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Constructivism and Direct Instruction as Competing Instructional Paradigms: An Essay Review of Tobias and Duffy's *Constructivist Instruction: Success or Failure?*

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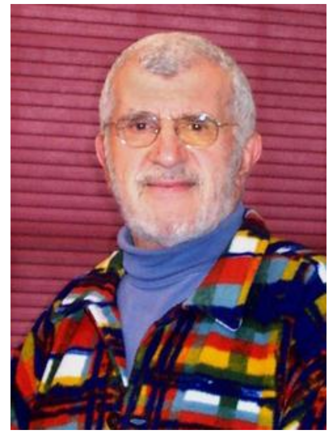
'*Constructivist Instruction: Success or failure?*' (henceforth *Constructivist Instruction*) is a collection of chapters debating the question of what makes for effective teaching, edited by Sigmund Tobias and Thomas Duffy (2009b). The book begins with an introduction written by the two editors. This is followed by three sets of chapters organised as arguing for constructivist approaches; critiquing the constructivist perspective; and exploring a range of issues linked to learning and motivation. Then the two editors offer separate concluding chapters. Most of the chapters are followed by a series of questions and challenges (raised by other book contributors), with responses by the chapter authors. This is a very welcome feature of a book presenting a debate in print. One of the editors describes how "this volume was started to discuss the present status of constructivism, one of the prominent contemporary approaches to instruction" (Tobias, 2009, p. 335).

The Agenda of Tobias and Duffy

Constructivist Instruction could be seen 'at heart' as less a debate about constructivist teaching (which as will be discussed below, is a somewhat fuzzy category), than a debate about the relative merits of 'traditional' and 'progressive' approaches. Yet this is not an empty ideological or purely theoretical debate, as teachers, school boards and even national governments may make decisions about practice and policy influenced by such considerations. So whilst there is a live debate in the US about constructivism and the state of school science (Taber, 2009a), in other countries, such as Turkey, governments are striving to replace what is considered as outmoded and ineffective traditional science teaching by constructivist instruction (Bektas & Taber, 2009) that is considered modern, progressive, and even essential for national development.

Constructivism and False Dichotomies

Tobias and Duffy's volume derives largely from a debate held at the *American Educational Research Association* annual meeting in 2007, that itself reflected the publication of, and responses to, a paper in the journal *Educational Psychologist* suggesting that constructivist teaching approaches were ineffective (Kirschner, Sweller, & Clark, 2006). The title of that paper, "Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching" gives a good sense of the flavour of the debate within the chapters of *Constructivist Instruction*. It also signals one of the major frustrations surrounding the issue: the problem of agreeing what is actually being discussed under various labels. For Kirschner and colleagues, constructivist teaching, discovery learning, problem-based learning, (so



Sigmund Tobias

called) experiential learning (as opposed to?, I wonder), and inquiry learning are all bracketed together as ineffective approaches that collectively provide 'minimal guidance' to learners. These approaches are contrasted to another set of approaches—'direct instruction', 'explicit instruction', 'training with probes', and the like—and the implication is, as one of the contributors to *Constructivist Instruction* suggests, that second category "of instruction is clearly distinct from the broad family of instructional methods associated with constructivist views of learning" (Klahr, 2009, p. 308). A careful reader of *Constructivist Instruction* may be forgiven for being less than convinced about this simple dichotomy.

The debate about constructivist teaching seems to encourage 'false dichotomies.' For example, it has been strongly argued that science educators (who commonly see constructivist teaching in a positive light) adopting constructivist approaches are rejecting the realist ontology at the heart of science, and admitting ('unscientific') relativist thinking (Scerri, 2003). Relativism, the notion that there is no objective way of choosing between competing traditions, or 'paradigms', is generally seen as heretical, and defeatist in natural science.

Thomas M. Duffy

However, there is a strong argument that constructivist *teaching* is better seen as adopting neither positivist nor relativist assumptions, but rather an instrumentalist (yet still realist) approach better reflecting the provisional nature of scientific knowledge in most post-positivist models of science (Taber, 2010b). In other words, science (including arguably the social sciences) should be less concerned with identifying the 'true' nature of reality, which may be an unrealisable quest, than with developing models of the world that are fit for purpose (Glasersfeld, 1989).

For this reader, *Constructivist Instruction* offers arguments that follow a very similar overall pattern of false dichotomies and 'straw men' (i.e. targets set up to be easily knocked down). The proponents of 'direct instruction' attack a caricature of constructivist teaching which is an easy target: vague learning goals, unstructured lessons, open ended student activity, minimal input from teachers, and acceptance that each learner will come to their own unique take on the topic (which may not match canonical knowledge). This 'straw man' is indeed an easy target, but would not be recognised or supported by many constructivists (cf. Taber, 2010b). The constructivist educator would see things differently: as *Constructivist Instruction* demonstrates.

Thomas Kuhn (1970) talked about paradigms as offering communities of ways of thinking about, carrying out, discussing and presenting their work. Scientists working in a paradigm are carrying out 'normal' science – the accepted way of doing things, as opposed to the rare revolutionary science that lead to paradigm shifts. Reading the various perspectives offered in *Constructivist Instruction* seems to offer a paradigmatic example of, well paradigmatic differences, but in the context of 'educational science'. In a sense, *Constructivist Instruction* presents the claims from educationalists working in two competing paradigms, each making a case for why their approach should be the basis of 'normal' educational practice.

Considering Educational Issues in Paradigmatic Terms

Kuhn's account of '*The Structure of Scientific Revolutions*' has been highly influential beyond its original focus on the natural, and especially physical, sciences. Indeed, Kuhn's use of the notion of paradigms (Kuhn, 1974/1977, 1996), in effect comparing scientific traditions with distinct language-games of the type proposed by Wittgenstein (Luckhardt, 1978), has been taken up much more keenly in the social sciences, than among natural scientists themselves (Bailey, 2006).

Tobias and Duffy's volume on *Constructivist Instruction* could then be considered to offer an effective illustration of Kuhn's thesis in the field of educational science. This book may be best understood as a dialogue between adherents of two distinct paradigms, which is something that Kuhn argued was intrinsically difficult, if not impossible. Reading *Constructivist Instruction* gives the impression of two camps, each with different understandings of what learning is; of what instruction is intended to achieve; of how success might be measured; and indeed of what counts as limited or minimal guidance within teaching contexts.

Indeed, seen in this light, it would seem that the attempt to answer the question 'constructivist instruction: success or failure?' was doomed to failure. Certainly, no one reading this book can feel that the debate presented in this volume has been settled. Yet, taking a Kuhnian stance (where such a consensus could not be a realistic aim) the book offers an excellent opportunity to consider the debate, at least for any reader prepared to tolerate the apparent inconsistencies across chapters and to undertake a little deconstruction of the texts. Indeed, even if some of the contributors seem unlikely to agree any time soon, *Constructivist Instruction* does offer the 'neutral' reader indications of how some form of productive synthesis may be built upon the various contributions, and the diverse range of studies cited to support the contributors' positions.

The Debate about Instructional Approaches

Education as an activity is centrally about teaching and learning, and research in education is intended (ultimately, if not directly), to inform teaching (Pring, 2000). Teaching and learning are often considered together, and indeed there is a growing field labelled as the scholarship of teaching and learning (Hutchings, 2007). Yet such associative labelling can lead us to ignore major asymmetries between teaching and learning. Learning can be a spontaneous activity that does not require any intentional teacher. We learn from experience – sometimes deliberately, but often without conscious regard to our own intentions and goals. As Schwartz and colleagues argue in their chapter in *Constructivist Instruction:*

> People can learn by being told; they can learn by observing social models; they can learn through spatial navigation; they can learn through reinforcement; they can learn by exploration; and they can even learn implicitly without any intent or awareness they are learning at all. These pathways of learning engage different brain circuitry.
> (Schwartz, Lindgren, & Lewis, 2009, p. 36)

Teaching however is a deliberate business of trying to impact upon learning (by, to some extent, controlling or modifying learning experiences). One might be a 'teacher' who engages in professional activity labelled as 'teaching', but unless learning occurs, one is not really *teaching* in terms of the primary meaning of the term. Indeed, in normal usage, a teacher is not considered to be doing the job of teaching *unless* what is learnt reflects to some extent a specified curriculum that has been set out as target learning.

What we find, of course, is that whereas most individuals are relatively effective learners in many informal settings, attempts to teach prescribed curriculum in formal educational settings are usually only partially successful (Geary, 2007). Students of all ages and levels only remember part of what 'they are taught', by any generally agreed criterion for evaluating learning. The new personal knowledge that students develop can be considered only as a *partial* reflection of the target knowledge set out in the curriculum: they remember some things and not others; and some of what they acquire is (when evaluated by canonical standards) an impoverished and distorted view of what was intended (Taber, 2009b).

Learning is a complex and only partially understood set of processes; and, indeed, it is not always clear when it is best understood at different levels, e.g. in terms of neuroscience, individual mental models, group dynamics, institutional and cultural structures and so forth). As Jonassen (2009: 14) comments in *Constructivist Instruction*, "learning is complex and multidimensional and cannot be understood from a single perspective."

Humans are complicated beings who share learning goals with their teachers and educational authorities to different extents. It seems highly unlikely that teaching will develop into an exact science capable of facilitating highly accurate learning of target knowledge any time soon, if indeed ever. Yet most of us who work in the system, especially those with considerable experience as classroom teachers, tend to retain a strong commitment to a view that (even allowing for the need to be realistic about what might be *possible*) teaching is often in practice far from optimal, and there is usually much potential for further research to support improved practice (Taber, 2009b, Chapter 7).

The Nature of Educational Science

Given this, educational science is welcome. As teachers, we tend to seek development that will help us become better teachers, so that we can better support the learners in our care (whether they be pre-school children or new post-doctoral appointees). Yet we also tend to retain healthy cynicism about what educational 'science' can actually offer, given the challenges outlined above. Despite this, we certainly do want to know ideas are supported by research evidence before we invest in major changes in our practice. Indeed, we may well want a lot *more* than just knowing that research supports particular ideas.

As practicing teachers, we remain highly aware of the differences—for example between students and between educational contexts—that may limit the value of fundamental of generalised advice. We often suspect, based on our own varied experiences of teaching outcomes, that it is less a matter of 'what works', than 'what might work here, now' (e.g. Taber, 2007, Chapter 6). That is, there may not be 'a' best way to teach 11 year olds about world religions, or 16-years-olds about evolution by natural selection.

Such a view may colour considerably the kind of educational research evidence we take seriously in informing our own classroom practice. Indeed, it could be claimed that prior commitments, perhaps paradigmatic commitments (of the kind Kuhn assigned to researchers in particular traditions), can lead to us interpreting the same research evidence in very different ways.

Two Contrasting Educational Research Paradigms

There are a variety of different ways of going about collecting research evidence in educational studies, but there is a commonly recognised distinction between two broadly different approaches, which reflect rather different notions of what educational research can find out. As these are to some extent themselves caricatures, it may be appropriate to simply refer to them as educational research paradigms (ERP) 1 and 2 (Gilbert & Watts, 1983). ERP1 is basically a positivist (and often broadly experimental) approach, which considers it relatively straightforward to develop useful operational definitions of factors of interest, and then to design experimental tests to answer educational questions (Taber, 2007). Such approaches may seek to undertake comparisons between experimental conditions and carefully controlled conditions (everything kept the same, except…); or more realistically to collect data from large enough samples to be able to use statistics to be confident that differences in outcomes are (highly likely to be) due to the intervention and not due to the 'noise' in the system. The assumption is that there can be enough commonality in educational episodes and contexts (commonality that may be across learners; classes; classrooms; teachers; institutions; topics; subjects; age ranges, etc) that it is meaningful to try to explain educational outcomes in terms of readily discriminated, identifiable and quantifiable factors).

ERP2 takes a less optimistic (or simplistic, depending upon which set of commitments are being adopted) view of what it is possible to determine from research. This approach tends to consider the complexity and variability in educational contexts as too great for positivist assumptions to apply, and so tends to work with enquiry approaches that seek to understand particular examples of educational phenomena that are studied and reported in depth, and interpreted as far as possible in their own terms (rather than in terms of externally imposed constructs). Often such studies are concerned with how people (teachers, students, etc) actually perceive educational contexts and experiences, rather than attempting to determine 'how things are' in some absolute sense. Such approaches tend to seek to offer examples which do not claim generalisability or direct transfer to other contexts: rather they provide an account that may offer resonances to those working on other contexts, putting the onus of 'reader' generalisability on the user of the research who uses the rich description of the case to judge how similar the research context is to the teaching context where the research might be applied (Taber, 2007).

It is worth reflecting upon this difference, which offers a useful perspective for reading the chapters presented in Tobias and Duffy's volume. Advocates of EPR1 may well consider that those who base their work in EPR2 are at best defeatist; or simply fail to understand the nature of experimental research, or the power of the statistics now available to support such enquiries. Conversely, advocates of EPR2 may see the situation very differently: they are certainly not defeatist, but rather than waste time on expensive technical studies, that can offer little meaningful advice in real teaching contexts, they focus on what is possible and so can be genuinely useful to practitioners.

Kuhn considered that full communication between the advocates of different paradigms was in principle impossible: that such paradigms were 'incommensurable'; indeed that the paradigm in which we work, in effect, partially determines the world we inhabit (i.e., such mental frameworks determine how we perceive and experience the world, cf. Dewey, e.g. see Biesta & Burbules, 2003). So, according to Kuhn's model, a phlogiston theorist was never going to agree with an oxygen theorist on how to best make sense of chemical reactions (an example that is supported by Thagard's 1992 analysis using the notion of explanatory coherence); geocentric and heliocentric worldviews each made good sense in their own terms; and that after Einstein's theories of relativity were published and accepted (and even more so after quantum theory became widely accepted) the world in which the physicists worked had in a very real sense changed.

Extending this to education might suggest that positivistic and interpretive researchers are never going to agree on the most useful basis for educational research. At best they will talk across each other, missing each other's arguments, failing to appreciate each other's fundamental starting points, and concluding that their opponents are ill-informed, deluded or simply irrational. Many debates between adherents of different political perspectives—free-marketpromoting-conservatives versus welfare-state-supporting-socialists—have exactly these qualities. And readers of *Constructivist Instruction* may well conclude that supporters of constructivist and 'direction-instruction' approach to teaching are caught in a similar activity of talking past each other.

Of course, not everyone agreed with Kuhn's analysis. Popper referred to Kuhn's notions on incommensurability as a 'myth' (Bailey, 2006); Lakatos offered a more inclusive model for how science changed, which encompassed a more objective sense of what is meant by scientific progress (Lakatos, 1970; Taber, 2006a, 2009b); and Kuhn distanced himself from being associated with radical relativism (Sankey, 2000), claiming that in that regard, at least, he was not a Kuhnian.

In terms of educational science, it has certainly been argued that there is no need for researchers to adopt overarching paradigmatic commitments (e.g., along the lines of ERP1 vs. ERP2): but rather that a post-positivist view admits a range of valid methodologies which can be selected according to the particular educational question being examined (NRC, 2002). This does not negate the debate about ontological and epistemological assumptions: but rather locates them as relevant to the choices made in a particular study, rather than applying to the broad field. From this perspective: there may be times when 'experimental' research is appropriate, even though it cannot always be assumed to a sensible option; and there are times when small scale in-depth enquiry is most helpful, even if it would seem highly parochial in the context of answering other educational questions. Indeed progress in educational science probably depends upon a judicial application of the 'methodological pendulum', as different types of study can often inform, and pose questions best answered, by complementary approaches (Taber, 2009b, Chapter 7).

Facets of Constructivism

The title of Tobias and Duffy's volume refers to 'constructivism', and this immediately raises the question of how they are using this term. Constructivism is used as a label for many different things in education and the wider social sciences, giving much potential for people to talk (or write) across each other if the referent is not clearly established.

So, within social science research, constructivism is often used to describe approaches to research that might be associated with terms such as interpretivism and subjectivism – i.e. the forms of research used in ERP2 (Taber, 2007). This brings us back to the earlier comments about research paradigms.

Constructivist Research Perspectives

'Constructivism' may be used to describe research into social phenomena where the notion of objective reality is either considered invalid or inappropriate. An example might be the practice of 'setting', that is, dividing a year group in a school into several classes to study a particular subject based on the perceived level of attainment of the pupils. It is of course only possible to do 'objective' research to find out whether setting or mixed-ability teaching is 'better' if we can agree on what makes teaching better. We might find that if our criterion was the average test scores at the end of the year, we would get a different answer than if we were primarily concerned with the progress made by the gifted and talented students. We might certainly get different answers in such circumstances than when our criterion was about student attitudes to the subjects, or about providing gender equity (e.g. Boaler, 1997). At one level, this is simply stating the obvious: we need to operationalise our research question, rather than just ask which arrangement is best.

However, the point of course is that better average scores, better progress by the most able students, more positive student attitudes, greater gender equity, and a great many other aims and possible objectives, can all be seen as desirable: and will be weighted very differently by different stakeholders (the parent of the gifted student and the parent of the struggling child may well disagree on what was more important; the capable and enthusiastic, but under-confident girl who is nervous about being in a group of high-achievers may take a particular view, etc.)

So here we have an objective research subject (how teaching is organised in terms of student ability), and many potentially measurable indicators, but a lack of clarity about how we could proceed with a positivistic study to find out what is best practice.

A very different example might be research into bullying. Here it is less clear that there is an objective subject for the research. That is not to suggest that bullying does not occur (far from it), but rather that what is most important may *not* be whether a school incident meets some objective criterion of being 'bullying'. What is surely more important is how events are experienced by those involved: the child who feels bullied, when no bullying was intended; the 'bully' who does not perceive his or her behaviour in those terms; the teacher who does not recognise bullying when children are experiencing intimidation that is making their school experience miserable, etc. The issue here is less about whether some incident is bullying or not, and more about understanding the perceptions of those involved (as a starting point for modifying behaviour where indicated, in ways that those concerned can understand and accept).

Research here would focus on the subjective experience of the participants. The researcher's job is not to find what the situation 'really is', but rather to interpret the participant's inputs to build up a model of how situations are understand, and why people are behaving in particular ways when they perceive certain situations.

Constructivism as Learning Theory

However, for many working in education, and especially in science and mathematics education, constructivism means something rather different. Here constructivism is a theory of learning, or - perhaps more accurately – a label for a family of theories and models of learning.

In this context, constructivism is at core the principle that learning requires active sense making by the learner. Constructivist perspectives also recognise that the sense that is made by an individual is largely dependent upon the available interpretive frameworks through which any new information can be filtered. There are many particular ways in which these ideas are set out, but a key idea is that learning is an iterative process, whereby whatever we learnt next always depends upon what we (think that we) already know. That in itself is hardly a new idea, being for example at the core of Jean Piaget's (1972) ideas. Indeed for many who are constructivists in *this* sense, constructivist learning theory draws upon key thinkers such as Piaget, and Lev Vygotsky, Jerome Bruner, David Ausubel, George Kelly, and even Robert Gagné (Taber, 2009b, Chapter 1).

A reader of *Constructivist Instruction* who was not aware of this background might be surprised to find constructivism linked with cognitive science in this way. Tobias and Duffy tell readers near the start of the volume that,

> This situativity view is one of the defining characteristics of the constructivist framework. It contrasts to the then prevailing information-processing view of learning as processing information composed of concepts, procedures, and facts. (Tobias & Duffy, 2009a p. 3)

Moreover, one of the editors, in a concluding chapter in *Constructivist Instruction*, suggests that,

> "It might be argued that a call for constructivist (socio-historical and situative perspectives) to include information processes is simply a call for reductionism." (Duffy, 2009 p. 353)

Yet, one of the early influential constructivist models of learning, 'generative learning', proposed by Osborne and Wittrock in terms of being "central to the constructivist tradition", was described in the following terms:

> people tend to generate perceptions and meanings that are consistent with their prior learning. These perceptions and meanings are something additional both to the stimuli and the learner's existing knowledge. To construct meaning requires

> effort on the part of the learner and links must be generated between stimuli and stored information… The empirical research which, in part, led to the idea of generative learning emphasized the importance of the learner in the interpretation and processing of stimuli…information-processing psychology, leads to the generative model of learning…This model attempts to illustrate the components involved in generative learning for the purposes of focusing thinking and encouraging discussion.(Osborne & Wittrock, 1985 p. 64)

So this *particular* constructivist learning theory encompasses the very approaches that Tobias and Duffy suggest are eschewed in constructivist learning theory. The problem here being that *even when we limit ourselves to discussing learning theories*, different commentators use the label 'constructivist' in different ways.

In particular there is often seen to be a large chasm between variants that are sometimes labelled as personal constructivism and social constructivism. The former focuses on the individual learner building-up their personal knowledge, whereas the latter focuses on the social context in which learning takes place. These are sometimes seen as contrary views, and indeed more extreme 'social' constructivist positions, sometimes labelled as social constructionism, suggest that knowledge has to be understood as something enacted in social interactions (and so necessarily situated) and would not recognise the notion of knowledge in individual minds as being meaningful.

It is quite possible to see personal constructivist and (moderate) social constructivist positions as perfectly consistent - offering different research foci within a complex situation that needs to be understood at different levels (Taber, 2009b, Chapter 5). One of the contributors to *Constructivist Instruction* makes the point that "in order to uncover the complexities of learning, we must use a variety of lenses and tools" (Jonassen, 2009, p. 27). However, social constructi*on*ism is rather different. Here there are fundamentally different ontological commitments relating to what knowledge is, and indeed what kind of entity it *could* be. The personal constructivist tends to think of student knowledge as represented in the mind-brain of an individual, and perhaps being activated within the subjective world of the individual's thinking: seeing the individual's environment as being a source of cues (Taber, 2009b, Chapter 4). This is a very different description to that taken by constructionists, who would not see the individual as the main unit of analysis, nor consider the context as merely a current environment.

Arguably, here we have a major 'fault line' in thinking about learning, and indeed within constructivism, with the fundamental (for those of us working in education) phenomenon of learning itself understood in ontologically very different ways by different commentators. Such differences in ontological commitment are likely to acts as a significant barrier to conversation across the divide (Chi, 1992). Indeed, Stella Vosniadou, a leading expert on conceptual change has argued that,

> "Students' difficulties in learning the concepts of current science and mathematics have been documented in hundreds of studies and represent one of the mot pressing problems of schooling. They are not going to disappear because they are not consistent with the radical sociocultural perspective. Rather it is the sociocultural perspective that needs to be modified to allow for the possibility to objectify knowledge."
> (Vosniadou, Vamvakoussi, & Skopeliti, 2008 p. 25)

Constructivism as the Basis of Instructional Theory

Given the differences in understanding what is meant by constructivist perspectives on learning, it would be surprising if there were a consensual view on what made for constructivist instruction. Indeed we find there are very different views on what constructivist teaching could look like. As Robin Millar warned: "a constructivist model of learning does not, however, logically entail a constructivist model of instruction" (Millar, 1989, p. 589).

Not surprisingly then, there are rather different views of what 'constructivist teaching' might be. Those who are opposed to constructivist approaches, may tend to see something of a coordinated and dangerous global movement, and a staunch critic, C. A. Bowers, has warned that

> At last count, 29 nonWestern countries were introducing the theories and strategies of constructivism into their teacher-education programs and into their schools. In addition, constructivist theories of learning had long ago become the basis of teacher-education programs in English-speaking counties.
> (Bowers, 2007, p. ix)

Yet the way constructivism has been (to some extent, see Coll, 2007) adopted in New Zealand/Aeotora to offer a curriculum intended to be flexible and responsive to the needs of different students in different schools (Bell, Jones, & Car, 1995), would seem to be somewhat different from the largely 'content-free' notion of constructivist inquiry teaching which some critics (Cromer, 1997) have characterised as a danger in the U.S. (Taber, 2009a).

Meanwhile, in England, key tenets of what many people see as the basis of constructivist teaching (Taber, 2009b, Chapter 4), have been adopted into a range of key policy and guidance documents related to teacher education and school science teaching. Despite this, science teaching in England does not typically 'look' especially non-traditional (Taber & Bektas, 2009), and indeed the general indifference to the strong constructivist flavour of official guidance (in the sense that it has not been the subject of any noticeable critical comment, within the profession or in the media) seems to suggest that in the English context this is seen by most in the educational community as little more than 'good practice' (Taber, 2010a). All of this creates a considerable problem in knowing what exactly *is* the constructivist instruction that is being evaluated in *Constructivist Instruction*.

So in his chapter in *Constructivist Instruction*, Mayer (2009, p. 185) reflects Millar's points from two decades earlier, in terms of "what I have called the constructivist teaching fallacy … – the idea that active instructions methods (e.g., discovery) are required to produce active learning (i.e., engaging in appropriate cognitive processing during learning)." It is worth considering Millar's argument in a little more detail, as it offers a clue to some of the confusion around this topic. Millar concluded that

> Rather than propose a constructivist model of instruction, it might equally well be argued that a consequence of the constructivist model of learning is that science should be taught in whatever way is most likely to engage the active involvement of learners, as this is most likely to make them feel willing to take on the serious intellectual work of reconstructing meaning…. The constructivist model of learning does not carry any necessary message about models of instruction. (Millar, 1989 p. 589)

Yet in reaching this suggestion Millar (1989, p. 589) understood learning in particular terms: i.e. "the process of eliciting, clarification and construction of new ideas takes place internally, within the learner's own head. This occurs whenever any successful learning takes place and is independent of the form of instruction." So Millar was taking a personal constructivist perspective, where learning is largely considered in terms of the development of the *internal* representations available to learners. From this perspective, traditional lecturing can sometimes (i.e. under certain conditions) be a very effective tool for constructivist teaching: that is when the learners are in a position to use the lecture as a productive resource for re-organising their own internal representations, and so developing their knowledge. Clearly such a way of thinking (where the social context involves one person doing a lot of talking, and everyone else listening) might make less sense from a constructi*on*ist perspective.

From the personal constructivist perspective that Millar takes, the most central condition for learning is that the teaching input (from whatever source it might be: lecture, group discussions, invited open-ended inquiry, etc) provides information that fits with the learners' current knowledge state (cf. Ausubel, 2000). Teaching goes wrong when the intended match between teaching and the learners' prior knowledge (i.e. the assumed prior knowledge that teaching has been designed to fit into and to develop) is misjudged (Taber, 2001).

If we accept that perspective, then a number of things follow. One of these is that it is essential that teachers plan teaching based on accurate intelligence about students' current knowledge states – and so (on-going) diagnostic assessment becomes a very important part of teaching. This is of course the basis of Ausubel's famous dictum: "If I had to reduce all of educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly" (Ausubel, 1968, p. vi).

It is also central to the way constructivist teaching has been largely understood in science education (Taber, 2009b), and this is emphasised in the official U.K. curriculum guidance referred to above (Taber, 2010a). Given this key focus of constructivist ideas, it seemed quite odd to this reader that it was only in one of the final contributions to the book, and then at the end of that chapter in response to other authors' queries that we find a clear acknowledgement of this principle: "the field has long recognized the impact prior knowledge has on learning, and probing students' understandings is a cornerstone of science education" (Duschl & Duncan, 2009, p. 324).

However, another consequence is that it does not make sense to judge what might be considered constructivist teaching in absolute terms. A lecture is unlikely to provide effective teaching for a large diverse class of adolescents of varying background knowledge and interest in the topic. However, a lecture could be an effective way of facilitating learning among a group of mature learners who have been selected for having strong subject knowledge; who are highly motivated to learn from teaching; and who have higher levels of metacognition and well-honed study skills. That is not to say that lectures are necessarily likely to be the most effective teaching in elite universities, but they are more likely to work in such a setting than in most schools.

However, even if lectures *per se* are not ideal vehicles for school instruction, that does mean that 'telling' is something that is excluded by constructivist thinking. On the contrary, Ros Driver popularised constructivist ideas in science education after realising (from observing open-ended inquiry teaching) how unlikely it is for most students to be able to rediscover great conceptual leaps of the past by being left to make sense of school practical work without clear guidance (Driver, 1983). As Paul Kirschner explains in *Constructivist Instruction* (2009, p. 147), "what experts already know determines what they see and how they it. Because novices know little about a subject or a domain, they do not now where to look and, having looked at something, have trouble correctly interpreting what they see."

Learning about Paris

Talking about 'canonical knowledge' may seem to imply certain types of learning outcome that may seem much narrower than many educationalists would wish to encompass. But for the sake of illustration, consider the 'fact' that 'Paris is the capital of France', and let us consider it part of canonical knowledge (Paris *is* the capital of France), set out as part of target knowledge in some hypothetical curriculum (e.g. 'Objective G4-c(vi): grade 10 students should be able to recall the capital cities of all the countries with seats on the United Nations Security Council').

A teacher could tell children that Paris was the capital city of France, and ask them to remember that fact. Perhaps on a later test, given the question 'what is the name of the capital city of France', these students could answer 'Paris'. If they were unable to demonstrate this knowledge prior to teaching, we might consider this response on a post-test as evidence of learning—although we should always remember that having knowledge is not a binary matter, and that failure to elicit knowledge under one set of conditions does not imply there would necessarily be failure under different conditions (Taber, 2003; 2009b, Chapter 1). Now of course, this could be rote learning, and so be considered as little more than a conditioned response ('Paris') to a stimulus ('…capital…France…'). That would still be learning, but just as with Skinner's famous pigeons trained to peck round figures of 8, we might feel it was a limited intellectual achievement. (The pecking that is, not Skinner training them.)

So we are not usually interested in rote learning, although we recognise it is sometimes important, but rather what Ausubel (2000) called *meaningful* learning. So what would meaningful learning involve here? I would suggest that for a learner to be prepared to meaningfully learn that Paris was the capital of France, they would need to already have a concept of countries and recognise France as a country; to have a concept of cities, and within that a category of capital cities as having a particular status. They would also have to understand the grammar of the teacher's talk, and to either know Paris was a city, or be able to deduce that in the context of being told it was the capital of France.

This analysis concerns a simplistic example, but offers an illustration of how the basic constructivist notion of what learning involves can inform teaching, and shows why constructivist teachers should have a strong focus on the prior knowledge state of learners.

What might a student who thought that Paris was a character in a Greek story make of being told that Paris was the capital of France? Perhaps some creative understanding is possible, but it would not be likely to match the target knowledge (although they could still give the 'right' answer in the post-test). What about the child who goes to school in East Texas, and who only knows of the Paris there? That student could potentially learn that Paris (understood as Paris, Texas) is the capital of France, and perhaps find it rather odd that the French should make such a choice, but could perhaps actually be more likely to get the correct answer on a later test than many classmates, as such an odd fact might better 'stick' in the mind (i.e. have more and/or stronger associations allowing ready retrieval).

That learner can certainly be said to have *knowledge that Paris is the capital of France*, but certainly does not 'share' *the teacher's knowledge that Paris is the capital of France*. Even with our very simple example, we can soon appreciate some of the complexities of teaching and learning. And much that we want young people to learn is considerable more complicated, of course. As Schwartz, Lindgren and Lewis (2009, p. 39) suggest, in their chapter in *Constructivist Instruction*, "direct instruction can be very effective, assuming people have sufficient prior knowledge to construct new knowledge from what they are being told or shown. In many cases, they do not."

Views from within the Paradigms

Most of the contributors to *Constructivist Instruction* seem to have sympathies that are largely aligned with the constructivist camp (labelled as 'minimal guidance' of course by many of their detractors); or are critical and can be considered to be based in the 'direct instruction' camp. This (false) dichotomy implies a demarcation in terms of whether teachers should offer learners clear direct instruction *or* minimally guided constructivist facilitation of learning.

The Notion of Minimally Guided Instruction

Tobias and Duffy's volume claims to compare 'constructivism' and 'direct instruction' as two instructional approaches (or in effect, it is suggested here, Kuhnian paradigms). However this begs the question explored above about what is to be understood by 'constructivist' instruction. As Walter Kintsch warns readers in his contribution to *Constructivist Instruction*,

> At issue here is the effectiveness of minimally guided instructional methods, such as discovery, problem-based, experiential, project-based and inquiry-based teaching, which are commonly labeled 'constructivist'. Constructivism, however, is also a theory of comprehension and learning. The central idea of this theory is that meaning

> must be constructed, that knowledge building is an active process on the part of the learner, not a passive process of information absorption. Just about every current learning theory is constructivist in that sense. (Kintsch, 2009, p. 234)

Kirschner and colleagues had referred in the title of their earlier paper to '*minimal guidance during instruction*', and a number of contributors to *Constructivist Instruction* refer to minimally guided instruction as being the real topic of discussion. That is fine, but many (I would suspect most) champions of constructivist teaching would *not* see it as minimally guided. So in *Constructivist Instruction* we read Herman and Gomez arguing that

> "Although guidance may be extremely important for effective instruction, we differ with Kirschner and colleagues in their assertions that inquiry-focused instruction is necessarily unguided and that direct instruction is the only way to provide guidance in schools…Kirschner et al argue that forms of instruction that have been vigorously labeled inquiry- and problem-based are not and do not seek to be 'guided'. We disagree."
> (Herman & Gomez, 2009, p. 62)

A big problem with the debate represented in *Constructivist Instruction* (for it is a problem with the debate, not the book), then, is that those supporting constructivist teaching do not recognise it as involving the limited guidance in the way its critics suggest. Indeed Duschl and Duncan (2009, p. 320) argue that facilitating significant conceptual changes "take[s] time and usually require[s] targeted guided instruction and designed curriculum."

At the end of the *Constructivist Instruction*, one of the editors concludes that "the constructivist authors have argued consistently that guidance is essential; that it is simply a matter of the context of the guidance" (Duffy, 2009, p. 352). So 'minimal guidance' is actually a characteristic of the 'straw man' that is sometimes presented as constructivist instruction. Given this objection, the issue may not be constructivist teaching at all, and the question explored becomes 'minimally guided instruction: success of failure?' That would be a rather different book, and indeed one that might struggle for a balance spread of contributors, as it is difficult to find many strong supporters of formal teaching that involves offering very little guidance to learners.

Arguments for Teaching Through Direct Instruction

A key principle underpinning the debate presented in *Constructivist Instruction* is that "according to Kirschner et al., minimally guided instruction overtaxes working memory" (Tobias & Duffy, 2009a, p. 5). The argument is that learning is about modifying (e.g. adding to) the contents of long-term memory, and that working memory – with its limited capacity (Miller, 1968) - is the key buffer in this system. Effective learning requires coordination of the new ideas (being presented by the teacher, or being developed by learners) with existing knowledge. This coordination is undertaken in working memory, which is easily overloaded.

From this perspective, limiting the information to be considered by learners to that which is directly relevant to the learning goals seems sensible. What would not seem sensible, from this consideration, is asking students to work in a complex learning environment, where it may not be clear which prior learning is relevant, nor which aspects of new information may be useful. John Sweller characterises the argument from the direction instruction camp,

> "Withholding easily presented information from learners is a major characteristic of constructivist teaching, inquiry and problem-based learning. Requiring students to discover knowledge rather than explicitly providing them with essential information has become a dominant teaching paradigm. It is a paradigm based on the assumption that knowledge acquired during a problem-solving search is more useful than the same knowledge presented explicitly by an instructor."
> (Sweller, 2009, pp. 127-128)

Sweller (2009, p. 128) argues that "for someone who is not already committed to a constructivist teaching approach, it can be difficult to find a theoretical or practical justification for the procedure."

Those supporting the direct instruction argument claim not only that it therefore makes sense *in terms of what learning involves* for teachers to directly instruct students in what they are expected to learn, but also that *the empirical evidence supports this*. They cite studies which demonstrate that students achieve the desired learning more effectively when they are told what is required, rather than when they are expected to undertake open-ended learning in the hope they chance upon what it is hoped they might learn.

This all seems very sensible, and perhaps even quite convincing. Unfortunately, the adherents of constructivist approaches respond that the arguments made by direction instruction supporters only apply in very particular circumstances, and that the research supposedly showing the superiority of direct instruction over constructivist instruction does not represent genuine constructivist learning contexts, and so does not provide a fair test.
In contrast, other studies discussed in *Constructivist Instruction* by supporters of constructivist approaches show that greater learning gains are made by students who are suitably prepared for direct instruction by previous opportunities to explore related problems: "there can be advantages to first letting students experience the complexities of a situation and then providing information that helps them understand expert techniques and concepts in light of their earlier successes, difficulties, and questions" (Schwartz et al., 2009, p. 44).

It seems both sides in the debate are able to cite research that compares constructivist instruction with direct instructions: and the outcome is that constructivist instruction is either more, or less, effective—depending which studies are considered. That in turn reflects which studies are considered by the adherents of different perspectives as being most relevant to, and informative about, the kind of learning that instruction is meant to bring about!

The Question of Transfer

A key issue here is the notion of transfer of learning. The simplistic example used above of learning a fact (that Paris is the capital of France) only represents one type of learning that is desired in education. Ultimately, the learning of boarder skills, such as those of critical thinking, evaluation and problem solving, are more highly valued. Fletcher (2009, p. 256) argues in *Constructivist Instruction* that "much instruction is intended to go beyond these limited learning objectives and is intended to develop analytical, evaluative, and creative capabilities. Such instruction requires richer learning environments to support the learner's representation-building efforts." Duschl and Duncan (2009, p. 311) explain for example that science education is more than teaching 'what we know'…Science education is importantly about 'how we know' and 'why we believe what we know over alternatives", and that the purposes of teaching science include enabling, "students to participate productively in scientific practices and dialogue pertaining to the creation, evaluation, and revision of scientific explanations and models" (2009: 321). The emphasis on 'dialogue' reflects a widespread recognition of the role of talking about ideas (in a genuinely dialogic way, that elicits and explores student thinking) in learning, which "ensures, on the one hand, that students understand the need to revise their beliefs deeply instead of engaging in local repairs…and, on the other, that they spend the considerable time and effort needed to engage in the conscious and deliberate belief revision required for conceptual change" (Vosniadou et al., 2008, p. 27).

So while having a repertoire of facts available in the mind can certainly be useful, it is certainly not enough to claim an education. As Wise and O'Neill (2009, p. 84) argue in their chapter, "one important reason for constructivists' very different approach to teaching may come from their greater ambitions where transfer of learning is concerned."

Yet, as *Constructivist Instruction* illustrates, there are different views on the possibility of learning transferable skills – at least in the sense of completely domain independent skills that can be learnt in one set of contexts and later applied unproblematically is completely new domains. If, however, somewhat more modest goals for transfer of learning are set (after all most humans beings do not become totally non-functioning every time they face a somewhat novel situation), then the logic of just telling learners what they need to know starts to look less straightforward - and the somewhat less direct approaches of constructivist teaching may come into their own,

> "Thus, while instructionists tend to view a complex problem-solving situation as a large problem space filled with extraneous demands on the learner's … a constructivist is more likely to view it as a rich set of contextual cues that may later aid transfer…"
> (Wise & O'Neill, 2009, p. 85)

Although to some supporters of direct instruction the notion of transfer of learning itself is quite questionable, there are many areas where we would wish to teach students, but where there is no clear unambiguous domain structure that can be simply presented. So in their contribution to *Constructivist Instruction*, Spiro & DeSchryver (2009, p. 111) argue that "direct instructional guidance is partially defined as 'providing information that fully explains the concepts and procedures that students are required to learn' [but] in an ill-structured domain, the ideal of full explanation is simply impossible."

It seems, then, that much of the difference between the two sides in the debate concerns how they actual model the learning process that instruction is meant to facilitate.

Understanding the Nature and Role of Long-Term Memory In Learning

One focus of debate is on the role of long-term memory in learning. In the paper that sparked the debate that led to *Constructivist Instruction,* Kirschner, Sweller & Clark (2006) consider learning in terms of long-term memory, which leads to a perspective on instruction as facilitating changes in such long-term memory. The supporters of the constructivist position do not deny this, but consider that it too readily ignores the complexity of memory structure, and how it is accessed and modified during learning (cf. Taber, 2003). So Gresalfi and Lester (2009: 265) point out that "the question is about the *structure* of long-term memory, and how it becomes *structured*", noting that "people can appear to have made changes to their long-term memories by solving problems in expected ways in one situation, and then fail to transfer the same information in another situation", whilst Jonassen (2009, p. 17) argues that "problem solving entails a lot more cognitive activity than searching long-term memory for solutions."

Jonassen (2009, p. 18) goes on to warn that "long-term memory is not a monolithic structure…[but] is replete with schemas, schemata, stories (experiences), procedures, behavioral sequences, patterns, and many other structures," and notes that "different learning outcomes…call on different knowledge types which are accessed by working memory in different ways." To become an expert in a topic means to "construct richer, more integrated mental representations of problems than do novices…their representations integrate domain knowledge with problem types, that is, they construct multidimensional problem schemas" (p. 18). From a constructivist perspective, the issue of conceptual integration seems central to learning. However, due to the difficulties in modelling students' existing knowledge structures, it has not received the attention it deserves in the empirical literature (Taber, 2006b). The discussion in *Constructivist Instruction* highlights how difficult it is to reach agreement about how to teach, without having an agreed understanding of what learning involves.

Not Really Like Cloning; A Bit Like Sex; But More Like Eating: Constructing The Right Metaphor For Learning, To Inform Instruction

Of course, learning is a fairly basic notion in debates about effective approaches to teaching, and so inevitably arguments about instruction hinge on how one perceives learning. One of the editors summarises a key difference between the two traditions when concluding that "for the constructivist (in my construal), but not for the direct-instruction researchers, learning is a process of the learners' sense making. Learning is driven by the learner's need to make sense of (to understand)" (Duffy, 2009, p. 365).

In his chapter in *Constructivist Instruction*, Sweller compares learning to reproduction. He argues that learning is not so much like asexual, vegetative, reproduction that leads to clones of the original. Rather, learning is more like sexual reproduction where the mixing of genes from different individuals to lead to a new unique individual in some ways similar to, but also quite distinct from, the 'parents'.

In this model, the student's knowledge after teaching is the offspring of an intellectual tryst when the learner's prior knowledge is probed by the teacher's seminal input. There are perhaps difficulties with such a fertile analogy, as a newly born child does not effectively develop and extend or replace its parents, who continue to exist, even if perhaps not unchanged from before!

Perhaps a better metaphor for learning is eating. Teaching offers intellectual food, but before it can nourish us it needs to be broken down into more fundamental units, and rebuilt anew. We build our bodies from proteins derived form the amino acids in the protein of our food; but we do not build tissues directly from the proteins in our food: rather the constituent amino acids become incorporated into the new structures of our proteins, and the original proteins no longer exist. In an analogous way, the learner breaks down, and rebuilds, knowledge in the learning process.

Stepping Outside the Cognitive Domain

If we take up this feeding metaphor, then another key theme in *Constructivist Instruction* is how supporters of constructivist instruction are concerned about the enjoyment of the meal, as well as the nutritional value of the food itself. Herman and Gomez (2009, p. 65) note how "proponents of inquiry-or project-based science have stressed the motivation benefits of inquiry as a key affordance of such learning environments" and argue that "in some cases students' motivation and affect may better predict lifelong trajectories than achievement" (p. 66). Indeed at the end of the book, one of the editors suggests "that guidance is not the driving issue that distinguishes the two perspectives.... The distinguishing variable that should be the driving force for research is the stimulus for learning" (Duffy, 2009, p. 357).

Testing Instructional Effectiveness

Given that the two camps represented in *Constructivist Instruction* have somewhat different ways of thinking about what is involved, and what it might be realistic to aim for in learning, it is hardly surprising that they do not agree on the best way of testing for effective teaching. As one of the editors reflects, "the consequence of the failure to seek an integration of the metaphors is reflected in the authors in this volume too often talking past each other in the design and interpretation of their research—and in what they consider to be evidence" (Duffy, 2009, p. 353).

Schwartz and colleagues (2009, p. 35) suggest that in many traditional assessments "students receive tests that measure how well they develop their efficiency at remember facts, executing skills, and solving similar problems. These assessments present something of a mismatch to larger constructivist goals." If constructivists look for transfer of learning, then they may wish to test for a students' ability to learn in problem contexts, but

> "most end-of-unit tests explicitly block students from constructing new knowledge during the test itself. These tests measure students' abilities at sequestered problem solving…because students are shielded from any resources that might help them learn during the test…[such] assessments are not ideal when evaluating whether students have been prepared to construct knowledge based on what they have learned." (Schwartz et al., 2009, p. 38)

In all then, the two sides of this argument conceptualise learning differently; have different notions of what kind of guidance is involved in constructivist teaching; have different aspirations in terms of what are realistic learning goals for schooling; and consequently have very different views of how one might find out which type of approach is most effective. Duffy (2009, pp. 354-355) reflects how "the direct-instruction researchers have focused on research in which variables are manipulated in tightly controlled experiments….[whereas] the constructivist approach is to study rich learning environments, examining the variables in the context of those environments." Schwartz and colleagues (2009, p. 55) argue that although "changing one feature at a time in the context of instructional research is a good way to find out what works for your brand of instruction. It is not a good way to compare different instructional paradigms", as the successive modifications made to shift one particular approach closer to the other to ease comparison would mean "research that has less and less ecological validity for conditions of instruction."

In his chapter, Jonassen recognises how in effect the two 'sides' are working in different paradigms,

> I am not able to identify 'high-quality research studies comparing the effectiveness of inquiry methods and direct instruction' because they probably do not exist and cannot exist. Researchers examining the effectiveness of direct instruction begin with fundamentally different assumptions, evoke significantly different theory biases, and use different research methods than researchers examining informal of inquiry learning. Therefore the questions they ask, the learning outcomes they seek and the research tools and methods they use are also quite different. We cannot compare apples with oranges. Each relies on intellectual biases that would leave the other at a disadvantage were we to compare results. (Jonassen, 2009, p. 29)

The differences are at the ontological level (what the different type of instruction involve); at the epistemological level (what kind of information is needed to demonstrate effective instruction); and at the methodological level (how one can go about comparing the different teaching approaches in a valid way).

One of the contributions to *Constructivist Instruction* describes the situation as a "a methodological catch-22", where "if one conducts a properly designed, classically controlled experiment varying *only* the amount of guidance provided in instruction, they are restricted to making comparisons *within* one of the two frameworks (instructionist or constructionist), or using a very impoverished version of one of the approaches. However, if we attempt to test a 'good' instructionist lesson against a 'good' constructivist one, we must involve differences in more than one variable, making our results ungeneralizable." (Wise & O'Neill, 2009, p. 87-88)

Moving Beyond The Paradigm Wars To Design Effective Pedagogy

In some respects, *Constructivist Instruction* reports a somewhat hopeless situation: certainly one of the editors suggests "'Constructivism and the Design of Instruction: Success or Failure?' That was the question underlying this volume. The not-so-surprising answer seems to be that success—or failure—is in the eye of the beholder" (Duffy, 2009, p. 351). Given the many differences typically found between the proponents of constructivist instruction, and the critics of 'minimal guided' instruction, Tobias and Duffy's book does a better job of illustrating Kuhn's incommensurability thesis than answering its titular question: 'constructivist instruction: success or failure?'

Yet earlier in this essay I warned of false dichotomies. ERP1 and ERP2 seem opposite ways of doing educational research: but much educational research follows a 'middle' post-positivist approach which rejects naive positivism, but without excluding a place for quasi-experimental research; and which rejects pure relativism, but recognises that interpretative studies are appropriate when dealing with social constructs and individual perceptions (Taber, 2009b, Chapter 2). Such an approach can be pragmatic without losing integrity. In the same way, constructivist approaches to learning can take a middle path between ignoring students' ideas because only canonical knowledge counts, and considering students' ideas as correct relative to the individual and so entitled to equal status with curricular target knowledge (Taber, 2010b). Learners' ideas may be valuable both because they are the creative products of individual mental work, and because they are the available mental resources on which students can build further. They are also valuable because research suggests that learning of target knowledge is supported by a rich initial conceptualisation (Ault, Novak, & Gowin, 1984). Taking learners' ideas seriously because they are significant for learning is very different from taken them to be as worthy as target knowledge (Taber, 2009b, Chapter 2).

Table 1: How constructivist teaching is perceived from two distinct perspectives

Viewed from the Direct Instruction paradigm	As understood from within the constructivist paradigm
Vague learning goals	Teaching encompasses wider aims than very specific learning objectives, including transferrable skills; some of the most valuable learning aims do not reduce to objectively testable elements
Unstructured lessons	Effective teaching is an interactive and dialogic process that builds upon students' thinking, and so lesson plans have to include some flexibility
Open ended student activity	Learning of complex material, especially in less well structured domains, is supported by time spent exploring the 'problem space'; allowing students to use and develop their imagination and creativity is an important aim of education
Minimal input from teachers	Teaching involves supporting students' learning using a wide variety of strategies and tactics, including setting suitable problems, organising group work, providing learning resources, helping students make explicit and reflect on their current understanding etc, as well as being a direct source of information
Acceptance that each learner will come to their own unique take on the topic (which may not match canonical knowledge)	Research shows (a) that students will inevitably start from different sets of prior relevant knowledge, will therefore interpret teaching differently, and so will come to somewhat unique final knowledge states; and also (b) that significant conceptual change is often only achieved over extended periods (even if the final shift may appear to be sudden): given this, expecting students to acquire copies of the teacher's or target knowledge is unrealistic, and the teacher's role is to help channel developing thinking towards canonical knowledge: accepting that what can be considered a productive learning trajectory, and a what should be judged an acceptable 'good enough' current understanding at the end of a unit of teaching, will vary from student to student.

Reading Between the Lines

So an alternative reading of *Constructivist Instruction*—perhaps to some extent a reading *between* the lines—can be a more optimistic reading. This reading would certainly highlight how contrasting constructivist instruction with direct instruction invokes a false dichotomy. This can be seen by considering how constructivists respond to the characterisation of their position given by their critics. Some of the key issues are summarised in Table 1. It seems clear that setting-up these two approaches to teaching as opposites creates a false dichotomy because,

a) constructivists consider they offer considerable guidance in their teaching, even if it not of the form of simply telling students what they are expected to come to know; that is, it is possible to offer a lot of guidance to pupils without 'telling them the answer';
b) such a grand distinction seems to imply that all learning is much the same, and therefore the choice is between two antithetical approaches to teaching; rather than perhaps having available a range of strategies to be selected form depending upon the teaching context (what is to be taught, to whom, etc);
c) even within the teaching of a particular topic, to a particular group, constructivist teachers may feel that their work is less a choice of whether to adopt or reject direct instruction, but rather how to develop dialogic teaching by planning when to facilitate enquiry and open-up discussion of students' ideas, and when to close down discussion and present canonical knowledge.

Indeed both 'sides' seem to agree that the best way to teach certain things (usually quite simple information, such as facts) is by telling learners what they need to know—at least providing the teacher has checked that the essential prerequisite knowledge is in place. Both sides also seem to agree that minimal guidance, almost letting the learners just get on with it, is seldom an appropriate educational strategy. As Schwartz and colleagues (2009, p. 39) argue in *Constructivist Instruction,* "sometimes, it is important to explore and develop one's ideas. Sometimes, it is important to receive direct guidance. The question is not which method is right; the question is what combination of methods is best for a given outcome." I suspect this would seem pretty obvious to most teachers, but it does at least offer some basis for moving the debate (and research programme) forward.

Constructivists do not wish to avoid teaching established knowledge, but rather to build upon what we know about learning, to create the best conditions (in both conceptual and motivational) terms for students to be receptive to that knowledge—and so have the best chance of making sense of it in ways similar to those presented as target knowledge (Taber, 2009b, Chapter 6). This is why there is a strong focus on existing understanding of a topic: as Duschl and Duncan (2009, p. 320) argue it is "important that students' prior knowledge be actively engaged and that they be encouraged to share their ideas and argue about them."

Selecting the Best Forms of Guidance for Intelligent Instruction

Given that constructivists are not proposing teaching involving minimal guidance from teachers, but rather that in many learning contexts simply being told what to learn is not the best kind of 'guidance', a key direction for useful research is identifying *the nature of the most effective guidance in different learning contexts*. There is already a great deal of research, especially from science education, about the difficulty in bringing about significant degrees of conceptual change (Taber, 2009b, Chapter 6). As Duschl & Duncan (2009, p. 324) explain in *Constructivist Instruction,* it has been widely shown that this "requires understanding and integrating the information through scaffolding and guided instruction, not direct instruction of what's right and what's wrong."

The critics of constructivism seem to think this type of talk is vague, and avoids engaging with details, and the editors of *Constructivist Instruction* conclude that "while scaffolding is central to the design of constructivist learning environments, constructivists have been slow to formulate testable principles—or even specific guidance—for the use of scaffolding" (Tobias & Duffy, 2009a, p. 5). This may be a fair comment in terms of the contributions to the book (which by their nature are not able to offer many detailed accounts of specific instructional episodes), but perhaps underestimates the progress made in these areas. Specific ideas about applying notions of scaffolding in teaching particular topics have been reported (e.g. Taber, 2002).

Certainly there is a lot of research exploring classrooms, to find out the different means by which teachers can guide learning, other than just 'telling', and some examples are reported in *Constructivist Instruction*. One example in the book describes how in a mathematics class, "the teacher's utterances were not targeted at supplying information or sharing connections between ideas. Rather, her work was to problematize claims or statements made by students, in order to ensure that ideas were accessible to all" (Gresalfi & Lester, 2009, p. 278). Gresalfi & Lester (2009, p. 274) note how "the form of the guidance comes in questions, probes, orchestrations of turn of talk, and decisions about when to move on. To call this guidance 'minimal', therefore, is to miss the work of teaching and the impact of guidance on student thinking." Wise & O'Neill refer to how "the collection of instructional moves discussed under the rubric of guidance seems to include explanation feedback, help, modeling, scaffolding, procedural direction, and others" (2009, p. 83).

Research is allowing us to identify design principles for developing pedagogy which is effective because it introduces the right moves, at the right point in a sequence of lesson activities (Ruthven et al., 2010). Such research shows that effective teaching does involve telling, but as part of a dialogic approach to teaching and learning (Mercer, 1995) where the teacher orchestrates shifts between eliciting and exploring student thinking, as preparation for the introduction of the canonical knowledge set out as the target for learning in the curriculum (Mortimer & Scott, 2003). As Wise and O'Neill (2009, p. 82) note in *Constructivist Instruction*: "from constructivists and instructionists alike, the *quantity* of guidance is just one dimension along which guidance can usefully be characterized. We introduce the *context* in which guidance is delivered and the *timing* with which guidance is delivered as two more important concerns."

Of course there is much work still to do, but there is much to be optimistic about. However, we need to drop the 'either/or' mentality. To return to the 'learning as feeding' metaphor, to dichotomize instruction as constructivist *or* direct is akin to asking whether it is better to eat carbohydrates or proteins, when what is needed is a balanced diet. Of course teachers need to be aware of when telling learners things is the best way to facilitate desired learning. But they also deserve to know all that educational and cognitive science research has revealed about why many complex ideas and skills are seldom effectively learnt that way. Teachers as pedagogic chefs need to know about the types of educational foodstuffs available, and how to combine and sequence them into tasty meals that are balanced and intellectually nutritious. So we can move beyond this false dichotomy. We should all be happy to give direct instruction when that is appropriate. Yet we should also all be constructivist teachers in terms of applying well-supported learning theories. Accepting this means offering a good deal of guidance, but within pedagogic strategies that are varied, flexible and responsive to subject matter, learners, and teaching context.

So can constructivist instruction be successful? Yes, if it is *genuinely* constructivist instruction that incorporates direct instruction where appropriate. I think we need a new term for this synthetic, inclusive approach. Perhaps we should just call it 'intelligent instruction'?

Editor's Note:

The discussion among Keith Taber, Sigmund Tobias, John Sweller and David Klahr continues at the *Advanced Distributed Learning Newsletter for Educators and Educational Researchers*, http://research.adlnet.gov/newsletter/academic/201010.htm#Constructivist

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Keith Taber trained as a graduate teacher of chemistry and physics, and taught sciences in comprehensive secondary schools in England. He moved into further education where he taught physics and chemistry to A level, science studies to adult students, and research methods on an undergraduate education program. He acted as the mentor for trainee science teachers on placement at the college. Whilst working as a teacher he earned his Master's degree for research into girls under-representation in physics and his doctorate for research into conceptual development in chemistry. He joined the Faculty of Education in 1999. Dr. Taber was the RSC (Royal Society of Chemistry) Teacher Fellow for 2000-1, undertaking a project on Challenging Chemical Misconceptions. He was the CERG (Chemical Education Research Group) Lecturer for 2000. He writes a column (*Reflections on Teaching and Learning Physics*) for the journal *Physics Education.* He led the Cambridge project on teaching about ideas and evidence in science for the National KS3 Strategy.