When Is a Constructivist not a Constructivist?

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> Upshot • I review the arguments put forward by Borg et al. as to why a teacher cannot be constructivist in their methodologies and ask why they have not considered constructivist methodologies that emphasise negotiation.

« 1 » Philip Borg, Dave Hewitt and Ian Jones present the Mathematics-Negotiation-Learner (M-N-L) framework, which they propose as a theory about what constructivist teaching (CT) *might* (my emphasis) mean, by "focusing on the role of the teacher in the educative process" (§4) and portraying her as a "negotiator" between the learner and the subject content (hence the dashes in M-N-L). The key concept within the framework is "negotiation," which I deal with especially in this commentary, but first, I must refer to the four primitives that Borg et al. forefront at the outset.

« 2 » The authors list four arguments to contest the existence of a kind of teaching that may be called "constructivist teaching." The issue of whether constructivism is or can be a teaching methodology or merely an epistemology has been argued extensively elsewhere (notably in Tobias & Duffy 2009), however, I think there are serious problems in authenticity in teaching when methodology is separated from epistemology. It is something akin to the "saving of appearances" standpoint from the history of science when Copernicus devised the heliocentric system but claimed it to be only a mathematical construct in order not to detract from the metaphysical worldview at the time. An epistemology that does not have a means to actualize itself is redundant, and a purported constructivist teaching methodology that is detached from authentic constructivist philosophy is at best "constructivism lite" or a kind of crypto-behaviourism. Certainly claiming to be constructivist in teaching but not in epistemology is contradictory.

« 3 » Referring to Martin Simon (1994, cited in §1), the authors list one of the arguments contesting the existence of CT as "Irrespective of [some] teaching approach[es], [some] learners will come to know by actively constructing mental constructs for themselves [some of the time]." Their argument appears to suggest that children will learn what they learn regardless of direction from teachers, and that what is needed is a minimal tweaking of the direction that construction takes place. The alternative in this paradigm would be a "teaching to the middle" or "educating some" paradigm.

« 4 » However, teaching approach does matter, as David Kolb (1984) would attest. Teachers must be clear about who should learn what, and why. Children construct idiopathically, and therefore the negotiation cannot be with the whole class but between small groups of learners, Constructivism seeks to move beyond "teaching to the middle" with the associated so-called differentiation: a little something harder for the smart kids and a little something easier for the others. **So, I must ask, what does it mean to Borg et al. to "know how to come to know?" (Q1).** To know how to come to know is to understand the process of learning itself, which is undoubtedly linked to exhibiting some understanding of the nature of knowledge. A mechanic must understand the process of a running car in order to repair a part or understand if a genuine/spurious part will suffice or even if doing nothing will affect the running of the car. This is dynamic knowledge, and a teacher must have something to say about the mind and the construction of concepts and their integration, hence the relevance to the work. Ernst von Glasersfeld (1989a: 123) stated that "'to know' means to know how to make." In other words, epistemology ("the what of knowing") is deeply embedded in methodology ("knowing how to come to know"). The big problem with CT is that the individual interaction it demands between teacher and student, or at best between small groups and the teacher is time-consuming – and the problem can only be solved by the quality of the teacher's ability to engage in small-group discussion in a whole class setting.

« 5 » CT may indeed be mistakenly equated with progressive modes of teaching (e.g., Engström 2014 cited in §1) such as "active learning," "problem solving," or "enquiry learning" but such a mis-equating of ideas is due to CT *not* being promoted as a progressive mode of teaching itself, with teachers and student teachers left to work out for themselves what works as a CT environment.

« 6 » Finally, Borg et al. believe a constructivist belief does not translate itself into a particular teaching method (Simon 1994, cited in §1), but to be constructivist it must still adhere to Ernst von Glasersfeld's two premises of constructivism.

« 7 » Borg et al. agree with all these arguments but still claim that the notion of CT is viable if it is attributed to a "teacher's sensitivity to learners' active and subjective construction of knowledge" (§2) during the teaching-and-learning process. So, if the child is a constructivist learner, the teacher can allow or tolerate it but not necessarily be a constructivist teacher – in other words, does it make sense to advocate constructivist learning without fully constructivist teaching? While Paul Kirschner, John Sweller and Richard Clark (2006) assume that learning is an individual process of knowledge acquisition, David Jonassen (2009) assumes that learning is seldom accomplished individually. According to Jean Lave and Etienne Wenger (1991) humans share their meaning and co-construct reality in communities of practice. Similarly, Marlene Scardamalia and Carl Bereiter (1991) used the phrase "communities of learners." Jerry Suls and Thomas Wills believe humans to be social animals who rely on feedback from peers to "determine their own identity and the viability of their personal beliefs" (Suls & Wills 1991: 116) such as affirmation within a community; therefore learning is socially negotiated.

« 8 » Socially-negotiated learning relates to concepts of metacognition according to the "five pillars of wisdom" of the general cognitive acceleration paradigm (Shayer & Adey 2002; Adey 2008). The Cognitive Acceleration through Mathematics Education (CAME) Project states the "five pillars" listed as follows with my own elaborations:

a *Social construction* of knowledge upon prior learnings, which can be sharing explanations and understanding of a problem and potential solutions.
b *Bridging* strategies with everyday experience, which can be working together

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to apply ideas "generated" in the lesson to problems in the world we experience.

c *Cognitive conflict* – challenging certainties, which can be thinking about a problem in a way that challenges prior knowledge.

d *Metacognition* – the explicit cognizing of students' constructions, which can be reflecting on thinking and articulating approaches to solving a problem.

e *Concrete preparation* of the cognitive "space" to determine "readiness" and which can be introducing a problem and helping with any new vocabulary or ways of doing.

« 9 » Negotiation is a feature of democratic and non-authoritarian personal interactions, as is metacognition. Social construction also involves negotiation and cognitive conflict can only be resolved satisfactorily through negotiation. Therefore, it is difficult to understand the decision neither to refer to the CAME Project, nor independently refer to metacognition or cognitive conflict. Therefore, this gives rise to a second question: **Why did Borg et al. not refer to or consider the CAME Project (Adhami, Johnson & Shayer 1995; Adhami, Robertson & Shayer 2004; Adhami, Shayer & Twiss 2005), or the wider implications of the cognitive acceleration paradigm? (Q2)**

« 10 » In the learning sciences, negotiation is best thought of as the means of seeking the student input into their own learning to arrive at a shared understanding. However, in the constructivist paradigm, it is not merely "tricking" the student to arrive at the same conception as the teacher by the artistry of teaching. In the constructivist paradigm, the teacher devolves their control by declaiming the ultimate authority of the subject content material itself, and thus the goal of mathematics education is not to acquire the mind of the teacher / mathematician, but rather develop the constructions of the student to be what they can be. The CAME project uses negotiation to assist learning in one or more, but at times all of the methodologies listed above. The thing is, negotiation, if authentic, does not try to steer a course to a direct goal known or pursued by one party to the negotiation. In constructivist learning, and teaching, negotiation will not be trivial, or inauthentic, but demand an openness that goes beyond mere sensitivity and makes the teacher as accountable to the learning contract as the student.

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Mathematical Observers Observing Mathematics

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> Upshot • Suggestions are made for ways of taking advantage of Borg et al.'s reference to the notion of observer for data analysis in mathematics education research.

> "Thus, if someone claims to know algebra – that is, to be an algebraist – we demand of him or her to perform in the domain of what we consider algebra to be, and if according to us she or he performs adequately in that domain, we accept the claim." (Maturana 1988a: 4f)

« 1 » In order to ground their idea of Mathematics of the Students (MOS), in their target article Philip Borg et al. make use of second-order models and the notion of observers to discuss issues of data analysis. In this commentary, I suggest that these ideas can be further deepened by making reference to Humberto Maturana's theory of the observer. In Proulx (2014) I argue that some aspect of Maturana's observer[3] could lead us beyond, and even question, Leslie Steffe's use of second-order models to describe the mathematics in students' minds. From an observer's point of view, MOS does not "exist" in itself in the students' minds, but emerges and is distinguished by observers through the act of observing. Therefore, MOS lies in the eye of the observer, and what is recognized as mathematics is what the observer recognizes as mathematics on the basis of her own experiences that she understands as mathematical.

« 2 » Henceforth, we can re-use Borg et al.'s views of what the curriculum is for conceptualizing MOS, where MOS could be seen as something that observers have construed for themselves:

> "RC teachers, however, believe that no such thing [i.e., curriculum/body of *a priori* mathematical knowledge] exists and that the curricular topics they are required to teach are actually knowledge they (the teachers) have construed for themselves." (§3)

« 3 » This view of MOS through the observer has quite some potential at the epistemological level for mathematics education research in relation to data analysis, as I already claim in a previous commentary (Proulx 2014). Here, I build on this commentary and re-insist and extend some of these ideas by adding concrete examples taken from my studies.

Observing possibilities

« 4 » In Maturana's theory of the observer (e.g., Maturana 1987, 1988a, 1988b), the observer is central to any *account* of any given phenomenon, for "everything said is said by an observer to another observer that could be himself or herself" (Maturana 1988b: 27). As explained in Maheux & Proulx (2015) and Proulx (2014), even if, as researchers in general, we may not believe that "the phenomenon being observed" is a fact independent of the observer and that it can be decontextualized from the observational act, we often take this position implicitly by how we report our findings. As Richard Barwell (2009) explains, even if we agree that we cannot account for what "really" happens, research is still being reported (and maybe even conceived) as if this were the case. This is, for example, the case when

3| I do not pretend to represent, make use or apply Maturana's ideas of the observer here. The issues I raise have been inspired and occasioned in relation to his work. Thus, there is more in his writing than what I offer here, but also less. But, nonetheless, his writing has made these distinctions possible for me as a researcher.