Book review
How we learn: The new science of education and the brain

Reviewed by **Dr Roslyn Neilson**

How we learn: The new science of education and the brain
Stanislas Dehaene
Penguin Books, 2020.

In 2009 Stanislas Dehaene, neuroscientist and science writer, published a book that captured the attention of many education professionals: *Reading in the Brain*. In that book Dehaene provided a very accessible account of some current developments in neuroimaging, explaining what brain imaging research can teach us about how humans learn to read. Dehaene described how neural networks that originally served other purposes, adapt to specialise in the demands of reading and writing — skills that are very new in human evolutionary history. He showed that our apparently effortless recognition of words is achieved through the activation of neural connections between the visual cortex and other parts of the brain that process sound and meaning. His explanation made perfect sense against the backdrop of what educational research has taught us about efficient teaching methods of teaching children how to read. The practical implications that Dehaene drew in his 2009 book, relating to systematic exposure to the phonemic basis of the alphabetic code, were very compelling indeed.

In his 2020 book, entitled *How we learn: The new science of education and the brain*, Dehaene displays a keen interest in both artificial intelligence and cognitive psychology, along with an inspiring reverence for the human ability to learn. The book is just as powerful as *Reading in the Brain* in terms of translating quite specialised research into accessible food for thought for readers, and its practical implications are equally compelling. Dehaene makes the point in the Introduction that one of the great human experiments in learning was the invention of formal schooling, which allows us to systematise and extend learning. The book is essentially a well-argued review of the evidence that is available to educators about how to maximise learning potential.

Parts 1 and 2 provide a fascinating but rather complex background. Part 1 begins by defining learning in some detail, arguing that it is a process in which the brain forms an internal model of the outside world, generates predictions, and changes itself on the basis of feedback about the accuracy of the predictions. Part 2 provides a wide-ranging account of how our brains learn, including the issue of plasticity and the nature and nurture question. This section presents intriguing data on babies' abilities to process environmental input and change their behaviour accordingly — I was surprised not only at how much babies can do, but at how much can be learned about babies if you know what to look for. Dehaene makes frequent references to artificial intelligence to help clarify the concept of learning, as he considers what programmers need to do to make computers learn.

Part 3 is the most accessible section of the book. It is organised around what Dehaene calls the four 'pillars' of learning: focused attention, active engagement, error feedback, and rehearsal and consolidation. A good deal of the material covered in this section may be familiar to readers who have thought about cognitive psychology, including concepts such as attention control, executive function, cognitive load theory and retrieval practice. The material is very elegantly organised and summarised, and the empirical support underlying the principles of learning is presented with clarity and simplicity. Interestingly, every point made about cognitive psychology research is accompanied by practical recommendations. For example, one fascinating area of research that was not familiar to me in this section involved the way in which sleep can allow the rehearsal of learned material — and one of the practical recommendations following from that point involved the suggestion that high schools could consider changing their hours to fit in with typical adolescent sleep cycles. The chapter that highlights the importance of immediate and supportive error feedback is perhaps at the heart of this section, with Dehaene arguing that errors, and the feedback that errors can generate, are an essential part of learning. His argument in this section steers a deft middle course between the two unhelpful extremes of passive acceptance of teacher input on one hand, and unguided discovery learning on the other hand — and along the way he provides a very cogent argument that end of year school grades are a very inefficient way to give feedback.

How we learn… is a challenging and very interesting book, and I think that it would be useful to set at least Part 3 as a core component of pre-service teacher education. It is certainly worthwhile for teachers to take the time to read and digest it, and parents will find it intriguing. Some readers may end up feeling that the book has served largely to justify, reinforce and perhaps extend the strategies that competent teachers already use, but I think that it offers much more than that. In the introduction, Dehaene writes: "When you close this book, I hope you will know more about your own learning processes." He has succeeded in this — this is a book that can make us all think.