

OPENING THE SPACE OF POSSIBILITY – FOR MYSELF (AND OTHERS?)

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Our efforts to understand the world are better thought of in terms of interpreting our own perceptions and patterns of acting within a dynamic context than in terms of coming to know that context as independent of our participation. (Davis, 1996, p. 14)

In 1990 I was invited to give a speech at the annual prize giving for the University of Cape Town Mathematics Olympiad competition. The topic of the speech was a thinly disguised biographical piece where I gave myself the name of Alfredo and described my coming of age as a learner (Breen, 1990). The starting section was given the heading “Closing” as I was trying to reflect my growing perception that my school learning experience had been limited by the constant attempts by teachers to mould me into a form that others wanted, and that I was allowed to negotiate. I was expected to learn without deep understanding and perform at ever-increasing levels, through the teachers’ use of competition as a hook to get my involvement.

At the end of this *closing* start, I moved on to the next section headed “Opening”, where I described the impact of my period of study on a master’s programme at Exeter University, UK, where I was first exposed to the ideas of Caleb Gattegno. This was the start of a journey where I began to reassert my right to try to understand how I choose to learn and how I want to make the learning my own.

This article describes some of the ways I have developed from then through using what has been called the Santiago Theory of Cognition (Capra, 1997) in my teaching. This theory refers to the work started by two Chilean theoretical biologists, Humberto Maturana and the late Francisco Varela (Maturana and Varela, 1986; Varela, Thompson and Rosch, 1991; Varela, 1999). I will not try to give an explanation of their theories, nor will I try to justify the use of these theories in preference to another. My intention, as I write, will be to select a few examples illustrating how my teaching and learning has been enriched and been encouraged to remain *open* to issues such as relationships, patterns and processes against the current context of *closing* through quality assurance management and measurement.

Affirmation

The perturbations of the environment do not determine what happens to the living being; rather it is the structure of the living being that determines what change occurs in it. This interaction is not instructive, for it does not determine what its effects are going to be [...] The changes that result from the interaction between the living being and its environment are brought about by the disturbing agent but determined by the structure of the

disturbed system. (Maturana and Varela, 1986, p. 96)

One of my biggest challenges in post-apartheid education’s adoption of outcomes-based education in South Africa has been to find a language to express the mismatch that I experience between these politically understandable ideals and my own teaching and learning realities.

Davis (2004, p. 75) uses the term “Teaching as instructing” to capture the conception of teaching that arises from taking a rationalist perspective, and firmly locates the setting of desired outcomes before starting to plan the lesson as a fundamental consequence of this approach to teaching. He also points to another important aspect of rationalist teaching being the “continuous need to examine learners’ understandings” (1996, p. 81).

This continual focus on the pivotal role of the teacher in determining outcomes and continually assessing learners’ attainment standards goes against the enactivist, a term coined by Varela (see, 1999, p. 12), position that a learning environment is constituted by teacher, learner and the context in which the learning takes place. This insight immediately broadens my gaze and re-focuses me from a narrow look at my own preoccupations as teacher and encourages me to become far more aware of what it is that the learners bring to the teaching situation. This is an old familiar belief of mine that was losing credence under the new orthodoxy. Enactivist ideas provide a timely re-affirmation of these beliefs.

Varela, Thompson and Rosch (1991, p. xv) describe the term “structure” as a fluid and temporal self, which is formed “by the combined influence of one’s biological constitution and one’s history of interaction with the world” (Davis, 1996, p. 9). The concept that, as teacher, I can become ‘a disturbing agent’ in the classroom but that the changes (which I take to be the learning) will be determined by the structure of the learner is extremely liberating. I can pursue my interest in becoming a better perturbator with relish!

Davis (2004, p. 170) refers to the product of a learning theory based on Complexity Science as being “Teaching as occasioning”, where occasioning signals the participatory and emergent natures of learning engagements as it points to both the deliberate and accidental qualities of teaching. This also gives me a space to operate that allows me to be surprised at what happens and to try to behave in an appropriate way in response.

Listening

In the enactive approach reality is not a given: it is perceiver-dependent, not because the perceiver ‘constructs’ it as he or she pleases, but because what counts

as a relevant world is inseparable from the structure of the perceiver. (Varela, 1999, p. 13)

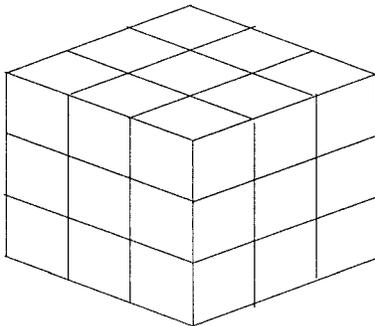
Davis (1996) focuses his main attention on developing a different form of listening from the common types of evaluative and interpretive listening. Following Levin (1989), he adds a third form – that of hermeneutic listening. In hermeneutic listening, we get into dialogue with one another so that our conflicting prejudices can be uncovered and transformed by listening as if we were the other so that we can see what they are saying through their own eyes. There are echoes here, for me, from a quotation from Kierkegaard that I was introduced to in my Exeter days.

No, to be a teacher in the right sense is to be a learner. Instruction begins when you, the teacher, learn from the learner, put yourself in his place so that you may understand what he understands and in the way he understands it [...] (Kierkegaard, 1939, p. 231)

I have used this emphasis on trying to listen to others as if you were them in an activity with my pre-service mathematics teaching class. I give the class a problem to solve in groups of three or four, and I tell them that their main task is not to get to the answer but rather to develop into a community of learners that embraces the diversity of thinking that exists in the group. At the end of the session, they will not be asked to give their answer, but rather to write about their perceptions of the different learning styles that were present in the group and the way in which different people had contributed to the community.

As can be imagined, in a class of successful mathematics students the students find it difficult to maintain a focus on the group rather than on the solution of the problem. In a previous class, I gave the students the task of solving the problem of ‘Painted cubes’ (see Figure 1). In order to assist with the visualisation task, I made some connectable small cubes available for their use in building the larger cubes.

In one group of 3 students, the issue of asking questions versus telling and the damage done by assumptions came to



A three by three cube is made out of 27 little blocks.
The outside of the block is painted red.
How many little blocks will now have
3 sides painted red? 2 sides painted red? 1 side? 0 sides?
Investigate this for different sizes of cubes.

Figure 1: The ‘Painted cubes’ problem.

the fore in a group in which Prince was working with two others. At the end of the session, when they were asked to reflect on the process, Prince immediately recorded his findings on audiotape. The overpowering presence of a ‘teller’ in the group and the way in which this crushes Prince’s own way of working was starkly evidenced in this extract:

I attempted to visualise it in my mind at first but I struggled with that so I decided that I would build just the one face of the cube and then see if I can work anything out from that. I took the blocks and put them together and just before I finished putting up one face, Michael already had the answer. He gave the answer to us [...] He went on with the other blocks – the blocks that would have only two sides painted, one side painted and no sides painted. He just gave us like the answers to all that.

I tried to ignore him because I was still looking at my face trying to figure out things but it was difficult for me to ignore the answers that he gave to us. So I don’t know if that put me under pressure or what. I don’t know if I should call it pressure, but basically I just couldn’t figure out things any more. I couldn’t think. I had the face in my hand. I tried to move my fingers across it, trying to visualise things and make a few calculations. I couldn’t, because he had already given us the answer and what he was doing now, as I was aware of my trying to figure what was going on, he was sort of moving on to a $4 \times 4 \times 4$ cube and that put me under even more pressure.

So I found myself asking him “How did you figure that out?” “Can you just explain that to me how you got the answers?” And then he went on like this, “OK, listen Prince, on the corners you have 4 and between them we have one blah blah blah and that makes ...” It didn’t make any sense to me.

This extended extract gives a clear and powerful insight into the way in which being told an answer can freeze a student’s thinking to such an extent that they might end up colluding with the ‘teller’ in their own mis-education. Fortunately, in this particular example, Prince is a capable mathematician with a persistent streak who had the support of the third member of the group, Joyce, in re-grouping and returning to the problem. Talking about the situation and exchanging perceptions with all three students and the rest of the class highlighted different views and motives such as the extent to which the fact that Prince is blind motivated Michael to try to ‘help’ him.

Ethical dimensions

Ecological discourses [...] share with complexity a conviction that all forms and events are intimately intertwined, but this conviction has prompted more of a concern for ethical know-how than practical know-how. (Davis, 2004, p. 174)

Davis (2004, p. 173) introduces “Teaching as conversing” as the consequence of an ecological perspective, and argues for the inevitable existence of a need for ethical action. This topic is the focal point of a set of lectures by Varela (1999).

This emphasis on the importance of ethical action, tied in with an understanding that I cannot stand outside a problem situation as a neutral observer, has caused me to pay attention to issues that I might previously have ignored. For example, the presence of at least one seriously fear-filled failing student on the pre-service primary teachers' course is an annual occurrence. I have started paying extra attention to these students (see for example, Breen, 2004) rather than try to superficially attend to them in the knowledge that they will soon leave my class.

The issue of ethical responsibility also came out in the 'Painted cubes' activity. One student (a middle-aged Black male) was generally silent during the session and was left on the fringes on the assumption that he was not able to contribute. Yet, to the surprise of the entire class, he later achieved one of the highest marks on a mathematics content test. If I, as teacher-educator, am inevitably a part of the situation by my very presence, the realisation that his peers may have made various assumptions on the basis of his silence, age and ethnic background propels me to explore the topic in class. This insight has subsequently grown into an ongoing challenge for me to act in a pre-emptive way to try to interrupt the taken-for-granted assumptions and beliefs of those on the course (including the teacher-educator!).

Second person research

When one puts objectivity in parenthesis, all views, all verses in the multiverse are equally valid. Understanding this, you lose the passion for changing the other [...] if the others also put objectivity in parentheses, you discover that disagreements can only be solved by entering a domain of co-inspiration [...] because one is not denying the other in the process of doing them. (Maturana, 1985, p. 1)

Depraz, Varela and Vermersch (2003, p. 1) attempt to "seek the sources and means for a disciplined practical approach to exploring human experience". They begin their search by identifying a basic cycle or "Epoche" of the reflective act consisting of three principle phases:

- suspension (of 'realist' prejudice that what appears to you is truly the state of the world)
- redirection (of attention from the 'exterior' to the 'interior')
- letting-go (or accepting the experience).

One of the ways that they identify that suspension can happen is if "another person tells you to suspend your prejudice or models this gesture to you (Depraz *et al.* 2003, p. 26). The process falls into what Varela calls *second person research* – an exchange between situated individuals focusing on a specific experiential content developed from a first-person position.

Varela (1999, p. 10) introduces the concept of "immediate coping" as we engage with the world. He claims that we have a readiness-for-action (micro-identity) proper to every lived situation (microworld). His interest is in the hinge moments where we move between microworlds and choose an appropriate microidentity. If a microidentity is generally

determined by the "common-sense emergence of an appropriate stance from an entire history of the agent's life" (Varela, 1999, p. 11), how can we become aware and increase the possibilities for action at a hinge moment?

The *Researching teaching* module, on the taught *Masters programme in teaching*, is a course that I offer (see Breen 2000, 2002) that is driven by the above perspective, which means, in effect, that teachers taking the course are asked to suspend their prejudices as they engage with the material.

One teacher explored the situation where she gives extra mathematics lessons to individual students. When she was asked to record incidents from her teaching life, she focused on the repeated situation where she was continually disappointed by students who had failed to do the homework that she had set for them in the previous session. The teacher's initial story described students entering her office and as they stay down she would ask for their homework and wait out the silence or awkwardness while they decided to own up to the fact that they had not done any and gave their excuse (*e.g.*, too hard, too busy, too sick). She could then feel her irritation growing and projected the (often unspoken) message that they had let her down. All of this would take place within the passing of a short moment and would often set the tone and culture for the rest of the session.

Working with the concept of hinge moments and belief systems in the module allowed the teacher to recognise that the arrival of the student presented her with a hinge moment in itself (which she habitually uses to enquire about homework rather than anything else). Using the technique of writing a brief-but-vivid account-of (Mason, 2002), she offered her account to the rest of the group of teachers taking the module.

He sat down. He turned his eyes away from me. I sensed what he was about to say. I stared at him with a straight face. He fiddled with his book and his face began to turn red. He said, "I haven't been able to do the homework". [1]

This is where we return to the importance of engaging with a diverse group of people whose life histories inevitably (in most cases) will have allowed them to develop a different range of micro-identities for each microworld. From their responses, the teacher gathered that this insistence on homework was not something shared by the rest of the teachers. Many of them suggested alternative beliefs and ways of engaging with the student. The process of listening to their responses as saying more about them than about her, has allowed her to accumulate a larger menu of possible microidentities for the future. She has already had some encouraging results as she experiments with this hinge moment:

She walked into the room smiling. She seemed happy. I felt that she had done her homework because she always does. She sat down and while I was turned away from her she stated, "I haven't completed all the homework". I realised that, at this moment in time, I had a great many ways of responding but that I had prepared myself to act in a particular way. I turned around with a smile on my face and with my best friendly tone of voice, I said, "No worries!" She relaxed and proceeded

to show me what she had done. I relaxed and there was no tension in the room. [1]

Voice and spaces of possibility

Don't impose on me what you know,
I want to explore the unknown
And be the source of my own discoveries.
Let the known be my liberation, not my slavery.
(Maturana, quoted in Zohar and Marshall,
2000, p. 290)

The stress on the importance of listening and the inescapable presence of a desire for ethical action has required me to explore the issue of voice and the way in which my practice closes down the space for teachers to feel comfortable about using their voice. The example of the student teacher who remained silent while tackling the 'Painted cubes' problem provides one example of a situation to engage with. However, a personally more challenging situation arose when on three separate occasions students who had successfully passed the taught modules on the Master's course, moved on to the dissertation stage at our university. All three of them wanted to explore the ideas that had been raised in the *Researching teaching* module (partially described in the previous section).

At our university the procedure is that all Masters students have to take a *Research methods* course that promotes a thesis that starts from a carefully expressed question and then describes literature search, research methodology and issues such as generalisability and validity. At the end of this module, the students have to submit a research proposal for consideration by those convening the *Research methods* module. During the *Researching teaching* module these successful students (they all passed each of the four modules with distinction) enjoyed the exploration and their voices grew stronger. When it came to submitting their research proposals they each took the task seriously but wrote it in their own way.

All three had their proposals rejected at this first submission, and it was left to me as their supervisor to see that they corrected their proposals and addressed the shortcomings to my satisfaction. Again, the tension and push for me (as responsible academic and university colleague) to close down their space arose. Instead, I decided to try to remain true to my espoused beliefs and encourage their exploration. But after I returned their writing to each of them saying that I could not hear their voice in what they were writing, they responded by each producing very different and exciting work. This experience has shown me the extent to which I had lost my own voice in the past decade under the assault of the management regime.

Davis (2004, p. 184) concludes his exploration of metaphors for teaching in a manner that highlights the way in which my journey into the world of enactivism has recharged my interest and commitment to my students:

[...] teaching and learning seem to be more about expanding the space of the possible and creating the conditions for the emergence of the as-yet unimagined, rather than about perpetuating entrenched habits of interpretation [...] Teaching, then, is never simply a

personal or an interpersonal act. It touches the subpersonal through the planetary. Teaching is participating in the transformation of what is.

Davis's invocation for teaching to become an activity that aims to expand the space of the possible is a re-minder to me of a journey started long ago when the work of Gattegno interrupted the closing forces of my own school experience. Time will tell if I can do justice to this new impetus.

In many ways this article will appear to have been about teaching in general rather than the teaching of mathematics. However, my own structure has been strongly influenced by my school experiences as a successful mathematics student followed by a career that has been devoted to mathematics education at the levels of both school (seven years) and university (twenty-two years). In this way, the teaching of mathematics is embedded in everything that I have written. Similarly, my choice of the 'Painted cubes' problem rather than any other example, gives a glimpse into the ways in which my structure asserts its presence into my understanding of what it means to teach mathematics.

Notes

[1] The assignment (submitted for EDN602X, University of Cape Town) from which these quotations were taken was written by Burgoyne, N. (2004) and entitled *The complexity of inner research*. A full copy of the assignment can be requested from the author at nickyburgoyne@yahoo.com.

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