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Cover Story - Surprising research about the brain and learning

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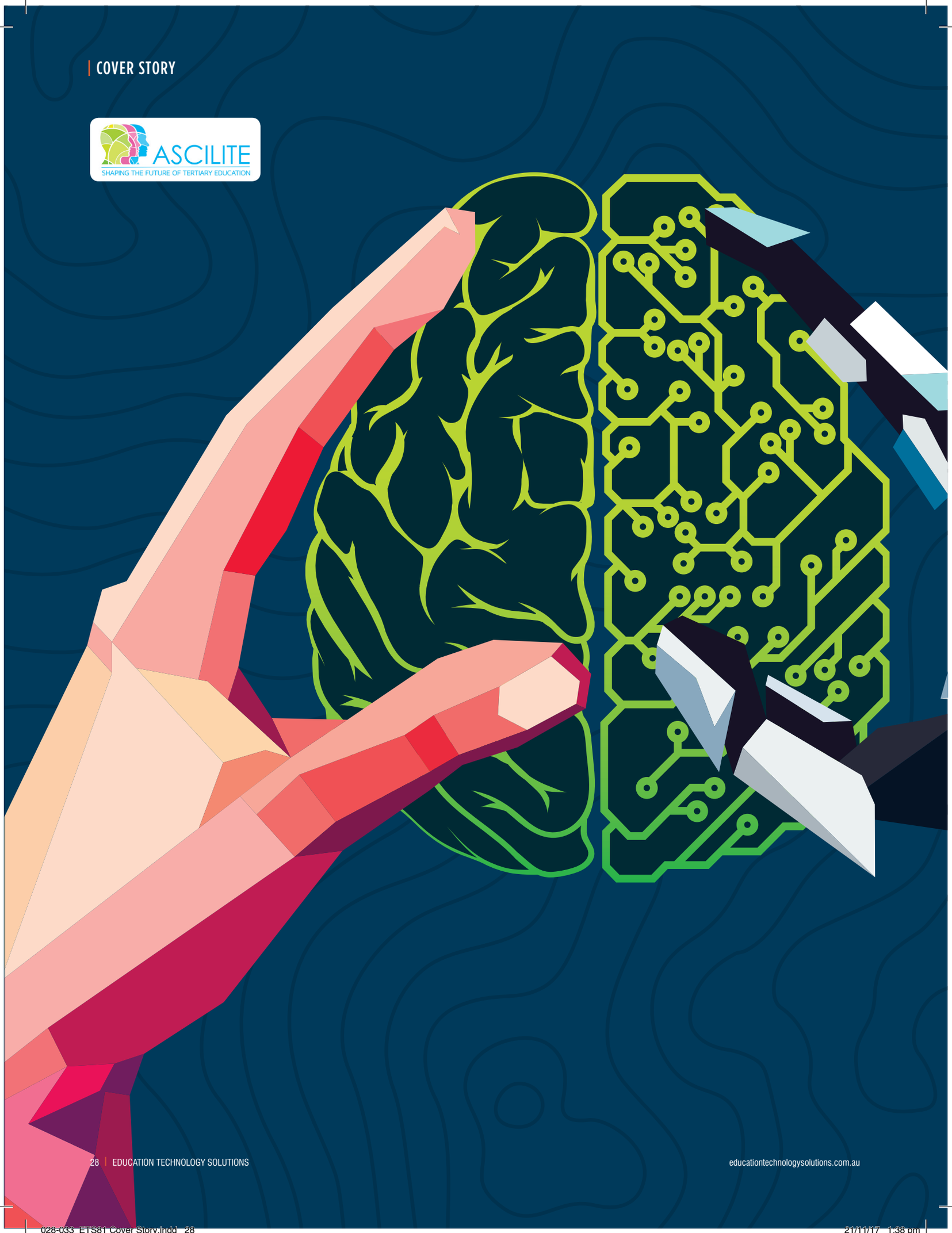
ASCILITE
SHAPING THE FUTURE OF TERTIARY EDUCATION



SURPRISING RESEARCH FINDINGS

ABOUT THE BRAIN AND LEARNING

BY JASON LODGE AND SHELLEY KINASH

What is education technology? A basic definition is the tools we use to learn and teach. Using this definition, then the brain is our ultimate educational tool. How far have scientists come in understanding our brains and how to enable and enhance what goes on inside our brains to maximise the impact of education? Human brains are still, as far as we know, the most complicated pieces of machinery in the known universe. Brains can do all sorts of things that we have absolutely no idea how to code into a computer system or a set of algorithms. This difference is going to become more and more important as we discover more about artificial intelligence and smart computing, particularly with generations of students who have never known education without computers. This article was derived out of an interview between Jason Lodge, a psychological scientist, and Shelley Kinash, a learning and teaching director. Together, they transformed the interview into an article about the brain and learning.

What is Learning?

The term learning is used to mean both a process (e.g. I am learning a theory) and an outcome (e.g. for me, your perspective was a new learning). Learning is fundamentally about development and change. Learning means that we come to know something that we did not previously understand, to gain a skill that we were not able to do, and/or to adapt and take on personal attributes that were not previously part of our make-up. University learning is about all three of these types of learning. Learning is the work of students that is contributed to by the work of academics, which

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is teaching. While the focus of universities used to be more on teaching, academics now think more about learning, because if students have not developed or changed as a result of completing their studies, then the teaching is not worthwhile.

What is the Relationship between the Brain and Learning?

People have been trying to depict the relationship between our brains and learning for centuries, if not millennia. At a biological level, our brains are pieces of organic hardware that we all have in our heads. Our minds are the more ethereal part, allowing us to consider and partially control how that hardware gets used. The cognitive way of thinking about this is the difference between the hardware and the software. Considering how the mind comes to be, as a result of processes that happen in the brain, is something that philosophers to this day argue about endlessly. One of the prominent theories at the moment is the idea of emergence, which argues that our minds and our experience of the world arise out of the brain in ways that we cannot fully predict by looking at the brain itself. The unanswered question is how do we get from this physical thing to this very different experience that we have in our minds? We still do not have a satisfying answer.

What does Magnetic Resonance Imaging tell us about the Brain and Learning?

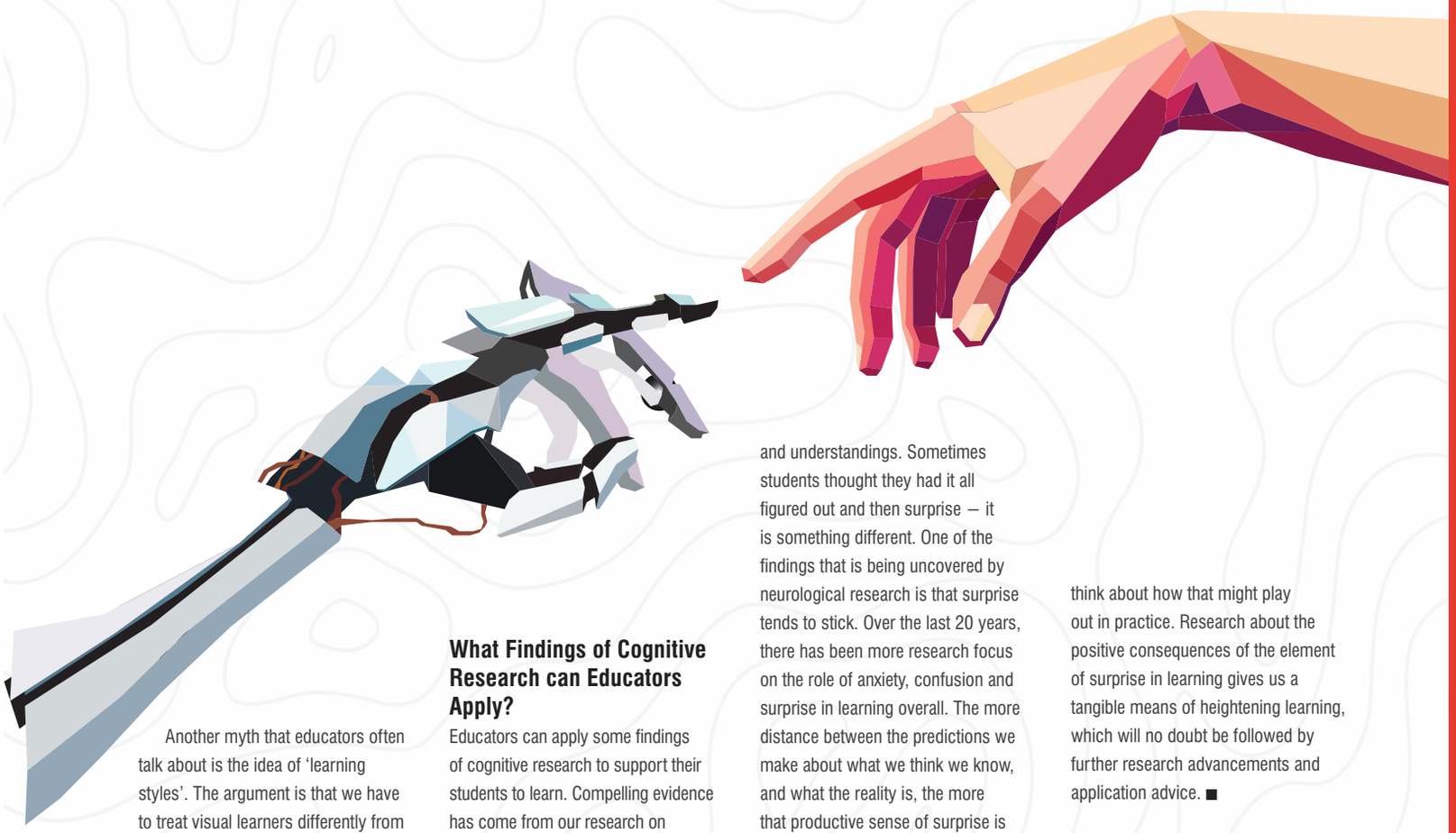
Over the last several decades, scientists have developed much more sophisticated ways of being able to image the brain. We can now measure electrical activity and blood flow and create revealing visualisations of what is happening in the brain. For example, functional magnetic resonance imaging studies are elucidating a lot of things about how the brain is processing information. For example, scientists have examined the difference between somebody who has been diagnosed with dyslexia, versus somebody who has not, revealing what looks like differential heat maps of the brain when the studied people are doing different types of tasks. Where this science starts to fall down is where we try to over-extend what that actually means. Just because we see a correlation between getting students to do a task (perhaps if they have dyslexia or not) and what 'lights up' in their brain, does not necessarily mean that we know what is happening in their minds. There is still a distance that we need to overcome, which is that between the biological activity and what is actually the mental process itself. We cannot see the mental process directly. So, we are trying to infer that through a biological process of some sort. As we discover really exciting new ways of looking in the brain and seeing what is happening, we get excited by this great data and we seem to think we know what is going on — but it is still an inference.

A metaphor is like that of driving. You cannot look inside the car to see the driving. You can look at the speedometer, the engine gauge and the indicator lights, but ultimately the driving happens outside of the car on the road and in the interaction with the other vehicles and other drivers.

What are the Main Myths that Science has Debunked?

Educators are desperate to understand how to teach in ways that will better support students to learn. As such, sometimes we grab onto popular ideas about learning that appear to be based in science and later learn that there is no substance or evidence for these beliefs.

One such myth is that students only use 10 percent of their brains. They might be using 10 percent of its capacity, or they might be using 10 percent for a particular task, but really the whole brain is active most of the time. The way that the brain works is that it will re-wire in some way if parts of it are not being used meaningfully.



Another myth that educators often talk about is the idea of 'learning styles'. The argument is that we have to treat visual learners differently from auditory learners and from kinesthetic learners. We have tested this directly under laboratory conditions and it makes absolutely no sense. People can come in declaring themselves as textbook visual learners or auditory learners. It makes no difference to their performance on a task. Learners will engage different tools at different times in order to do the task that they have been asked to do. The onus is on the educator coming up with a really good authentic kind of task for the student, rather than saying, "Oh, I'm going to come up with something for the visual learners, and something different for the auditory learners." The challenge to educators is to structure an environment and a setting in ways that give students the best chance of achieving the sorts of learning outcomes that we are looking for. Rather than talking about 'learning design', we need to talk more about 'design for learning'.

What Findings of Cognitive Research can Educators Apply?

Educators can apply some findings of cognitive research to support their students to learn. Compelling evidence has come from our research on confusion. Traditionally, confusion has been seen as a negative student state that teachers should avoid. However, the research that we have been doing has shown that being confused is actually a critical part of coming to understand a complex concept, particularly if we have a misconception about something. There is something about that sense of disequilibrium (which is really bringing about the confusion), that students feel between I think I know this, but now you're telling me it's something else, so I'm a bit stuck here. It seems to be an important part of the process of reaching a point of insight, where students think "Oh, I'm really confused. I'm really confused. I'm trying to understand this." Then they can have what we call an 'aha moment'.

Sometimes learners are surprised at the answer or the thinking about something, in that the concept is more complex, or fundamentally different, thus confronting their previous beliefs and understandings. Sometimes students thought they had it all figured out and then surprise — it is something different. One of the findings that is being uncovered by neurological research is that surprise tends to stick. Over the last 20 years, there has been more research focus on the role of anxiety, confusion and surprise in learning overall. The more distance between the predictions we make about what we think we know, and what the reality is, the more that productive sense of surprise is generated. So, if we do not think we know much about something, and we are told something else about it, we are not really going to be that surprised because we did not know anything in the first place. Whereas if we think we know something quite well, and then we find out that we are wrong, the distance between the prediction that we make and what the reality is, is much bigger. There is something about that surprise that comes along with the realisation that means that we are more likely to remember that and will then change the way we think about that concept.

For researchers and educators, what is most surprising is just how complicated all of this really is. There is so much out there about learning, and just when we think that we have a handle on what might be going on, this whole other area opens up to us, and we realise that it is much more complicated and difficult to think about how that might play out in practice. Research about the positive consequences of the element of surprise in learning gives us a tangible means of heightening learning, which will no doubt be followed by further research advancements and application advice. ■

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