

## **Moving beyond rote memory towards trial and error learning**

by André Croucamp

Does anyone know what CPF stands for? No I wasn't thinking of Community Policing Forum. CPF is an acronym that university students use to describe their learning experience. It means: Cram Pass & Forget. Think about your own school experience. How much of what you memorised for exams do you still remember? Could you remember it even two weeks after the exam? Cramming only alters memory temporarily. It is possible to cram and, with mnemonics and other memory tricks, get a distinction without understanding much. How useful is that skill? We reward children for cramming, but how is this preparing them for a meaningful, sustainable and satisfying life?

As teachers we often confuse what is in the textbook with what needs to be in a learner's head. We confuse the memorisation of content with learning. This is perhaps the single biggest error in our education system. The power of the technology of printing, and now the digital medium, is that it does things brains cannot do very well. Books and computers store and stabilise information long enough for us to engage it, reflect on it, criticise it and edit it.

The ability to memorise information or faithfully reproduce a procedure is something computers do far better than us. Graduating from school with the skills of a poor computer is not a strategy for thriving in the 21st century.

If you look closely at the current Curriculum you will notice that its presentation of study skills, subject choices and career paths are stuck in the 20<sup>th</sup> century. At Sacred Heart we no longer promote the idea of a linear and singular path to success. In the 21<sup>st</sup> century you need to become a multi-disciplinary, life-long learning, shape shifting, innovator that can adapt to change.

Last Friday we played a game in which learners had to work together in teams and figure out what the hidden rules of the game were. There was minimal instruction. Learners had to do something, start somewhere, and risk experiment, so that they could bump up against the constraints of the game. Learners would come up to me and say, "Sir, I am so confused." I would reply, "Of course you are confused. You do not know the rules of the game ... yet." Each time a new dynamic was discovered learners would shriek in excitement. With 150 Grade 8 and 9 learners it was chaos, but in all their eyes there was a spark – the thrill of uncovering knowledge.

This kind of project-based learning encourages learners to work things out for themselves, through trial and error performance, adapting to feedback. It challenges the popular perception of learning as the passive process of receiving pre-designed knowledge from a teacher or an expert. To appreciate its value it is necessary to understand that – and this is my main message tonight – ***we have been getting memory wrong.***

The idea that we can upload information into learners' heads in any useful way, and then assess those learners on the basis of their ability to reproduce the information needs to be challenged. Neuroscientists tell us that the human brain cannot store memories at all! This is a very counterintuitive idea, but the old information processing computer metaphor is inaccurate. This has huge implications for the way we teach, and is why Sacred Heart is putting more emphasis on engaging learners in an open-ended, challenging, meaningful, immersive, experiences of trial and error learning.

Of course, accurate replications of abstract information or procedures that have been rehearsed through repetition in a classroom are easy to assess. But we need to question whether we should base what we teach on how easy it is to assess or on what learners need to thrive in the 21<sup>st</sup> century.

Leading educational institutions in the world are saying that content should no longer be the priority. Content will keep changing, and is changing more rapidly than ever before. Many textbooks are out of date before they are even printed. We need to go beyond prescribed content and teach learners how to engage any content, so that they can become active agents of their own knowledge production. This requires a focus on "how to think" rather than "what to think".

So how does human memory work? Rather than being stored accurately, memories are performed from scratch each time, with a fair amount of inconsistency, through a decentralised, distributed process of making associations. You are not just replying a scene you are reconstructing it from many different components all over the brain.

In order to "retrieve a memory" it is necessary to experience an input or a cue that triggers a pattern of associations between nerve cells or neurons. The smell of your favourite home-cooked meal, for example, may trigger any number and combination of neural firing habits or components associated with that smell. One chain of associations may lead to a recreation of your mother's face. That in turn might create the associated neural firing habits that make you feel warm and loved.

When you try to remember something, your search is not for the correct label but for associated (matching) performances. You may even "recall" related things before "recalling" the desired association. The "recollection" of the wrong items occurs because they bear a resemblance to the association we desire. Our final "recollection" is always partial with some amount of fabrication, which is subjectively indistinguishable from actual past experience.

When these neurons are not firing at a particular strength and in a particular pattern, the associations are not there! When you are not thinking of your mother's face it is not stored anywhere. It only appears in the re-enactment. Furthermore, this re-enactment is not completely accurate. It changes over time, and is different in different contexts, in ways you cannot even be aware of. There are in fact many different ways of recreating different versions of your mother's face, which are indistinguishable from the subjective experience of the particular

version you are recreating in that moment. Your brain will even fill gaps in your memory with good guesses.

Organic memories are not the products of accurate recording, storage and retrieval. Memories are performances, imperfect but highly adaptive re-enactments and re-combinations of past performances, in response to whatever is happening now, and in anticipation of what is going to happen next. Memory is all about being able to predict the future.

In our Grade 10 class we explore the idea of throwing the bones. We have created an immersive game using small plastic toys, bits of technology, domestic objects and natural materials that reframes African divination practices as information technology. We throw the bones together in order to explore complex systems thinking and innovative associations. After the experience we work together with the learners to use their insights to develop a neurological model of the relationship between analytical and associative thinking.

In reality the future is not always like the past, so simply reproducing accurate representations of it, what we incorrectly tend to think of as memory, is not always enough. This is especially true for humans that have to deal with social contexts that are inconsistent and full of subtleties and nuances. A human needs to be able to associate activation habits in ways that are responsive and adaptive. While an inaccurate memory may seem like a disadvantage, the advantage lies in the potential for malleability, creative associations, useful reinterpretations and the ability to transfer knowledge from familiar contexts to unfamiliar ones. In the knowledge economy where innovation is valued this is critical to understand.

Brains are not enclosed spaces that download information from outside and organise it into stable internal representations of the world. No. Brains are completely integrated into the ecosystem, being influenced by it and influencing it.

We talk about neural performances rather than neural structures, because the notion of structure reinforces stable internal representations, whereas performance is a more accurate description of what neurons do in relation to each other, the body and the world.

It could be said that learning is the ability to change behaviour on the basis of experience. Most real learning happens when children are motivated to risk performance, through trial and error, get meaningful feedback they can reflect on, and then continue to experiment with changing their performance without fear of failure, while acting and moving through the world with curiosity and the confidence that they can work things out. Feedback happens when we reflect on our outputs, and that reflection becomes a new kind of input. It can also lack any conscious reflection and simply be a form of unconscious conditioning. You get constant feedback from your own body. You get feedback from the people around you and from the environment, substances, media and technology. Feedback can also be experienced when you compare what you think you know with new information, or when you reflect on the consequences of your actions.

In a school environment we can ensure that feedback happens in a safe enough space for trial-and-error learning to take place. The real challenge facing us is to reframe failure so that learners do not fear it, but gain valuable insights through it. When there is no fear of failure learners will linger longer in the learning experience getting more out of it.

The opposite of being afraid and fragile is not being tough and resistant, but being able to adapt to change, and more than that, being able to benefit from the changes around you. This is what Nassim Nicholas Taleb calls 'antifragile' in his book *Antifragile: Things That Gain from Disorder* (2012). Taleb is interested in what we do when we cannot predict what is going to happen next. Rote memory and accurate recall doesn't help us here.

One of the crises we are experiencing in our educational institutions is that we value obedient learners who can memorise the predictable order and get good grades. Research is starting to confirm that good grades don't correlate with long-term success. Pressure to get good grades also takes a toll on wellbeing, causes unreasonable anxiety, encourages cheating, and discourages risk and creativity.

The learner who benefits from trial and error learning on the other hand develops a kind of ecological intelligence that:

- thinks systemically – stepping back and able to read the relationships between things and how they change each other over time;

This is a learner who

- is open to the information around them;
- does not fear failure;
- risks lots of small reasonable experiments;
- is responsive to feedback and actively engages disagreement (not because they are trying to win an argument, but because they are genuinely trying to understand what is going on);

This is a learner who

- perseveres and lingers in the learning experience long enough to create multiple 'rough drafts' that integrate critical feedback;
- who takes advantage of unexpected opportunities;
- is able to reassess habits and goals in the light of new information; and
- adapts to change with as little anxiety as possible.

This kind of learner is more resilient in life than a learner who can memorise prescribed material and get good grades in standardised tests.

By privileging individual memory we also affirm the misconception that exceptional ability is individual rather than the product of collaboration between diverse abilities and perspectives.

Some educators make a distinction between *cooperation*, in which the labour is divided between participants (and participants passively accept this – often

reluctantly), and *collaboration* in which all participants are involved in the same task and are equally responsible for the output of the whole product.

During real collaboration there is a more intense interaction between participants and the need for constant negotiation. Collaboration creates opportunities for learners to engage disagreements and, in so doing, develop their critical thinking skills. In particular, we encourage learners to come to an agreement on the criteria for mutually beneficial disagreement. This is an opportunity for learners to uncover knowledge together, negotiate a learning path or strategy, interrogate each other's points of view, respond to probing questions, deal with feedback, and even correct each other's misconceptions. Furthermore, this is the kind of learning they will encounter in excellent tertiary education learning environments and in creative workspaces.

The future belongs to technology-literate knowledge workers; resilient problem-solvers who are not afraid of failure; risk-taking experimenters; maverick innovators that can break their society's thinking habits; critical consumers; active citizens; ethical hackers; and independent thinkers.

André Croucamp has been a friend of Sacred Heart for many years. Together with his team from MindBurst Workshop he helped us redesign our media centre; facilitates week-long creative workshops with refugee children from Three2Six; collaborates with the high school to create critical thinking skills interventions; helps Colin Northmore set the IEB exam on thinking skills; and has even performed on our radio ads. He has also been a passionate practitioner of project-based learning, whether getting Grade 10 learners to work in Crime Scene Investigation teams to analyse garbage or Junior High learners to design the interior of the spaceships that will take humanity to the stars. Andre's first degree was in Theology at Rhodes University. He later completed his Masters in Cognitive Archaeology at Wits. For most of his life he has worked as an educational media developer producing comic books, games, textbooks and documentaries. His most recent academic paper "The Natal Government Railways and their Production of 'the Zulus'" appeared in the publication, *Tribing and Untribing the Archives* (2016). The journal *Choice*, which provides book reviews for academic libraries, has picked the publication for the 2017 Outstanding Academic Title list. Andre designs and develops museums all over the country. Some of you may have visited Liliesleaf, which contains many exhibitions he has created together with Totem Media. Their most recent exhibition is *Unthreading Mandela*, a critical reflection of Mandela's legacy. It can be seen at the Nelson Mandela Foundation.