UNTANGLING CONSTRUCTIVISM, KNOWLEDGE, AND KNOWLEDGE-BUILDING FOR 'FUTURE-ORIENTED' TEACHING

Jane Gilbert
Auckland University of Technology

ABSTRACT

Building on earlier work in *Set* on "confusion" around the term constructivism in education, this article explores four different meanings of constructivism, looking at their very different origins and purposes. It argues that mixing up these meanings has produced the confusion identified in the earlier article. The article also suggests that constructivism has been pushed to its limits as a framework for thinking about teaching, learning and/or knowledge development in 21st century schools, and another idea is now needed. The article reviews Bereiter and Scardamalia's 'knowledge-building' concept as one possible contender.

INTRODUCTION

In a recent article in *Set* (McPhail, 2017) the author aims to "clear up the confusion" between constructivism as a theory of how we learn, and constructivism as a theory of how knowledge is 'built'. He points out that these two meanings are often conflated, and that this can produce confusion between pedagogical concerns and issues of curriculum content. McPhail worries that this confusion is contributing to a focus on learning as an end-in-itself, as opposed to the learning of specific concepts. He is also concerned that the confusion around constructivism has produced the idea, evident in some current resources for teachers, that school students can be the 'creators' or 'co-constructors' of new disciplinary knowledge.

This article is intended to add to this earlier work. The first part of the article looks at the different forms of constructivism that have influenced New Zealand education, focusing in particular on how they have represented learning and knowledge. Untangling this goes some way toward understanding how the confusion McPhail identifies could have come about. However, the confusion is, in part, also the result of constructivism being over-extended into areas beyond its original remit. This section of

the article looks briefly at how and why this happened. Its conclusion is that constructivist theories of learning can be useful for framing teaching approaches designed to support students' learning of specific concepts. However, in situations where there are other goals, they are less helpful.

The second half of the article outlines a different approach to scaffolding students' intellectual development. This approach, known as 'knowledge-building', is probably the main source of the idea that school students can create new knowledge. But, as with constructivism, there are traps for the unwary, particularly if this idea is picked up without a deep understanding of how and why it was developed. Because its purpose is very different from the more familiar approaches to teaching and learning, it is initially quite challenging to get one's head around. But, for teachers interested in what future-oriented pedagogies might look like, the effort is worth it.

CONSTRUCTIVISM'S MANY MEANINGS

Constructivism's origins are usually traced back to Kelly's personal construct psychology and linked to the work of Piaget and Vygotsky (e.g. Driver & Easley, 1978; Kelly, 1955; Piaget, 1929, 1972; Vygotsky, 1978). In the 1980s and 90s constructivism was very influential in research on teaching and learning, particularly in science and mathematics education. This was its heyday: constructivism's influence on research has been in decline for a while now and there is a well-developed and powerful internal critique of its ideas in academic contexts (e.g. Millar, 1989; Osborne, 1996; Solomon, 1994; Suchting, 1992). However, the term is still widely used in practice-based contexts and, as McPhail points out, here it has several meanings.

Constructivism's first meaning is as a psychological theory of individual *learning*. For constructivists, learning is an internal process of building—and re-building—an individual's personal intellectual 'constructs'.[1] Piaget wrote about the child as 'builder' of their own intellectual structures, using 'materials' from the culture around them (e.g. Piaget, 1929). He saw this is a natural, spontaneous process that takes place without conscious awareness. New structures are built on the foundations of older structures: however, sometimes the old structures need to be replaced. The intellectual structures for many concepts are relatively easy to build, because the child is immersed in the necessary 'raw materials' (experiences, activities and interactions with others). However, other concepts can be harder to build because the 'raw materials' aren't readily available in the surrounding culture (Papert, 1980). Here, more formal experiences, structured by older or more experienced others, are often required. Constructivist *teaching* is designed to provide these experiences.

This is constructivism's second meaning. As well as being a theory of learning, it is also an approach to teaching. Constructivist models of learning were first taken up by educators as a way to better support student learning of 'hard to build' concepts (mainly from mathematics and science). These concepts, derived from disciplinary knowledge and specified in the school curriculum, are, in school contexts, the *focus* of learning. This matters here, because, in the move from constructivism as a theory of learning to constructivist pedagogy, learning is no longer the central focus, but a means to an end. This end is the acquiring of particular kinds of knowledge.

The constructivist teacher, drawing on constructivist models of learning, sees the learner, not as an empty vessel to be filled up with knowledge, but as an individual 'builder' of their own personal, internal intellectual constructs. They see the learner as arriving with pre-existing sets of ideas, ideas that they are often satisfied with, and reluctant to give up. However, where these pre-existing ideas (known in the research literature as 'alternative conceptions') are blocking the learner's developing understanding of a new curriculum concept, they must be disrupted. Thus, the constructivist teacher's starting point is the learner's pre-existing ideas (e.g. Driver, 1983; Driver *et al,* 1985; Strike & Posner, 1983). The teacher's role is to access and understand these ideas, and then to design experiences that can build on, or, where necessary, disrupt them.

Constructivism has a third meaning, known as social constructivism. Like personal constructivism, this is a psychologically-oriented theory of learning, but there is a focus on the *social* aspects of learning. Learning is still seen as the building of an individual's intellectual constructs, but this construction takes place, not in individuals alone, but in the spaces between them. Learning is a collaborative social process. It takes place, and is mediated by, interaction with others, and is influenced by socio-cultural factors (e.g. Lave & Wenger, 1991; Rogoff, 1990; Solomon, 1987). Social constructivism, like personal constructivism, has informed the development of new teaching approaches. But, again, the goal of these teaching approaches is not to improve learning *per se*, but to improve students' learning of *particular* pre-specified things.

A fourth meaning for constructivism, confusingly also known as social constructivism, has been influential in educational contexts. Unlike the others, this version of constructivism does not originate in psychology and has nothing to do with individual learning. Rather, its origins are in sociology, and it is a theory of how knowledge is constructed in the disciplines. Thus, its focus and its purposes are very different to those of constructivism's other meanings. The sociological form of social constructivism

emerged in the 1960s and 70s as a framework for understanding how social knowledge develops (e.g. Berger & Luckmann, 1966; Schutz & Luckmann, 1973). However, it later came to be used to study how *disciplinary* knowledge is built. There was a particular focus on scientific knowledge, and the large body of work now known as the Social Studies of Science emerged from this (e.g. Knorr-Cetina, 1983; Latour, 1987; Latour & Woolgar, 1979; Traweek, 1989).

In this kind of social constructivism, knowledge doesn't just exist 'out there' waiting to be 'discovered'. Rather it is 'socially constructed' by people working—and talking—together. Experts, following the protocols of a specific disciplinary or cultural context, articulate, theorise, test and debate the field's existing ideas, in order to build on, refine and improve them. Most social constructivists see the new disciplinary knowledge that results from these processes as an objective thing-in-itself, something that exists independently of the social processes that produced it. A few, known as radical constructivists (e.g. Gergen, 1995; Glasersfeld, 1989, 1993), see knowledge as entirely socially constructed, and reality as something fundamentally unknowable. This position is controversial in philosophy.

Research influenced by this form of social constructivism looks at the way experts interact with each other as they build new knowledge in their discipline (e.g. physics, history, or economics). There might be a focus on the strategies these experts use as they argue, negotiate and test new ideas with each other and/or a focus on how these strategies are different in different disciplines. The point of the work is to investigate the processes that occur *between experts* as new disciplinary knowledge is built. It is not concerned at all with the issue of how non-experts might *learn* this knowledge.

CONSTRUCTIVISM, LEARNING AND KNOWLEDGE IN EDUCATION

In the 1990s, some constructivists working in science education were influenced by the sociological form of social constructivism. They began to study student interactions in science classroom to explore how they were being 'socialised' to think, act, and interact like scientists (e.g. Driver *et al*., 1994; Driver & Oldham, 1985; Tobin, 1990).

This was a new direction for science education. Instead of focusing on how best to support learners to 'take in' science concepts, some researchers began to explore how learners could be 'apprenticed' into the intellectual activities involved in scientific work. One result of this was that, in some work, constructivism the theory of *learning* (meaning 1 above) was extended and combined with constructivism the theory of *knowledge* (meaning 4 above) to become an emerging theory of *curriculum*. As some scholars have since pointed out, this move over-extended constructivism into

areas it was not well-equipped to deal with (e.g. Small, 2003). As one science education academic put it at the time:

> constructivism, this new saw in the science educator's toolbox, is being used not only for sawing, but for hammering and planing and measuring (Geelan, 1997: p. 23).

The interest in fostering disciplinary thinking (as opposed to the learning of a discipline's concepts) had a clear educational purpose. However, constructivism was probably not the 'answer' to the issue being addressed. However, before I move onto this issue, I first want to reiterate the differences between the four forms of constructivism, in particular, the different meanings given to the terms 'learning' 'knowledge' and 'construct'. It seems to me that this is where the confusion McPhail identifies comes from.

In personal constructivism (meaning 1 above), *learning* is the focus. The term knowledge, if it is used, refers to the personal knowledge of the individual doing the learning: it is what they have learned. This knowledge consists of the 'constructs' they have built in their mind, as a result of learning, which is thought of as an individual activity. In constructivist pedagogy (meaning 2 above), individual learning is also the focus, and 'construct' has a similar meaning. But 'knowledge' means two different things. It is the personal knowledge of the learner, but it is *also* 'content' knowledge, the specific concepts to be learned in school contexts. This is the first source of confusion.

In educationally-oriented social constructivism (meaning 3 above), individual learning is also the focus, and 'constructs' are also 'built' in individual minds. However, the *site* for learning is the spaces *between* individuals. Knowledge, in this context, means the knowledge that is 'co-constructed' in groups of individuals as they work together: however, this 'ends up' as personal knowledge in individual minds. This is a second source of confusion. As well, as with constructivism's second meaning, the term knowledge has an additional meaning: it is also used to refer to the curriculum concepts to be learned, which are largely taken as given.

In contrast, in constructivism's fourth meaning, *knowledge*, not learning, is the focus. Here, the term knowledge is *not* used to mean personal knowledge – the internal constructs an individual makes as they learn. Rather it means disciplinary knowledge – the knowledge that results from experts in a field working together to build, test and improve new ideas in that field, using the protocols of that field. The uptake of ideas from this fourth meaning of constructivism in educational contexts is a third source of confusion.

These differences in the meanings given to knowledge across the different versions of constructivism are significant, not only for understanding why the term constructivism is used in confusing ways, but also for what they tell us about our implicit understandings of education's purpose. If education's purpose is to support learners to understand key curriculum concepts in ways that closely match the way these concepts are understood in the parent disciplines, then the problem could be solved by making sure that these different meanings of knowledge (as well as pedagogy and curriculum) were clearly distinguished. But, if education's purpose is changing, things are less straightforward.

FINDING A WAY FORWARD FOR OUR FUTURES

Recent years have seen much discussion of 'future-focused' education. This is an umbrella term for a broad grouping of ideas with many origins and purposes. Some currently high-profile ideas include the '21st century skills' idea, the 'digital literacies' idea, and the 'innovative learning environments' idea. A less-often discussed set of ideas have to with the educational implications of the new orientations to knowledge that are evident in the world beyond education. There isn't space to go into detail on this here, but there is a well-established body of work showing that knowledge's exponential rate of growth and change, and its now deeply networked nature, are changing what disciplinary knowledge *is* and how it 'works' (e.g. Castells, 2000; Lyotard, 1984; Weinberger, 2011). In reaction to this, some educators have questioned the *educational* function of disciplinary knowledge's current representation in the curriculum. Instead of being 'content' students are to learn, the case is made for fostering the capacity to 'do things with' disciplinary knowledge, to draw on and use it to create new knowledge and/or make new things (e.g. Gilbert, 2005). Some are arguing that we should re-configure schools as centres for knowledge creation, not knowledge transmission (e.g. Bereiter, 2002). Others have written about students as the 'creators', 'producers', or 'co-constructors' of new knowledge (e.g. Bigum, 2003; Hargreaves, 1999). This has added yet another layer of complication to the constructivism debate, further increasing the potential for confusion.

The next section of this article looks at one branch of this educational work. My purpose is to show that it is possible to make a robust case for the idea that children can create new knowledge, *without* conflating personal and disciplinary knowledge. However, before going any further here, it is important to say that, in the work I am about to outline, the authors do *not* argue that disciplinary knowledge isn't important. Nor do they argue that it doesn't matter *what* children learn. Rather, in thinking about how education could build the kinds of intellectual capacities needed in the 'knowledge age', they have developed a new concept, which they call 'knowledge-building'. This concept's focus

is *not* personal knowledge construction or learning. Nor does it focus on how disciplinary knowledge is constructed by experts, or how it is acquired by neophytes. Rather, it explores the space *between* these, not to 'achieve' one or the other, but to make *this space* the primary focus. The authors of the 'knowledge-building' concept have taken a great deal of care to dissect out the different meanings of knowledge that are in play in this space, and, for this reason, I think this concept is useful to the present discussion.

KNOWLEDGE-BUILDING – WHAT IS IT?

In a large number of publications over more than thirty years, the Canadian educational researchers Carl Bereiter and Maxine Scardamalia have argued for, and provided examples of, the concept they call 'knowledge-building' (e.g. Bereiter, 2002; Bereiter & Scardamalia, 2006, 2010, 2014; Scardamalia & Bereiter, 2006, 2010). The purpose of this concept is to provide a frame for building the intellectual capacities needed to successfully participate in expert knowledge construction. This isn't a new idea in education. What is new here is the argument that this is best done, not by 'taking in' the discipline's concepts, but by a staged apprenticeship in the discipline's ways of developing knowledge. The catalyst for this work was the 'knowledge age' developments outlined above.

Bereiter and Scardamalia define 'knowledge-building' as creative, sustained, collaborative working with ideas, with the aim of *improving* those ideas. These improvements are made available for further work by others, and to make some sort of contribution to a context beyond the individuals involved. For Bereiter and Scardamalia, knowledge-building is intentional, collaborative, cognitive activity, the purpose of which is to build collective capacity, while at the same time also contributing to the wider social good (Scardamalia & Bereiter, 2006). Knowledge-building can involve abstract 'idea work', but it can also take place in physical contexts: for example, it has potential affinities with the 'maker space' concept (Gilbert, 2017).

For the purposes of the present discussion, it is important to unpack Bereiter and Scardamalia's careful framing of the various meanings of knowledge that are embedded in their knowledge-building concept. The first step in their logic is to distinguish Knowledge (with a capital K) from Knowledge-in-Development. For them, Knowledge is the validated, agreed-on, codified and published set of concepts that form the basis of a given discipline at any point in time. Knowledge-in-Development, on the other hand, describes the *processes* by which new Knowledge in a given discipline is developed over time: that is, the experimentation, collaboration, argumentation, negotiation, and debate that

takes place between the people who are the field's experts, as they 'construct' new knowledge, using the procedures and protocols of that discipline, with each other - i.e. socially. Successfully participating in Knowledge-in-Development requires skills and dispositions over and above personal mastery of the discipline's key concepts, skills and dispositions. These skills and dispositions usually develop informally, *alongside* conceptual knowledge, as individuals are inducted into a particular expert context. Bereiter and Scardamalia's knowledge-building idea involves apprenticing students into this process at a much earlier, pre-expert stage (Bereiter & Scardamalia, 2014).

The second step in their logic is to distinguish Knowledge and Knowledge-in-Development in *professional* contexts from knowledge and knowledge-in-development in *school* contexts. They use knowledge (lower case k) to refer *not* to disciplinary Knowledge, but to the collective 'constructs' made by groups of students as they work together on 'knowledge-building' activities, while (lower case) knowledge-in-development denotes the processes students experience together as they do this work (*ibid*).

Bereiter and Scardamalia are very clear that that knowledge-building and learning are *not* the same thing. Individual participants in knowledge-building activities *may* experience learning, just as individual researchers on a research team may learn something from participating in the research, but individual learning is *not* the objective (Bereiter, 2002; Scardamalia & Bereiter, 2006).

Similarly, Bereiter and Scardamalia are clear that knowledge-building is *not* synonymous with constructivism. Its goal is not individual conceptual change, but collective *idea improvement*. While it is possible that students may create new disciplinary Knowledge, this *isn't* the point. The point is to foster intellectual development through active apprenticeship in aspects of the Knowledge-in-Development process. Knowledge-building in schools is also very definitely not professional R&D. Its aims and ends are educational. To be successful, it requires careful management/leadership by skilled teachers, as students will not come with the necessary skills or knowledge. The point of knowledge-building is to scaffold these, slowly and carefully.

Bereiter and Scardamalia are also clear that knowledge-building is not another name for the more familiar classroom practices of inquiry, collaboration, project-based learning, and so on. These activities, they say, are usually teacher-directed, often contrived, and encourage students to depend on their teacher, and, for this reason, they actively militate *against* knowledge-building (Bereiter, 2002).

Knowledge-building is useful, not just for students, but for teacher development. For example, it has affinities with New Zealand's 'Communities of Learners' initiative, and the linked idea of promoting 'innovation from within the system', at least at the ideas level.[2]

Knowledge-building's purpose is thus very different from that of constructivism. Constructivist approaches to teaching aim to facilitate better learning of pre-specified curriculum concepts, that have been derived from disciplinary knowledge. Where this is the goal, constructivist models of learning can be helpful. Learning experiences can be designed to take account of and, where necessary, disrupt, students' pre-existing ideas. There are however some obvious practical limitations, particularly when teachers have classes of 20-30 individuals, all bringing different background experiences and pre-existing ideas, and many concepts to teach. However, the extension of constructivist thinking into new educational purposes—e.g. investigating how students might be 'socialised' into the intellectual practices of a discipline—tested it to its limits. This could be a signal that constructivism (as well as the focus on individual learning) has had its day.

There are some synergies between what knowledge-building is designed to do and what the science educators of the 1990s were beginning to do. However, because knowledge-building clearly separates out the different meanings and purposes of knowledge construction, it offers a much clearer structure for thinking about teaching and its purposes, on the one hand, and curriculum and its purposes on the other. It is also, in my view, much more useful as a framework for developing pedagogies designed to foster children's intellectual development in ways that are appropriate for the 'knowledge age'.

For teachers interested in exploring knowledge-building further, there are many resources available. Over the years Bereiter and Scardamalia and their associates, in addition to their many academic papers, have produced a range of resources for teachers, many of which are freely available on their website.[3] They have also produced software packages designed to support knowledge-building in schools. These include CSILE (Computer Supported Intentional Learning Environments), later replaced by Knowledge Forum, which is available for purchase by New Zealand teachers and schools.[4] And in New Zealand there is a group of researchers and teachers, known as Knowledge Building New Zealand, who convene regular meetings for interested teachers, and host a website with resources and research-based information for teachers.[5]

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AUTHOR BIO

Jane Gilbert is Professor of Education at Auckland University of Technology. She has also worked at NZCER as Chief Researcher and in the Schools of Education at Victoria University of Wellington and the University of Waikato. Many years ago, she was a secondary school teacher of science. She is the author of *Catching the Knowledge Wave? – The Knowledge Society and the future of education*.

ENDNOTES

[1] It is important to note that in this context "building", "construction", "scaffolding" and so on are all being used as metaphors.

[2] In the current operational conditions, many Communities of Learners might not be ready for this yet, but it is worthwhile as a future aim.

[3] See: www.knowledge-building.org. For examples of knowledge-building being used in classrooms, see the paper by Tarchi et al. (2013) listed in the references above.

[4] See: http://knowledgeforum.com. See Scardamalia (2004) for a description of the software.

[5] See www.otago.ac.nz/kbnz/resources and/or https://sites.google.com/netnz.org/kbnz/home. The material on this webpage could also be helpful: https://theconstructionzone.wordpress.com/2015/01/22/knowledge-building-what-is-it-really.