers' questions are like normal questions that anyone might ask - genuine requests for information (Joanne, where were you last lesson?, Simon, have you finished your homework on time this week?, Has anybody seen the board rubber?), but many are not like normal questions.

The questions teachers use when in their teaching mode (as opposed to their administration and classroom management roles) are not designed to find the answer to the question posed: the teacher already has that information, and is trying to elicit the extent to which the pupil also holds that knowledge, understands a key point, or has made some relevant connection. Both teacher and pupils are aware that the teacher already knows the answer, and is testing whether the pupils do (e.g. Edwards & Mercer, 1987). Similarly, in those situations where a pupil responds with 'you should know, you're the teacher', both the teacher and pupils know it is not usually the teacher's subject knowledge being questioned, but rather their authority to direct the class that is being challenged!

The teacher, then, needs to encourage *the active and effective processing of information*, as this is how learning takes place. The learner, *and no one else*, can construct a better understanding of a topic, by developing their understanding of the meaning of concepts and the relationships between them. The teacher knows from her own most intense learning experiences that this is a personal activity: something that occurs within the learners' head. Luckily evolution has equipped us with the appropriate cognitive apparatus to make such learning possible: we are all

autodidacts in some sense. As Rosalind Driver pointed out, young children naturally behave as scientists, drawing conclusions about the world in which they live on an empirical basis (Driver, 1983). However, as the conclusions that they draw from the data sometimes readily illustrate, they are often rather shabby scientists who do not look to falsify their ideas, and are happy to make *ad hoc* assumptions. Evolution has given us the apparatus to create knowledge of the world individually, but it has also provided the social institutions which enable us construct somewhat more reliable models of the world, and how to learn about it, that we can communicate to each other, and develop collectively (Ziman, 1991).

The teacher knows that by the time she had the maturity to direct her own learning *effectively* she had been exposed to many years of formal education which provided both a close familiarity with the nature of the subjects being studied, *and* opportunities to develop the metacognitive tools needed to take control of the learning process: to set goals, to plan strategies to reach learning targets, to evaluate one's own learning, and to use that information to modify the goals, the plans and even the assessment tools as appropriate.

For just as evolution has equipped us all to be learners, it has also primarily fitted us for the role of *learners from others*. Through most of human evolution we learnt by an informal apprenticeship within our mixed-age social group, gradually developing skills in real-life contexts with genuine motivation (e.g. Mithen, 1998). We should not over-romanticise this 'natural' learning context: we can imagine what the equivalent of 'D minus' is when the real-life test is hunting, escaping from a predator, or foraging away from the group. But by 'survival of the fittest' we evolved into a species that was efficient at learning in such social settings (Geary, 2007): not in large groups of similar age novices, being taught in a clinical context by someone who only forages in the supermarket (and usually has a similar second hand experience of most of the areas of the curriculum being taught).

The school system is convenient for most people, and is a fairly effective way of socialising young people in an urban post-industrial society: but is hardly an ideal way to teach disciplinary subject knowledge. At the beginning of this essay I suggested that teaching was a *natural activity* for human beings: we only have to see how virtually all parents (whatever their level of 'general intelligence' or particular skills) are effective at passing on many of their nemes - sadly sometimes including bigoted values (Blackmore, 2000). However, the issue is not whether one can teach: but whether one can *teach effectively in the clinical setting of the formal school or college*.

FOLK PSYCHOLOGY AND EDUCATIONAL PSYCHOLOGY

To be successful in this task, the teacher needs to appreciate something of how our cognitive learning apparatus works. As of yet, we do not fully understand learning. There is a lot of good work in psychology and increasingly suggestive information deriving from neurology and related fields (the 'cognitive sciences'). Some of this research is not yet directly applicable to classrooms; and - sadly - the psychology of learning often seems to mistrusted by many teachers who often seem to feel it is either blindingly obvious, vague 'psychobabble-waffle', or too theoretical for practical use.

Teachers often seem to prefer to work with a 'folk psychology' approach based more on instinct. This is all very well, but when their pupils bring 'informal' ideas to class (for example, 'intuitive physics' notions of force and motion) the teacher labels these ideas as *misconceptions*, and sets

about trying to extinguish them (Taber, 2006)! Intuitive physics usually works fine in an everyday situation, but does not match the formal presentation of the subject in educational settings, as is required in examinations for instance. By analogy, 'folk psychology' might be appropriate for the elder of a small foraging family group: but perhaps the professional teacher needs something more technical to ensure success in the classroom! (Taber, 2008).

One key part of a teacher's craft is finding the right *pace* at which to present ideas. Even when working within the constraints of a prescribed curriculum, teachers will make executive decisions about what certain groups of pupils are *ready* to cope with. We all know that the human brain can easily get overloaded. We know because all but the real geniuses amongst us have experienced such overload.

Indeed the human cognitive apparatus seems to have a very severe bottleneck (Miller, 1968). The rate at which the human sensory system can collect information is immense, and the capacity of the human memory is *practically* unlimited (in the sense that people have never been found to reach a point when they can no longer form memories except in cases of clinical deficits). This is not the same as saying that we can always remember everything we might wish - far from it - but no matter how much we learn, there is always the capacity to remember more. And yet, at the part of the system where sensory input and memories may be called into consciousness, i.e. the 'working memory space', the capacity is extremely limited. It is known that much *creative* thinking has a subconscious aspect: what the Nobel laureate geneticist Barbara McClintock referred to as 'integrating', but that is of little practical use to teachers (Keller, 1983). Sadly, the approaches reported to be effective by creative scientists: - such as taking a bath, going to the movies, climbing mountains or having a sleep - are not options that a teacher feels comfortable in suggesting to a 'blocked' pupil in the middle of a timetabled lesson! The present author taught a graduate trainee teacher who would excuse himself during classes at the points where he felt overloaded, and go for a short walk in the grounds. I doubt he felt able to offer the same option to his own students when he started teaching in school.

Most of us can only hold a very limited number of factors 'in mind' at once. Perhaps this limitation confers some survival advantage to a species that evolved in the (physical and social) environments of early humans? Alternatively, perhaps early brain development before humans acquired hand and symbolic tools channelled what was possible later? (After all, our ancestors never needed to hold in mind international telephone numbers, or had to plan several moves ahead in chess games.) Whatever the reason (cf. Sweller, 2007), human learning is highly constrained by the limited amount of novel information that can be kept in mind at one time.

The qualification 'novel' is important, because the *perceived* complexity of any learning task varies greatly depending upon the prior knowledge brought to bear. For example, a sports fan who follows Manchester United F.C. is more likely to remember the details of an account of that wonderful goal that Solskjaer scored after Giggs' shot from the half-way line rebounded back from the crossbar, than someone who is not already familiar with the rules of Association Football ('soccer') or the players concerned. The fan already has the conceptual frameworks in place to make sense of the new information. The problem for the teacher is often to re-cognise [sic] the *complexity* of a topic, that years of familiarity have almost converted to tacit knowledge, when perceived 'at the resolution of the learner' (Taber, 2002).

In practice the bottleneck in the human conceptual apparatus is an asymmetrical one: it acts to bias understanding in favour of existing knowledge. We are normally able to *make* sense of what

is said to us: we find a fit between what we have heard and what we already think we know. But, commonly, our understanding only *partially* matches that of the person who spoke to us. The match can be improved by an extended dialogue, or constant transactional calibration, as Jerome Bruner (1987) described it. This is one reason for teachers' talk being peppered with questions: the teacher is checking that the pupils have understood the information *as intended*. The pupil usually knows, and often will say, if they do not understand. The pupil does not know when she has 'understood differently' by interpreting information to have a distinct meaning from the one in the teacher's mind.

Within science education, for example, there are now thousands of research papers that report on what learners of different ages from different countries believe they know about most science topics. Pupils' alternative conceptions of mechanics, electricity, plant nutrition, etc., etc. derive from various sources: interpretation of natural phenomena, linguistic cues (what Hans-Jürgen Schmidt (1991) delightfully describes as the label as a hidden persuader), folk knowledge - and they are also often the result of formal instruction: pupils misconceive the teacher's meaning because they interpret new teaching in terms of their existing understandings.

The importance of prior knowledge to the learning process is *now* probably one of those aspects of the psychology of learning that most teachers feel is blindingly obvious. Yet I have a sneaking suspicion that its progression from learning theory to accepted craft knowledge was helped by David Ausubel's (1968) masterful tactic of reducing his system to a teacher-friendly 'simple truth': *find out what the pupil already knows, and teach accordingly*.

Part of the reason that the cognitive bottleneck biases understanding in terms of existing knowledge is the time delay in laying down permanent memories. Trainee teachers entering school classes are often shocked at the limited amount of new subject knowledge that experienced teachers introduce in a lesson. The teacher knows that it is counter-productive to introduce too many new terms or ideas at once. Unfortunately, as the time required for the laying down of *permanent* memories is of the order of hours and days (and the subsequent process of integrating that knowledge with existing schemes may take months or years!), any one lesson counts, in effect, as 'at once' (Taber, 2003).

The teacher has to make sure that the material to be taught is introduced *slowly* so as not to overload the pupil, *logically* so that the intended connections are understood, and in the context of the necessary *pre-requisite knowledge* already being place, so that the pupils' interpretations match the teacher's as closely as possible.

Given the limited amount of new material that can be meaningfully introduced per lesson, the untrained eye may suspect that much else that goes on in the class is padding, to fill out the time. Even '*telling them what they are to be told, telling them it, and telling them what they have been told*' will only take up a fraction of the class time. But this is one area where the teacher's own experience of being a learner can be valuable in planning classroom activities.

SUCCESSFUL LEARNING INFORMING EFFECTIVE TEACHING

The teacher who feels that she really 'knew her stuff' once she began to teach will have spent a great deal of time interacting with the subject matter - playing with ideas, trying out juxtapositions, developing examples and so forth - in trying to *reformulate* the material for presentation in the classroom. The relationships between ideas were explored and tested, rather than just accepted. The applicability of ideas to new examples, perhaps even contemporary

examples, was examined. The personal conceptual map of the topic was redrawn, certainly internally and perhaps on hard copy as well.

The teacher can use this experience as a guide: to build a lesson around the key new information, and find contexts in which the pupils can explore and test the new ideas, and their relationship with existing knowledge. Most importantly, the pupils can be given challenges in *using* the ideas: in talk, in writing, in designing. The pupils can be asked to create something with the new material, and at the same time be given the opportunity to rehearse the use of ideas that *until recently* were just as novel. Pupils can be asked to justify their work to one another (in pairs, groups or the full class) to provide the sense of audience the teacher found so motivating, and to show that knowledge needs to be seen as something to be used and not just stored away (Taber, 2004). In this way the teacher can help the learners to build up their own knowledge structures, as she did hers.

In a very real sense each learner has to construct their own knowledge, but the teacher can provide the appropriate conditions, and interaction with peers is often an important part of this. By playing with concepts, they become familiar, and by discussing their ideas the pupils gain confidence that their understanding is robust enough for public scrutiny.

Another key aspect of successful self-regulated learning is the level of challenge that the learner sets herself. Forty years ago Jerome Bruner (1960) hypothesised that *any subject could* be *taught effectively, in some intellectually honest way to any child, at any stage of development*. This has the ring of being another 'simple truth', but it should perhaps be viewed more as a challenge to the teacher than a truism. Finding the balance between effective teaching (that the pupil is ready to take on board) and intellectual honesty (that does not distort the meaning of concepts so much as to make the presentation invalid) means identifying an optimum level of simplification (Taber, 2000) for that particular pupil. This requires fine judgement on behalf of the teacher, and assumes the teacher has a good knowledge of the subject matter, the subject pedagogy and the pupil.

As a rule, successful self-directed learners do not waste too much time on tasks that they are clearly unprepared for: and similarly pupils in class will usually let the teacher know when they are completely at a loss. The effective self-directed learner also recognises when a skill or topic area has been effectively mastered, and it is time to move on. In classroom situations, some pupils are quick to report when are bored: but many seem quite content to continue working on tasks well within their capability. This is an area where the teacher's skills need to be finely honed, so that individual pupils are set work that is both achievable and yet still a challenge.

Effective learning takes place in 'the zone' (after Vygotsky, 1986/1934) and the teacher, as a successful learner herself, will have felt the exhilaration of moving beyond what could previously be achieved. There may seem to be a paradox here: how does the autodidact manage to achieve what was beyond them? Surely, it might be thought, the task is either beyond them (and won't be achieved) or was always achievable and hardly a genuine challenge? (This, of course goes back to Socrates's paradox of how the slave boy could be shown to 'know' something he had never learnt.) In practice, the successful scholar is able to show a flexibility of mind that somehow enables the previously unachievable to be restructured in such a way that, when reconfigured, it falls within their competence (cf. Karmiloff-Smith, 1994; Lakoff & Johnson,1980). And once mastered in that form, it can then be dealt with in its original configuration.

Pupils do not usually share the ability of teachers to restructure learning tasks, and so it is up to the teacher to set work such that, by increments, and with carefully structured support ('scaffolding'), the learner can come to achieve something that would have been unachievable before. It is the teacher's role to bring the task to be mastered into the learner's personal 'zone'. Once the task is mastered the zone moves beyond it, to encompass new challenges (Scott, 1998).

A single example (from the author's experience) may illustrate this principle. The particles in some materials - sulphur is an example - are held together by forces (called van der Waals' forces) which are due to something scientists describe as 'transient fluctuating dipoles'. This (as might be appreciated) is a concept that is rather abstract for many learners. In a research interview, a young student, just setting out on a college course, constructed an explanation for how such a material could be held together by these transient fluctuating dipoles (although she did not use that term!) She did not recall ever having been told about, or having read about, van der Waals' forces, but she formed the explanation *in situ*.

Although this concept is one that learners normally find difficult, the series of questions that the interviewer posed acted as a 'scaffold' which led to the student (re)creating this scientific idea. The student knew all of the individual component ideas needed to understand this principle, but there were too many steps in the logic, too many factors to keep in mind, to expect her to spontaneously construct the argument. Yet the interviewer was familiar with the concept area, and by asking the right questions provided an external structure for eliciting the students' knowledge in a configuration that she had not previously explored, thus leading to a new understanding. To borrow another expression from Bruner, the interviewer acted as a vicarious form of consciousness for the student: almost like a plug-in extension card for working memory! The knowledge creation was personal, but it was also intra-personal, supported by the dialogue of the research interview.

TEACHING LEARNERS TO BECOME AUTODIDACTS

This brings me to the final point I would like to make. In ironic contrast to the trainee teacher's shock at how little material is covered in a school lesson, we can juxtapose the bewilderment of new college students who are sometimes stunned at the rate at which new ideas are presented (by necessity rather than choice) when they start advanced level courses: something that usually becomes even more acute in university level study.

Our teacher has somehow survived being taught in schools where little psychology of learning was heeded (or known), and in college and university courses where the rate at which novel ideas arrive cannot be matched by the cognitive apparatus available to process the information. This is because the teacher was an effective autodidact. Success in college and (even more so) university courses requires the learner to see the classes as *resources* for learning, which must largely be made use of at other times (reading ahead of the lecture and/or reviewing the material afterwards). The teacher (when a student) was successful in marshalling lecture notes and other available resources (books, periodicals, tutors, peers...) in order to teach herself.

This teacher also checked her own learning by testing herself as she learnt. The autodidact has to take on the role of self-assessor as well as self-teacher. Progress must constantly be monitored by finding effective ways to ask '*do I really understand that?*', through an internal critical dialogue.

The motto for the present thesis is 'teacher, teach *thyself*, and *then* teach others *by your example'*. If this teacher is working in a school, she can draw on her own experiences of being a successful

learner to help plan the work for her pupils. She will make sure that they process information, rather than just record it. She will provide opportunities to explore, relate and justify, to practice and rehearse, and to extend concepts. She will ensure challenge: but provide a structure that makes the challenge one that the pupil can accept.

However, if that is not enough of a Herculean task, she will also know that as well as providing support, she needs to gradually *withdraw* it. She needs to provide pupils with the opportunity to develop their metacognitive skills: to start to think more deeply about and *to* plan their own learning. She will make sure that the ongoing assessment of knowledge is explicit, and is seen as a key part of the learning process. The questions that have to be fielded by pupils can *act as model* for the type of critical internal dialogue that will be needed when the pupils come to regulate their own learning.

The teacher not only has a responsibility to structure the pupils' learning, but a duty to *enable* the pupil *to learn to take responsibility for directing their own learning*. And as with the subject-specific learning, this learning-to-learn must also be 'scaffolded' carefully so that pupils are set incremental tasks that challenge but do not overwhelm them.

At the moment the formal education system acts like a filter. Those that learn successfully, including the ability to learn to regulate their own learning, can enter such roles in *society* as lawyers, academics and teachers. For many people, schooling may have been enjoyed, and a good deal learnt, but *the actual process of learning itself* remains a mystery. Failure to learn in certain subjects may just be accepted as being 'bad' at the subject or due to having had poor teachers, revision is seen as no more than repeatedly reading the same material over, and scholarship as something best left to egg-heads.

I trust we have moved beyond a time when it was considered dangerous to teach the masses to think for themselves. The next step is to make it a priority of schooling that we should *teach* children *to learn* for themselves. To finish on another 'simple truth', it is said that *education is what's left when you've forgotten everything you were taught at school*. If 'what is left' is the confidence, desire and ability to regulate one's learning, then I would quite happily settle for that.

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