

# Reconstructing Constructionism

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It is more than a quarter of a century since the idea of constructionism was launched by Seymour Papert - the n-word rather than the v-word, constructivism. While the latter idea captured nicely the psychological substrate on which all learning (irrespective of teaching) is built, the n-word sought to develop a theory of pedagogy that could foster learning. More than that, while on the surface, the constructionist project seems like a pedagogical theory, it is as much a theory of epistemology as one of pedagogy, seeking to develop knowledge structures in the mind alongside physical or virtual structures external to the mind. Understanding the development of the structure of knowledge is part of and integral to the encouragement of an inclusive and powerful pedagogic theory and practice.

Constructionism symbolised a way of thinking about learning, a metaphor for the ways that human beings come to learn most effectively; building, debugging, sharing in ways that could at last be reasonably straightforward, or at least achievable thanks to digital technologies - particular what Seymour called its "Protean" nature - its potential for being all things to all people. The Logo movement was, of course, emblematic of this approach and continues to leave a powerful mark on the educational world, a mark that is evident in the proceedings of this conference.

How odd, then, that so many believe that Logo, and more importantly, what Logo stands for, has failed in its essential mission to transform learning and teaching. Even learning settings that share Seymour's vision implicitly, seldom recognise their practice as an instance of the constructionist class. More often than not, it is confused with its psychological cousin, constructivism - a word that has all but lost its real meaning in the rush to embrace an alternative to behaviourism and its offshoots, a meaning diluted to the point that almost any pedagogy is routinely described as 'constructivist', as if a recognition of how humans learn is sufficient for prescribing how and what they should and could be taught.

I think there are many reasons for this, and they include political, sociological and philosophical as well as epistemological dimensions. I believe our conference here will touch on all these dimensions. The challenges are many: they include what it now means to collaborate, the idea of modelling, how to tap into young persons' cultures, new problems of design - the challenges are considerable. Here I want to focus on one difficulty that I think is particularly pertinent.

There is a fundamental difficulty of constructionism as an epistemological idea. As Papert says, the difference between instructionism and constructionism

"looks like a split about strategies for education: two ways of thinking about the transmission of knowledge.

But behind this there is a split that goes beyond the acquisition of knowledge to touch on the nature of knowledge and the nature of knowing".

In a world where the mismatch between telling and learning is all-too-evident - perhaps to all but the most regressive of educational policy makers - constructivism is an unproblematic alternative. Precisely because it is a theory of how the mind constructs knowledge, it does not threaten what needs to be known; the grain size of the constructivist description of human

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learning makes it homogeneously applicable, it does not challenge who needs to know what; and since constructivism focuses its attention on the learning capability of the individual mind<sup>2</sup>, it does not require a rethinking of how to foster learning in the light of new tools that make the inexpressible possible to express. Constructivism is interpreted as constructionism minus epistemology.

At root, therefore, is the extreme reluctance of the educational enterprise to change what to teach and its preference for straightforward evolution of pedagogy (at most). Compared with reevaluating what can be taught and to whom, the switch from instructionism to some other ism that recognises the complexity and heterogeneity of learners, is unproblematic. Doubtless we will see many examples at this conference of genuine epistemological transformation, expressed as instances of what the constructionist project intends. It is time to gather these examples together, to develop a theoretical framework that can encompass the tremendous range of existence theorems that are instantiated in this conference, and turn them into a programme - of research and practice - that can do justice to Seymour's idea.

One possible starting point is a seminal paper by Andy diSessa and Paul Cobb. In it, they argue for the importance of theory in educational design experiments, and they survey different roles played by theory in design. In differentiating between four types of theory -- from 'grand' theories such as Piaget's constructivism (which they properly point out was not intended and largely fails to inform design) to "Domain specific instructional theories", which involve testable conjectures about learning processes and how to devise pedagogic situations that encourage them.

Constructionism, like 'learning by designing', Cobb and diSessa argue, falls into a category they call "Frameworks for Action", and they argue that while these frameworks do provide some heuristic power and structure to the design of learning environments, they typically:

... do not cleanly separate their scientific claims and validation from their suggested actions. That is, the theory or theories behind frameworks for action are relatively inexplicit, complex, and often involve multiple very diverse elements that cannot plausibly be brought under a single umbrella.

DiSessa and Cobb argue for the need to 'manage the gap', the failure of most frameworks to accommodate the complexity and interactions between the elements of instruction itself. It is a truism to note - as have so many others - that instructional effectiveness depends on many variables, not least the nature of technology - a field which is chaotic in the literal sense: tiny changes in, for example, the user interface can make massive changes in learning. The primary point is that in order to test theory, it is necessary - as far as possible - to maintain a gap between the pedagogical strategies at stake and the theories that motivate them. This is, of course, a difficult and mostly unattained task.

In contrast to these prevalent theoretical constructs, diSessa and Cobb propose the idea of ontological innovation, the idea, familiar from the realm of natural science, that it is necessary to 'develop theoretical constructs that empower us to see order, pattern, and regularity' in the settings under investigation. And here is the crux of a challenge confronting constructionism as a theory.

The tendency of most educational research - and by implication the producers and consumers of education research - is that the fundamental concepts remain invariant over time and technologies. It is tempting to take this observation as merely trivial: educational change is slow, it seldom takes account of the possibilities of knowledge transformation, and it is almost always concerned only with teaching more effectively, rather than learning within new epistemologies.

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<sup>2</sup> I am aware that one of the flavours of constructivism is social constructionism. But here too, while the role of others in the development of individual cognition, and even technologies, is acknowledged, the nature of knowledge is largely uncontested. One exception to this is the French didactic tradition.

While this is true, it misses a key point about constructionism. When we build, we build with things - not just ideas. Of course, if we design properly, the things we build with have an epistemic foundation - of 'powerful ideas' say, that students are supposed to bump into. But the ways the things are connected, the relationships between them, and the behaviours they are given have to be expressed in the system of the things, not in the system of ideas. I could express the fact that the paragraph settings of this paragraph are contained in the final paragraph marker as a line or two of code; but as i am building this paragraph, it is much more natural to say (to myself), "If I merge this paragraph with this one, it will inherit the second one's properties. Note the informality of my expression: 'this' means nothing outside the situation of writing.

This particular property of construction systems (like programming languages) is both a powerful advantage and a difficulty. It is powerful because the complexity of an idea often inheres as much in the way it is represented as the idea itself, and being able to express the idea without learning a new language allows access to otherwise inaccessible knowledge. But it creates a difficulty that educational research has yet to confront: that of building an ontology for constructionist environments which, by definition, involve expressing relationships between objects.

Let us give an example of this problem. Some years ago, Celia Hoyles and I noticed a recurrent pattern in students building computational expression for mathematical and scientific ideas. We saw that while they seemed often clearly able to abstract from the particularities of the activity, as evidenced by an often implicit recognition of the relationships between variables, these abstractions did not resemble in their expression, the standard forms of algebraic or even quasi-algebraic representations. Naturally enough, they employed the tools - objects and relationship between objects - with which they had used successful in the activities. The tools-in-situation, in other words, acted as a means to express abstractions that might not have been expressible in standard forms: we called these 'situated abstractions' to try to capture this idea.

Situated abstraction is an ontological innovation in the sense that it identifies and organises a class of behaviour and expression that occurs in the context of activity in constructionist environments. Like any useful theoretical idea, its power lies in its application - in the potential of the idea that started as an observation of behaviour to influence and shape behaviour. The hypothesis is that there exist a range of ontological innovations that are yet to be identified and used, and that there exists some common element among them that derives from the constructionist setting in which they are identified.

Any ontological innovation worth its salt becomes natural over time: perhaps the most famous example is that of 'powerful idea' and its associated design principles (e.g. Papert's "Power Principle". And while 'powerful idea' works as an ontological element of educational discourse, the idea of ontological innovation is itself an ontological innovation in the domain of research. In that respect, we could ask how ontological innovations arise - and particularly, how can we use the idea here at our conference.

As I said earlier, I think we have at this conference a tremendous opportunity to study examples of genuine constructionist practice. Can we abstract from these examples some organising structures, elements of a new ontology for educational transformation? Can we develop elements of and relationships between those elements -- a grammar for constructionism?

This is the challenge for this conference: to reconstruct the idea of constructionism and transform it from a framework (or slogan) for action into a set of ontological innovations, ways of conceptualising what people do in constructionist environments, and to use this as in a way that can assist us in designing those environments.

Seymour often made the point that we don't have a language for discussing the kinds of radical transformation of learning (and by implication, schooling) he envisaged and most of us have

inherited. It is time to invent that language as a step towards realising his and our radical transformation.

I think that, at last, there is a convergence of technological forces that will mean that we are cutting with the grain. It is the complete transformation of human interaction that has been occurring for about 10 or 15 years, and which shows no signs of abating. This is not technological determinism: the mobile phone has transformed the way people meet - that is obvious and while the phone itself doesn't of course have agency, it makes perfect sense to talk about a technological transformation as shorthand for a social transformation catalysed by technology.

Lenin once said that for revolution, only two conditions were necessary<sup>3</sup>. One it that people cannot continue in the old way. That is true for us now: educators cannot continue for much longer teaching what we have always taught, ignoring the possibilities and potential of technical transformation, and simply squeezing the last drop from the infrastructures that were set in place in the nineteenth century. Neither can we, ourselves, ignore any longer the importance of engaging teachers as agents of change, rather than something to be changed (or even, in some versions, abolished).

The other condition was that people could see some alternative to the old way. For that to happen, we need more than the instances we will hear about this week: we need the language, the grammar, the ontology and above all, the voices of students and teachers that will help us reconstruct that vision into a reality.

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<sup>3</sup> I'm leaving aside how we *get* to our revolution: maybe Wally Feurzeig is right - evolutionary change can build to revolutionary change.