The brain and teaching: using research on neuroplasticity to inform our teaching

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What can educators take from recent brain research, especially the research around neuroplasticity? Neuroplasticity claims that the brain is able to change in ways that previously were not thought possible and the research around the changing brain provides a convincing argument that educators are not simply facilitators of their students' learning but, rather, play a crucial role in that learning.

Since the research identifies language development, where language is the critical resource for making meaning, as being critical to brain development, that will be a focus here.

Some observations from the research and the main pedagogical implications are the following:

1. Strong brains are built through the simultaneous activation of brain cells. This is neatly expressed by Doidge (2007) as: "When two neurons fire at the same time repeatedly (or when one fires, causing another to fire), chemical changes occur in both so that the two tend to connect more strongly."
2. The more a system in the brain is activated, the more the system strengthens.
3. Language development (and, therefore, brain development) doesn't happen discretely in compartmentalized parts of the brain but involves complex synergies between multiple brain systems. (Deacon 2012)
4. The stronger brain is the one that has developed through moderate stress in patterned and recycled activities. Also, the brain functions as a predictor and is alert to identifying meaningful patterns in the messages it receives. The direct implications for pedagogical practice are:
    a. understanding and framing teaching according to the patterns in the knowledge, which are construed through the patterns in language (text, lexis and grammar), and predominantly visuals (still and animated)
    b. making the patterns explicit to students.
    c. designing activities in teaching programs in sequences that are meaningful to the disciplines in schooling and, hence, the teachers and students
    d. recycling meanings (not simply repetition) through the myriad interactions that occur between students and teachers using the various resources in the classroom.
    e. maintaining a suitable challenge for students but providing the support that allows them to meet the challenge—this is the meaning of scaffolding.
5. Our students' brains are responding to all of the complexities of a classroom through all the different senses and so we need to be making meanings in ways that give students multiple access points to the meanings.
6. It is difficult to unlearn the learned—the paradox of neuroplasticity. When learning something new, those parts of the brain that are involved can get so efficient at doing their job that they resist doing the same thing in a different way. That is why the learning pathways for students ought to be set up for success in order to mitigate the need for repairing so that both students and teachers are not de-motivated in their attempts to learn.

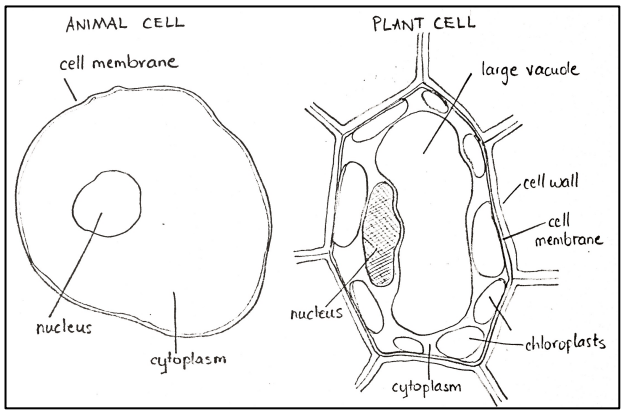
I will elaborate here on the research evidence that teachers should be providing students with multiple access points to meanings, and using the patterns in the knowledge and

language to shape their teaching; the 'how' we teach should resonate with 'what' we teach, which I have termed pedagogical resonance (Polias 2010, 2016).

When we talk about making meaning in multiple ways, it is not a matter of quantity only but of quality as well. Using a range of meaning-making resources may not necessarily result in effective and efficient learning; we need to consider the patterns in what we are teaching and the patterns in how we are teaching. There are recognisable and, therefore, predictable patterns that construct knowledge, which teachers of that knowledge need to be intimately acquainted with. These are the generic patterns that construe discipline knowledge and the patterns of texts that are construed predominantly through language. The more teachers use these patterns as framing tools for how they teach, the more likely it is that students are not encountering hurdles in their learning. This interplay is pedagogical resonance and, in this way, we can and should maintain a high challenge for the students in what they need to learn.

I will use one simple example of how discipline knowledge is patterned and what is meant by not creating hurdles for students in their learning. If a science teacher is comparing the components of animal and plant cells, then some representation that sets up the comparisons would be appropriate. For ease of comparison, this would have to have the things to be compared immediately adjacent to each other rather than physically distant from each other. This could be in a Venn diagram format but it would preferably be in a table format with columns and rows allowing the reader's eyes to quickly and easily compare. All of this might be co-constructed by any combination of teacher and students. Taking the table of animal and plant cell comparison (Fig. 1), we can see that the column for animal cells should be on the left of the plant cell column because we read, in English, from left to right and because the simpler one, as the teacher's starting point, is on the left.

The teacher who knows the discipline knowledge is also aware that all of the components in the animal cell will be found in the plant cell but the plant cell will have more components. This allows us to say to the students that when they think about the components of the cells, that they should not think randomly but according to the structure of the cells themselves—start from the outside of the cell and then move to the centre and then fill in the last two parts of the plant cell.



Animal cells	Plant cells
	Cell wall
Cell membrane	Cell membrane
Nucleus	Nucleus
Cytoplasm	Cytoplasm
	Large vacuole
	Chloroplasts

Figure 1: Comparison genre: Comparing the components of animal and plant cells

Keep in mind that, in the classroom, while all of this knowledge is being talked about and drawn up, the student is sending the many visual and sound messages to the brain and the brain is setting up nascent networks or linking to and expanding existing networks. If all of this knowledge were presented to the student in, say, a mind-map that is constructed through some kind of brainstorm, then there is much more work to be done in the students' brains, trying to make sense of what they are seeing, hearing, and drawing. So

we can see that, in accordance with the research evidence, the way we represent knowledge (in our spoken texts and in our visual texts on the board and in our worksheets) is crucial to the efficiency of the learning. With the success in learning maximized, the students can get through the curriculum faster.

In this article, I have introduced some of the recent brain research supporting the claim that an efficient pedagogy is an effective pedagogy, and that we can both support and challenge our students concurrently. This kind of pedagogy provides students with the meaning-making resources needed to venture further, independently or collaboratively, to interrogate their worlds, and inquire and explore. Importantly, the exploration and the taking of, say, critical perspectives on their worlds is from the point of being equipped with the resources needed for taking a challenging approach and being 'successful' in that endeavour. The efficient pedagogy is now an effective pedagogy.

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