Deconstructing Creativity

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> Abstract • The authors of the target article provide insight into various ways creativity has been presented in the past 50 years or so. In my commentary, I identify some historical antecedents of key 4E ideas that can be found in the work of Dewey, Piaget and von Glasersfeld. I also allude to some crucial differences between radical constructivism and 4E cognition, and wonder whether implicit epistemologies may impact on the creative process.

Some historical antecedents

« 1 » My career was centrally involved in explaining ideas that guided the Irish Primary School constructivist curriculum of 1971 and 1999 to intending primary teachers. Prior to that I worked for two years as a post-doc with Charles Smock at the University of Georgia in the US on a Piaget-based Follow Through intervention. One of my first papers at that time (Gash 1974) was about the similarities between the epistemologies of John Dewey (1960) and Jean Piaget (1970). That paper raised my awareness of some of the key ideas now presented afresh in new language in the 4E approach, as portrayed in the target article by Ronnie Videla, Tomas Veloz and María Carolina Pino. For example, there are similarities in Dewey's and Piaget's accounts of thinking processes. I was intrigued that Dewey had objected to reality as the test for knowledge. He presented idealism and empiricism as each depending on the concept of a prior reality:

> "According to both systems of philosophy, *reflective* thought, thinking that involves inference and judgment, is not originative. It has its test in antecedent reality as that is disclosed in some non-reflective immediate knowledge." Dewey (1960: 109)

« 2 » In contrast, Dewey gave an account of the relation between ideas and action in which ideas were uncertain and their validity or viability depended on the consequences of actions in concrete experience. Ernst von Glasersfeld (2007) noted historical origins for this position in the works of the philosophers Giambattista Vico and the George Berkeley, for example, truth in Vico depended on what was constructed ("verum ipsum factum") and being in Berkeley depended on what is perceived ("esse est percipi"). These ideas were central in his radical constructivism (RC).

« 3 » Dewey (1960) emphasized the importance of activities in knowing. In Piaget's theory (1970), sensorimotor activities were the foundation for cognition. And action is also central for Humberto Maturana (1988), who described language as recursive consensual co-ordinations of co-ordinations of actions in a shared consensual domain. Each of these examples resonates with sensorimotor engagement as a foundation of the 4E approach and is important in STEAM education as described in the target article (§4). The importance of human action leading to experience is also prominent in Maturana's second criterion for science:

> "The proposition in the praxis of living of the observer of a mechanism that as a consequence of its operation would give rise in him or her to the experience of the phenomenon to be explained." (Maturana 1988: 34)

« 4 » Dewey (1960) discussed these views concerning ideas as hypotheses whose value depend on the activities used to test them, thereby acknowledging both Charles Sanders Peirce's (1923) pragmatism and Percy Bridgman's (1964) emphasis on operations. I do not claim to know how these historical ideas fit in the broader works of Peirce and Bridgman. Rather, I want to observe that these historic ideas being part of constructivist and, in particular, RC thinking reappear in 4E cognition in a fresh context. Von Glasersfeld (1974, 2007) considered that Piaget was rather ambiguous about the status of reality in his genetic epistemology. In RC, any mind-independent reality cannot be known as we cannot go beyond our experience (Glasersfeld 1974). In addition, RC lends itself to conceptual analyses affording precision in relation to what happens in the mind when we use words (Glasersfeld 1972), and in recent work based on Piaget's theory, heuristic probabilistic models have been exploited (Tourmen 2016). Do these formulations in RC of conceptual analyses and of computational models fit with the rejection of formal mechanisms or logical rules in 4E cognition emphasized in the target article (e.g., §11)? Q1

Is there a paradigm distinction to be made?

« 5 » The development of creative processes may be helped by making previous prototypes opaque or invisible (§6), however, once new solutions are created, it is part of the scientific process to model them. In the process of finding creative solutions, there are times when new ideas occur spontaneously and creative solutions just appear without reference to internal processes (§3). There are other occasions when finding the solution is more open, with ideas appearing in the mind and then being tested. This was the case in a video I made of a 5-year-old doing a conservation-of-number task. The conservation-of-number task assesses whether children appreciate that the spatial organization of a set of objects is irrelevant to the number in the set. At one point, the 5-year-old thought that when I moved the four objects further apart that the number had increased. I asked him a second question to get him to count the objects again. This was to clarify the purpose of the first question. He counted the set and then said: "It looks like there are more but there aren't!" Here the purpose is signalled to orient the intention, this is contrary to §6 where there is no intention in the mind. Further, the acquisition of conservation of number is generally regarded as a fixed product in the mind, and this is contrary to §3 where it is preferred to avoid end products. Acquiring conservation of number traditionally means having constructed a reformulation of the pre-operational perceptual way of perceiving this task.

« 6 » How can we interpret the link between conceptual understanding and creative processes? Prior to the work on mathematics education, von Glasersfeld (1972) worked on formal language analysis, operational semantics and machine translation. This led to his use of interviews, derived from Piaget's clinical interview, to discover how children construct their

mathematical concepts (Glasersfeld 2007). Models of what is happening in the child's mind are useful to teachers and examples are provided in work on children's counting types (Steffe et al. 1983). The formal approach to analysing concepts could be seen in contrast to the 4E approach to cognition, which in its ambition to move beyond the distinction between the dualism of mind and body, views concepts and images as emergent procedures, as is pointed out in the target article (§§11–13). Despite this, Videla, Veloz and Pino hold that RC is still in tune with 4E cognition and enactivism in particular (Footnote 4). However, this view may not be shared with all scholars working with the 4E approach. In his review of 4E cognition, James Carney (2020), for example, makes the case that the 4E approach eschews any computational model and emphasizes that there are a series of arguments for retaining computational probabilistic models of cognition.

« 7 » Such an "emergent" component can also be identified when distinguishing von Glasersfeld's constructivism from Maturana's work. Vincent Kenny (2007) called the latter even a "radical realism" in that, in RC, dualism is rejected because reality cannot be known, and all we have are constructions. Whereas in Maturana's "radical realism," the inside–outside distinction is irrelevant because being and acting and knowing are interlinked. The lack of the inside–outside distinction makes Maturana's views appear closer to 4E cognition and also to Dewey's.

« 8 » Kenny (2007) described a second distinguishing feature between RC and Maturana (whose autopoiesis concept "inspired" enactivism, §12): RC is concerned with the epistemological basis of knowing and Maturana was concerned with the biological basis of knowledge and cognition. So, different language and assumptions or foci are involved.

« 9 » Could it be that there are fundamentally different aims between RC and 4E cognition, like the different aims Kenny identified between von Glasersfeld's and Maturana's project? In von Glasersfeld's work, one can talk about the mind and mental structures, and so on. Whereas in Maturana's theory and in the 4E approach, the mind–body distinction is no longer relevant. Perhaps it is the case that the language used in RC does not reflect the distinctions made in the 4E approach, because in either of them the meanings and connotations of mind, mental, cognition, and so on, are different? John Naughton[1] cites the debate in AI concerning the meaning of intelligence and sentience and how AI may be intelligent in being predictive on the basis of available data, but only sentient in the restricted sense of acting deliberately. There is a need for a philosophy of AI, because use of words like intelligence, sentience and thinking in AI can be misleading. In the recent history of cognition described in this commentary, the word "mind" was used following the Cartesian approach in which mind and body were separate, whereas in the 4E approach this division is merged in the language of embodiment. Language hides processes and the theoretical differences between RC and the 4E approach are reflected in the language used. If so, RC and the 4E approach must be considered different paradigms with different assumptions. RC's approach to cognition is designed to describe, explain and model new creative solutions, whereas the 4E approach pertains to the here and now and has its place when it is important to ignore past creative solutions and focus on the unknown in solution seeking (§6). Can RC's emphasis on the importance of cognition in explaining new solutions fit with the 4E approach?

« 10 » The implicit epistemologies of participants is a variable that may be important in the work on creativity described in the target article. Josua Cruz and colleagues (2021) studied the implicit epistemologies of engineering students working at the intersection of engineering and the arts. Their study identified positivist, constructivist and pragmatist student epistemologies and made recommendations on how helping teachers' awareness of the students' ways of thinking could influence the ways the teachers framed questions. In addition, they recommended that students who came from more artistic persuasions should be encouraged to develop their creativity and expressive qualities by their teachers, whereas more scientifically oriented students needed more help when approaching the artistic side of their work.

« 11 » In previous crosscultural work with Zdenka Chocholouskova (Gash & Chocholouskova 2013), we identified various ways teachers in the then Czech Republic varied from Irish teachers in their views on the importance of such factors as learning to communicate (most important for the Czech teachers) and learning to learn (most important for the Irish teachers). Future work on projects like the target article might find these types of variation in the thinking of student and teacher participants useful in promoting creativity.

« 12 » My hope is that the fresh approach and language embodied in 4E cognition will stimulate educational work requiring creativity, while cognitive and computational modelling in an RC framework remains a viable alternative to the 4E approach. Paraphrasing Carney (2020), the jury is out on the status of empirical claims for 4E cognition, and if it is vigilant, its promise may lead to a significant contribution to the study of human cognition. This may also shed light on whether the main difference between RC and the 4E approach is just the language or whether there are deeper paradigm divisions.

1| See his "Misplaced fears of an 'evil' ChatGPT obscure the real harm being done," in *The Guardian,* 5 March 2023. https://www.theguardian.com/commentisfree/2023/mar/04/misplaced-fears-of-an-evil-chatgpt-obscure-the-real-harm-being-done

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Diving Deep into the Ocean Through Skillful Problem Posing|Solving Experiences

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> Abstract • In this commentary, I extend Videla, Veloz and Pino's conceptual analysis of their design-engineering students' flow of actions by drawing similarities to some of the recent developments in problem-posing and problem-solving research in mathematics education.

« 1 » In their target article, Ronnie Videla, Tomas Veloz and María Carolina Pino demonstrate how the 4E approach to cognition can be used to explain creative experiences of a group of students in a STEAM educational setting involving solving lived environmental problems through design, prototyping, and collaboration. Presenting creativity and problem solving as important skills for the 21st century, Videla, Veloz and Pino also illustrate how creativity can be fostered in STEAM environments that are rich in sensorimotor engagement opportunities, and involve building new artifacts, experience with different types of materiality, and problem-solving experiences that are based on the 4E approach to cognition.

« 2 » Reading the target article made me immediately think of similar conceptual analyses of students' flow of actions, explained from enactivist perspectives, by Jerôme Proulx, Jean-François Maheux, and Robyn Gandell (Proulx & Maheux 2017; Gandell & Maheux 2019) in the field of mathematics education. In their analysis of mathematical problem solving, Proulx and Maheux (2017) ground some of the ideas of the mathematical problem-posing and problem-solving literature in Francisco Varela's problem-posing perspective (Varela, Thompson & Rosch 1991; Varela 1996). Although I have also been conducting educational research with colleagues for quite some time on the co-evolution of problem posing and problem solving, but from a radical constructivist perspective (Sevim & Cifarelli 2013; Cifarelli & Sevim 2014; Cifarelli & Sevim 2015), I am delighted that Proulx and Maheux (2017) offered equally useful explanations that detailed the dynamic interactions between problem posing and problem solving. In their re-conceptualization, Proulx and Maheux (2017) offered *posing|solving*, or *problematizing*, as a continuous dialectical process of small problem-posing and problem-solving instances (Gandell & Maheux 2019), where posing and solving emerge as inseparable activities. As a form of asymmetrical organism–environment coupling (Harvey 2017), posing|solving orients me to consider Videla, Veloz and Pino's students' flow of actions, in which they observe-document-do-reflect-show (§§30–38), as part of project-based learning in STEAM education, as having close resemblance to Gandell and Maheux's (2019) students' posing|solving paths.

« 3 » In posing|solving, there are no problems pre-existing out there, independently of solvers' interactions with them, with built-in conceptual structures or meanings; instead, solvers bring them forth through their interactions with what Proulx and Maheux (2017) and Elaine Simmt (2000) call a "given prompt." When faced with this given prompt, the solver reacts to it and makes it her own by posing a problem. This posed problem, in return, becomes a new prompt (a self-generated prompt) to react to (Sevim 2017). Interactions with, or reactions to, prompts and problems are called problem solving, which bring the solver closer to the solution of the given prompt. The posed problem, as a new