



Alex Beard

**NATURAL
BORN
LEARNERS**

OUR INCREDIBLE
CAPACITY TO LEARN AND
HOW WE CAN HARNESS IT

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INTRODUCTION

A Tale of Two Academies

The future is here, it's just unevenly distributed.

William Gibson

Into the Light

The Hippeios Colonus lay a mile north of ancient Athens. A hill thick with vine, olive and laurel, topped with a temple to Poseidon and a sacred grove to the Eumenides, or Furies, it was said to be the resting place of Oedipus and birthplace of the great playwright Sophocles. Climbing it in 385 BC on a warm Mediterranean evening, the pink light playing on the Aegean and the scent of oregano wafting up from the baking ground, you might have looked down to the west and caught a glimpse of one of the great inventions in human history – the school.

This school was situated in the groves of Akademeia, named after the Greek hero Akademos, one-time saviour of Athens. The area was known at the time as the destination

for an atmospheric ritual, a torch-lit race from the city in which late-night runners sped along a path flanked with the graves of dead Athenians to arrive first with their flame at the altar of Prometheus. It was also sacred to Athena herself, goddess of wisdom.¹ Back then a middle-aged and much-travelled nobleman called Plato had just taken over a large part of it to host his new ‘Academic’ club, devoted to the pursuit of knowledge.

Plato’s Academy quickly became an intellectual hothouse, the MIT or Cambridge University of its day. The many illustrious alumni included Aristotle, who would go on to found his own Lyceum, and tutor Alexander the Great. Its ideas would inform civilisations. Learning consisted of discussion around particular texts and case studies, with a teacher – often Plato himself – posing problems for the members to consider in conversation, just as they do at Harvard Business School today. Topics included mathematics and philosophy and ranged from the scientific analysis of the movements of heavenly bodies to consideration of the best modes of government. Plato wrote down many of these cases in *The Republic*, interposing his former mentor Socrates as the textual teacher and other members of his entourage as his protégés. One of the most famous is the Allegory of the Cave.²

Picture an odd grotto. In it a group of people are chained to the floor on one side, their legs and necks fixed in such a way that they can only stare at a blank wall. They have been secured in that position since early childhood and the cave wall in front of them is all they have ever seen. Behind them is a fire and in front of it a low screen over which a variety of objects are raised by hidden helpers, who also make sounds. The prisoners see moving shadows cast upon the wall and attribute the noises to the spectral shapes. They assign meaning to what they see and start to

understand the play of shadows as reality. It is all they know. The flickering forms and sinister sounds are their whole world.

What would happen, asks Socrates, if one of these prisoners were freed?

On turning, the bright light of the fire would dazzle the prisoner at first and he would be unable to make out the shapes of objects, or make sense of the new visions assailing his senses. He would turn fearfully back to the wall. Imagine then that someone dragged him forcibly from the cave, past the fire and into the sunlit lands above ground. The prisoner would be angry, resistant and near blind, holding tightly to his old ideas of existence. After the wall and the shadows, the technicolour world about him would seem a shocking hallucination. But slowly his eyes would become accustomed to the light, the pain would recede and he would come to terms with a new and infinitely more beautiful reality. He would bless himself for the change and rush to free his other cave dwellers.

We can read in Plato's Cave a parable about learning. Two and a half thousand years later its imagery of light and dark as metaphors of knowing and ignorance remain familiar. We see ourselves as sentient, conscious and rational beings, as people who have 'seen the light'. We sense that more and more of humanity has passed out of the cave and into the world above. For Plato, however, it was clear that most of us were yet to make that journey. His mission – and that of his school – was to lead more people into the sunlit lands of enlightenment. It was the work of the philosopher to push at the frontiers of human apprehension, to more fully understand the world, and to better decide how individuals and societies should live in it.

Today we face an even greater challenge. We believe that *everyone* should be well educated, not just rich

noblemen. Our young must thrive in a world whose pace of change seems destined to increase exponentially, whose future is unclear. Yet when we look at our school systems, we don't see Plato's clear-sighted mission of human betterment, but ailing bureaucracies struggling to maintain bright points of light amid the gloom. Like stars on a hazy night above modern Athens.

If at First You Don't Succeed

I could, so I taught. One bright September morning a decade ago, I pedalled my way down the Old Kent Road – London's cheapest Monopoly property – to begin my life as an English teacher. The school was in one of London's poorest and most diverse neighbourhoods, Elephant and Castle, named after an eighteenth-century coaching inn. I knew it only by reputation. The area was dominated by two housing estates, the Aylesbury and the Heygate, whose maze-like walkways and dingy stairwells meant they were no-go zones after dark.³ Walworth School didn't seem a lot better. At a meeting of new teachers in the area, a veteran from a nearby secondary revealed: 'That's where we tell our kids they'll end up if they don't behave.' My first assembly would begin with the stark announcement that a 14-year-old boy had died, stabbed after a game of football.

That first day marked a new dawn for Walworth, however.* It had just begun life as an academy, part of a government scheme to give more money and more autonomy to struggling inner-city schools, though it was a far cry from the Athenian original. I pulled up to the gates that morning with the potent mix of nerve-shredding trepidation, rank incompetence and platonic ideals familiar to all beginning teachers. I was scared, I was ill-prepared, but I knew – *knew!* – that I'd be *Dead Poets Society's* Robin

Williams by the end of my third week. After all, everything I'd learned in my own school and university days told me that education was simple. You posed the right problems, outlined interesting thought experiments, then sat back, engaged minds and discussed.

My first classes were failures. Initially placed in the lower school, I found the younger kids enthusiastic but unfathomable. Eleven-year-old Kai approached me during one class in his socks claiming his shoes had *dropped* out of the third-floor window and asking if he could retrieve them. A particularly wild break-time ended with Shaun at war from one side of the class with Marcel on the other, using chairs for ordnance and tables for cover. Every lesson began with a dispiriting chorus of lost books, missing homework and attempts to break out to the hallowed freedom of the toilet. News of my struggles spread and competent fellow teachers were regularly called in to assist. The groves of Academe seemed a distant dream.

Over in the upper school, things didn't go much better. Although intermittent attempts at reading and writing were known to break out among them, the habits of the older kids more typically comprised a mix of uninterested gazing out of the window, mind-boggling feats of misunderstanding and an unending ability to find new variations on 'Your mum' cusses. One Year 10 class was like a UN General Assembly, comprising 30 kids of British, Irish, Chinese, Jamaican, Liberian, Congolese, Afghan, Somali, Sudanese, Nigerian, Turkish, Portuguese and Vietnamese backgrounds, with just as many disagreements. Many spoke no English at home. But to me their situation was increasingly unfunny. They had an English GCSE to prepare for, a high-stakes exam that would decide their future. The class was averaging Ds, Es and Fs. They'd have to score As, Bs and Cs within eighteen months if they were

going to stand a chance.

As part of the course, over the next year and a half together we would cover two Shakespeare plays for coursework. I was looking forward to this as an opportunity to flex my intellectual muscles, whatever the doubters said. (In my interview for the teaching post I'd mentioned my love of literature, and plans over the summer to fill in dangerous gaps in my subject knowledge by reading classics – Milton, Marvell, Woolf and Eliot. The interviewer had looked at me patiently and replied, 'That's great, but I'd start with *Holes* and *The Boy in the Striped Pyjamas*.) The school had chosen *Romeo and Juliet* and *Macbeth* as set texts, and I spent a few weekends sharpening my opinions. The kids would excel, despite their challenges. This is what I had entered teaching to do.

Things did not go well. Progress through *Romeo and Juliet* was stultifyingly slow. We spent a week trying to understand the prologue and ultimately read only a few scenes of the play. The kids could express opinions about it if I created fill-in-the-blanks activities with a choice of three adjectives, but were otherwise short of ideas. After we watched the Baz Luhrmann movie adaptation to fill in the story gaps, every subsequent essay on the sixteenth-century text featured personalised revolvers, Miami muscle cars and exploding petrol stations. Despite my high hopes that the class would find fulfilment in the pursuit of understanding and a love of literature, in their first coursework essay they remained resolutely stuck on low grades.

I thought back to my own school days. I'd had the good fortune to attend a good primary school in a small Midlands town, where the teachers, who were more like surrogate mums or grannies, had inspired me. From there I'd gone on a scholarship to a private school. It boasted the largest single expanse of mowed grass in the UK and an

altarpiece – referred to in Old French as a *reredos* – reputedly valued at £6,000,000 (it was the chaplain’s favourite game during RE lessons to invite boys to try to evade the security system’s laser beams to reach the altar, like trainee gentleman cat burglars). We called our teachers dons and head teacher the Warden. In our English classes, we’d pontificate on Jane Austen and T. S. Eliot, and then all write A or A* essays. There was a sense of inevitability about it – just as there was a sense of inevitability about the failure of the class that I was teaching.

Yet a realisation drove me on. Getting to know these South London kids, working with them and talking to them each day, I quickly found that there was no fundamental difference between them and the kids I’d been at school with. They had the same dreams, the same camaraderie, the same feuds and the same teenage angst. Their parents, like mine, desperately wanted them to do well, and to be happy. They didn’t wear gowns to school or have access to a pack of beagles, but these were superficial details. In potential, in ambition and especially in jokes, they were more than a match for my privileged peers at boarding school. But where society had given us a leg-up, it was letting these kids down.

It all felt a long way from Plato. A long way even from Robin Williams. The class was failing, and I was at a loss.

This Solves Everything

This book is inspired by those kids at that South London academy. As a teacher I was startled to realise that school is fundamentally the same now as it was in Plato’s day. A time-travelling child from ancient Athens might be mystified by our smartphones, overwhelmed by our populous cities and alarmed by the cars on our roads. But she would have

no trouble at all recognising a classroom with its teacher and pupils. With all the progress we've made in other fields of human endeavour – in medicine or neurology, psychology or technology – aren't we long overdue a revolution in the way that we learn?

The 2,400 years that separate us have witnessed epochal changes: near-incomprehensible growth in the global population; huge agricultural, industrial and technological revolutions; incredible transformations in the ways that we create and disseminate knowledge; new forms of social and political organisation; insight into the secrets of the mind. These have thrown up the myriad challenges of globalisation, automation and climate change. If we're to overcome them, we must further increase our extraordinary ingenuity, more fully develop our skills and radically improve our co-operation *as a species* to unleash our full human potential. Learning must be the cause of our generation.

How should we approach education today? Over the pages that follow, I'm going to take you on an exploration of what it means to thrive in today's rapidly changing world and what we can do to ensure that all of our kids do. In Plato's era the main concern was to push at the frontier of human knowledge and understanding for grown men. Today, while we continue that quest, a more important question is how we extend access to the furthest reaches of human development to every child, to all people. Our aim is no longer the flourishing of a few philosopher-citizens in an ancient city-state, but the flourishing of a philosopher-race to steward our high-tech, globalised civilisation.

Following those first faltering classes a decade ago, I confronted my bafflement at the low learning levels of my pupils and embarked upon a lifelong quest for new ideas and exciting innovations that could inspire us to reimagine

schools and remodel the creaking ziggurats of our global education systems. In this journey, time and again I asked myself the question central to all learning – why? Why do schools now look so similar to schools in ancient Athens? Why do we prize academic success above all? Why are kids so often unhappy in their learning? Why do we continue to pursue an industrial model that businesses have left behind? And throughout it all I have obsessed over a single goal: to show what learning in the twenty-first century *should* look like.

The search you're about to join me on has taken me across the world, from the intelligent machines of Silicon Valley to the exam factories of Seoul; from Finland's greatest teacher to Britain's brightest student; from the MIT professor raising a robot to the Hong Kong schoolkid battling a superpower; from teachers trained like athletes to students learning without teachers. I have visited schools on every continent of the earth, talked to the leading neuroscientists and experimental psychologists, met the most fabled educators. I have explored the frontiers of the mind and the limits of the latest technology. I even ended up in Hollywood. The good news, as you'll find out, is that everywhere I have seen signs that we are on the cusp of a revolution in the way that we learn.

This book outlines for everyone the three key tenets that will drive that transformation. The text is arranged into three parts.

The first argues that we must *think anew*. Science has begun to delve deep into the inner workings of our brains, showing that each of us has a far greater capacity for learning than we realise. We're literally *natural born learners* – every one of us – but we're too often held back by the false belief that our intelligence is fixed. It isn't. Our understanding of the mind is limited by metaphors of

computing, but it is not a machine to be programmed by schools. The brain is alive, unruly, engaged in an unending process of inquiry. As medicine underwent a scientific revolution in the nineteenth century, so can education today. Thinking anew about human development focuses our attention on upgrading ourselves, not our technology.

The second part urges us to *do better*. Our schools are reasonably effective at achieving what they set out to: producing a solid blue and white collar workforce well drilled in what Sir William Curtis dubbed the ‘Three Rs’ of ‘reading, ’riting and ’rithmetic’ in an 1825 speech in the British Houses of Parliament.⁴ But as automation and globalisation cause traditional jobs to disappear, so must traditional models of schooling give way to those that grow creativity and purpose. A craftsperson aspires to make works of great beauty, is an able user of the most appropriate tools and feels flow when mastering skills. Doing better means beginning with human creativity. We must ensure kids develop the means to express themselves and find a place in the world. This applied scholarship is our noblest aim.

The final part explains why we must *take care*. The education of our children is a perpetual labour, and it remains the most important undertaking of our race. Yet in recent years it has lost touch with its innate human imprint. Schools borrow increasingly from paradigms of the factory or market, vaunting efficiency and competition. This has brought great surges in literacy and improved exam results, but it has pitted kids against each other in a brutal race to the top, narrowed the parameters of learning and taken economic output as education’s only measure. In the future, we must rediscover the ethical and human dimensions of learning. Taking care requires us to build our systems around shared values, not new technologies, framing them

as ecosystems rather than corporations. The well-being of our species, and of our planet, depends on developing our social and emotional intelligence. We must learn to cooperate in building the future we wish to see.

We begin our endeavour from a stable foundation. There is no better time to be a pupil than today, with more than 1.2 billion children in school. Standing in front of them in classrooms from Lima to Lucknow are more than 50 million teachers, almost all passionate, able and committed.⁵ And yet unless we can rapidly adapt the way children learn to the evolving needs of the world today, we risk a lost generation. Six hundred million of those kids are currently failing to master the basics, let alone the tools they need to succeed tomorrow.⁶ Meanwhile, our experience ties us to the past. School is something that everyone feels expert in. Most of us have spent at least twelve years – more than the fabled 10,000 hours – in classrooms. But we've learned the wrong lessons. Not quite an art and not yet a science, the field of learning still paradoxically seems at times devoid of a deep, unitary expertise.

The time for us to unite that expertise is now. Through thinking anew, doing better and taking care, we can bring about a twenty-first-century enlightenment in education that ensures more and more kids fulfil their potential. As the physicists have their Theory of Everything, and the philosophers their Absolute Mind, so we educators must strive for the flourishing of all humanity. As *Homo sapiens*, wisdom – learning – is our defining characteristic, marking us out from our hominid ancestors. The cultivation of this attribute should be our species' highest purpose. We must use this moment of technological disruption, with its jobless future, diminishing resources and driverless cars, to step back and imagine a world that places human development at its centre. Everything depends on our ability to do so.

Failing Again, Failing Better

A year later and my GCSE class was about to graduate into Year 11. Their first exams were a little over six months away. Soon they would be leaving school for sixth form colleges and universities beyond. Their grades would be the only evidence of their abilities they could show to future institutions or employers. The other path, with rates of youth unemployment above 50 per cent for those without degrees, did not bear thinking about. Dreams remained in the balance.

One day we confronted a particularly difficult passage in *Macbeth*. Fabrice, a 15-year-old boy who had been born in the Congo and come to London via some years in Rotterdam, was wrestling with an idea. He'd been leader among a group of troublemakers that were finally developing the abilities to enjoy learning. The topic was stage directions, and we were reflecting on the decisions that a theatre director might make about performing the 'Is this a dagger which I see before me . . . ?' scene. The question I had posed involved a difficult combination of higher-order thinking skills – what would the implications be for the audience's understanding of Macbeth's character if the director chose to show, or not to show, the dagger?

It was a problem worthy of Plato's Cave. Amir, a slight teenage boy from Afghanistan who had been moved to my class as a troublemaker, had his hand up desperate to answer. Triggered by his fresh cultural perspectives – he believed wholeheartedly in the evil magic of cats – he had become entranced by the themes of witchcraft and sorcery in the play, and had used these as a foothold to develop striking and original opinions on Shakespeare. Fabrice continued to consider.

'Oh,' he exclaimed suddenly, 'I get it.'

As Amir bounced on his seat with his hand raised,

Fabrice carried on confidently. It was one of the few times that I remember seeing *visible* learning in my classroom. I could almost hear his brain whirring. He was mastering a new and complex way of thinking.

‘If we see the dagger, then we might think the witches have used magic to trick him.’

‘And if we don’t see the dagger?’ I replied.

‘If we don’t see the dagger, then we would think . . .’ He pondered. Amir continued to bounce. Suddenly Fabrice’s face flickered with understanding: ‘We would think that he is *bare* crazy!’

He turned round to Amir and held his finger to his lips, like a footballer scoring against an arch rival.

It was a watershed moment. Fabrice went on to score As and Bs in his GCSE coursework – Amir got As and A*s. When the exams came around, almost all of the class achieved at least the C that they required to continue on to higher education.

I was elated. But I was also unsatisfied. The kids had succeeded, but only in a narrow sense. They achieved their necessary GCSE grades, but school hadn’t been able to offer them much else. With a proper go at it – and a better teacher – they could have excelled. They were far behind when they came to my class, with many unable to read or write properly after eight years of education, and their Cs, though cherished, didn’t suggest they were ready to change the world. On top of that, I wasn’t entirely sure how we’d made progress. There had been a lot of sweat – and tears – to my approach, but no science. My early incompetence and lack of imagination had cost us valuable learning time. Surely, given all that we knew these days about the mind, the brain, the body, about human behaviour and the science of performance, we could devise a better approach than this? Surely, given the challenges our society faced, we had

to?

The small success I experienced with my Year 10s gave me confidence in the power of education in the twenty-first century to fuel the lives of individuals and to power societies. But we'd have to get it right. We'd have to think anew about the potential of our kids, better equip them to use the tools of today and ensure we took care of them all. Every child was born to learn, but our systems, rather than building on that potential, seemed to be inhibiting it. I set off that day on my journey. Starting out in Silicon Valley, I'd travel across new countries, through new roles and into new classrooms, to find out how we might get started.

If these kids could succeed – from a backward starting point, with a new teacher – then all kids could. The trick in this complex, ever-shifting and rapidly changing world was to ensure that all of them did.

* Walworth Academy has changed in the past decade. In 2008, it came in the bottom 12 per cent of schools in the UK for students achieving five A*–Cs including English & Maths. Today it is rated a good school, with kids performing around the national average. For disadvantaged students, it ranks in the top third nationally for attainment, and the top 20 per cent for progress.

PART I

THINKING ANEW

CHAPTER 1

Artificial Intelligence

Beware Geeks Bearing Gifts

Whom the gods would destroy, they
first call promising.

Cyril Connolly

The Robot Teachers are Coming!

Brett Schilke sat in a back room of Singularity University’s Mountain View headquarters talking about the future. Since his school days he’d been on a mission to revolutionise learning. ‘I was *that* kid,’ he said, ‘I was like, “Tell me why I have to learn this.” I had one teacher who just pissed me off. He had the same answer every time I asked – it might be a question on *Who Wants to be a Millionaire?* And I was like, you literally can’t come up with anything better than that? Can I *leave?*’

Schilke had worked in education since he graduated from college, where naturally he excelled. He was an

unashamed enthusiast: an adventurer, educator and instigator who – *Welcome to California!* – loved stories, puns and high-fives. After starting out running cultural, arts and education development programmes in Siberia and Transylvania – ‘Yes, the former gets cold. No, the latter does not have vampires’¹ – he had returned a few years earlier to the Midwest to run IDEAcO, an education non-profit whose projects included City X, a problem-solving and 3D-printing curriculum for kids. He then joined Singularity University, the organisation set up by the high priest of futurology and author of *The Singularity is Near*, Ray Kurzweil, ‘to educate, inspire and empower leaders to apply exponential technologies to address humanity’s grand challenges’.²

The Singularity was Kurzweil’s term for a hypothetical point in the future when artificial intelligence would become trillions of times more powerful than our human minds, ushering in a new civilisation ‘that will allow us to transcend the limitations of our biological bodies and brains’ by merging with our technology.³ A cool notion, if a little scary. While Kurzweil, who now leads Google’s AI division, foresaw a utopia in which our augmented minds achieved unimaginable feats of cognition, others envisioned a human face crushed for ever under a hyper-intelligent robot boot. Singularity University – SU to believers – could be interpreted as Kurzweil’s effort to tip the outcome towards the former.

Brett Schilke had recently been appointed SU’s director of Youth and Educator Engagement. It was his job to be obsessed with the future – he was careful to distinguish it from education or school – of learning.*

Behind him hung a painting of a robot on a Harley-Davidson leaping from a tower of iced doughnuts towards a golden horizon. He spoke fast, ideas pattering up like

popcorn in the microwave.

‘It’s a super-exciting time to, like, be alive,’ he said. ‘That sounds really corny, but it *is*. It’s awesome. It’s just so unexpected what you can do every day.’

He looked at me with clear eyes.

‘It’s *wild*.’

He was talking about how technology was changing the world, and how the world – and our schools – had to change with it. In Silicon Valley the idea that we humans are capable of more was as commonplace as the belief that technology is a purely positive force. Schilke had drunk that Kool Aid. In fact, he added that we must *learn* and *create* together to achieve our machine-assisted potential. For historical reasons, we were not yet doing this.

‘We have a system that was designed for the Industrial Revolution. That’s where modern education came from. We needed to produce a massive workforce that does simple tasks over and over and over and over. And how do you do that? Well, let’s get them when they’re young and teach them to sit up straight and raise their hand.’

He paused, a little hysteria in his voice.

‘It’s all about building this almost *militarised* group of people.’

This was broadly true. Education systems had been influenced by a militaristic model. In the 1830s Horace Mann, then education secretary in Massachusetts, pioneered a state-wide form of schooling that became the basis for free and universal education in the US. The model was inspired by a visit he had taken to Prussia, a country renowned for its strict hierarchies, obedience to power and military might, where a few decades earlier Frederick the Great had signed into law the world’s first national system of education. That paradigm, strengthened by the ideas of industrialisation, mechanisation and massification, came to define universal-

education systems that soon cropped up all over the world. But thanks to computers and other new technologies, Schilke felt that finally these notions were being challenged.

I'd made Silicon Valley the first stop on my journey into the global learning revolution so that I could find out how. The technohumanists of the Bay Area exerted a powerful influence over our view of the future. And I wanted to know what artificial intelligence could tell us about the power of our own minds. Was human learning becoming obsolete, as some suggested, or could we use computers to augment our brainpower to unimaginable levels? I thought we risked underestimating our own natural capabilities, fittingly adapted over millions of years of evolution, and instead had to think anew about our own capacity for learning in the digital age. If we could better understand our brains, and learn to use our technology wisely, the potential might be much greater than we realised.

The first thing to understand, thought Schilke, was that we had not simply to invest in the latest gadgets, but to radically change how we thought about learning.

'SU focuses more on how you equip teachers for the larger technological and social trends that are coming,' he explained. 'We don't teach 3D printing to teach 3D printing, as a job skill like you learn to be an accountant. We teach 3D printing to teach 3D *thinking*, to learn how you conceptualise ideas.'

This focus on higher-order thinking was increasingly backed up by research. Two futurist economists at the Oxford Martin School, a centre set up to predict and plan for societal changes to come – had concluded a couple of years previously that of the 702 current jobs done by humans (by their calculations), around half might soon be taken over by artificially intelligent machines.⁴ If during industrialisation the robots had eaten muscle jobs, in the era

of computerisation they were coming for those of the mind. This posed a double challenge to schools, first to incorporate the newest technologies in the learning process and second to reimagine the content of a useful education. If anyone in the world knew how to meet these challenges, I thought it would be technophiles like Schilke.

Earlier we walked round the campus where SU had its home, an old NASA research institute and military base dominated by a huge skeletal structure, the uncovered frame of the old hangar where airships were constructed in the 1950s. Now empty, it was sometimes used by Google as a venue for exclusive staff parties – their campus swallowed the land on three sides. Just beyond the fence we could see the Moffett Field airstrip where the tech giant was testing pilotless flying transports, and which was used by President Obama to land Airforce One on his visits to the Bay. An eagle circled overhead, nature's proto-drone.

Schilke revelled in SU's place at the heart of all this innovation. He pointed out the base's dilapidated McDonald's, long since repurposed. 'In there is a project to map the surface of the moon,' he said, 'it's *so* cool. They call it McMoon.' On site was a *Who's Who* of tech companies: Tesla, Carnegie Mellon, Moon Express. In the distance were the looming towers of NASA's rocket-engine testing facility and dotted around the car park the latest hybrid vehicles and electric cars. This sun-kissed place, with its mountain backdrop and hulking government warehouses, now commandeered by friendly-faced tech corporations, was at the heart of all the new in the world. It was intoxicating.

The final stop on the tour was to be the Classroom. Schilke talked excitedly of the toys that we'd find there. When I'd been teaching Fabrice and Amir, the latest technology meant beaten-up laptops that had got in the way

of progress. Now, I couldn't wait to see the gadgets, Virtual Reality lecture halls and robot teachers, 3D printers and nano-materials. I thought about Neo in *The Matrix* downloading learning into his brain in seconds. Perhaps technology really was on the cusp of revolutionising learning. Maybe, in that room, was the future of school.

I'd had my first sip. The Kool Aid didn't taste too bad.

Are Computers the New Books or the New Televisions?

For people who deal exclusively in preparing others for the future, we educators are surprisingly reluctant to embrace the new. Our own experience biases us against it. Wasn't school just so for us, and didn't we turn out alright? Certainly at St James' Primary School in the 1980s there was not a single computer. My Year 1 teacher – Mrs Calcutt – outlined our first words and numbers in chalk (which we only occasionally used as a projectile). The tools of learning were pencils, paper and books. We practised handwriting and met the inhabitants of *Letterland* from Annie Apple to Zig Zag Zebra. It was decidedly no-tech. And if that worked for us, we now tell ourselves, it will work for our kids.

It's wise to be somewhat circumspect about the potential of the latest technology to change the way we learn. The lustre of the new has a tendency to hypnotise. In 1922 Thomas Edison predicted a dramatic transformation in public schools:

I believe that the motion picture is destined to revolutionize our educational system . . . in a few years it will supplant largely, if not entirely, the use of textbooks. I should say that on the average we get

only about two percent efficiency out of textbooks as they are written today . . . Through the medium of the motion picture . . . it should be possible to obtain one hundred percent efficiency.⁵

The trend continued. In 1966, dazzled by the potency of advertising in shaping the habits and behaviours of the American people, President Lyndon Johnson was moved to intone that ‘unhappily, the world has only a fraction of the teachers it needs’, but that this could be compensated for by ‘educational television’.⁶ Unless I’ve just not been to the right classrooms, neither of these revolutions came to pass.

Yet new technologies *have* at times radically transformed learning. Five thousand years ago, the invention of writing enabled humans to transfer knowledge through space and time, storing it outside of our minds as never before. Even then there were sceptics, with Socrates lamenting the written word in the *Phaedrus*, arguing that it undermined our capacity for memory and distanced us from authentic truth.** But the transformation effected was in no doubt. No longer would learning be defined by the quality of the tutor you could afford; nor was the evolution of knowledge limited to a dialogue between two people. Now across space and time ideas could be shared and adapted through the minds of the many, and new structures of thought created. This transformation was boosted a little over 500 years ago when the printing press and first vernacular Bibles precipitated a tipping point in the access to knowledge of the masses. The availability of cheap, plentiful books played a huge part in the great surge of literacy experienced by the West in the late nineteenth century.

It looked like our parents were right – books *were* better for us than TV. So, if we were unsure about the likely impact of technology in education today, the question we

had to ask ourselves was this: were computers the new books or the new televisions?

Why Computers Might be Books Squared

One measure of a person's education is their intellect, and the cerebral world of chess has long been its proving ground. The Cold War showdown between Boris Spassky and Bobby Fischer in 1972 captured the imagination of the world precisely because it could be construed as a victory for the American over the Soviet mind (no matter that Fischer was the son of European immigrants). While the young maverick and the old master were squaring off in the match of the century in Reykjavik, around the same time computer scientists in the US were working on a seemingly more innocuous conundrum – could a computer beat a person at chess?

By 1972 there was already pretty strong evidence that the answer was yes, at least at the amateur level. In 1967 a group of MIT students put together a computer called Mac Hack IV to take on the philosophy professor Dr Hubert Dreyfus in a game. A strong amateur player and leading human mind, he looked down on the gimmicky machine, declaring that no computer could yet beat even a ten-year-old child at chess.⁷ From a winning position Dr Dreyfus's fallibility got the better of him, and he lost to the machine. The same year, Mac Hack IV became the first computer to win an official tournament match. Over time, these challenges became the battleground of human versus machine mind. The most sought-after scalp was to be hard won – that of the world's leading grandmaster.

In 1997, after decades of attempts, a team at IBM felt that they had finally prepared a machine that was up to the task. Echoing the 1972 match of the century, Deep Blue

the work of teachers, and wondered what that meant for the minds of our kids. I decided to pay a visit.

The Teaching and Learning Machines

It was a bright October morning and as the workers of Silicon Valley collected their drive-thru Starbucks, the 400 students of Rocketship Fuerza Community Prep were filing out of the school yard. They had just completed ‘The Launchpad’, a daily routine in which the mic’d-up head teacher, Ms Guerrero, readied the young Rocketeers for class, leading them through the pledge of allegiance, whole school cheers, songs and the handing out of prizes for things like ‘grit’ and ‘*ganas*’.† The highlight had been a singalong to Des’ree’s ‘You Gotta Be’ and a whole school dance routine – parents included – to ‘Shake It Off’ by Taylor Swift.

‘It’s morning coffee for the kids,’ said a teacher. It looked like it. The Rocketeers leaving in teams – The Broncos! The Spartans! – were pumped.

The strange-sounding terminology was carefully chosen. Rocket-ship lifted off in 2007 as the first in a new wave of West Coast schools that would self-consciously surf the tech tsunami. Software entrepreneur John Danner was one half of the founding team. He saw an opportunity to harness the growing potential of machine learning to personalise the school experience for each child. The zero cost replicability of digital tools also appealed to his entrepreneurial nature. They would rapidly test and scale a hyper-efficient school model that within 20 years would reach 2.5 million kids in 2,500 schools nationwide. If AI could win *Jeopardy!* it could teach a few elementary schoolkids how to solve maths problems.

The school’s other co-founder was Preston Smith, a

career educator and teaching superstar, who'd run highly successful schools for marginalised kids in the San José area. When I met him in his office downtown he explained how thinking machines were beginning to help schools. 'There's a place for technology around instructing things that are really hard for teachers to teach. I think math, how you can visually do things is profound. Practice is profound. Getting things off teachers' plates because they are really way too talented to be doing sounds and letters with all their kids. We think about the opportunity in terms of time. It's gonna help my teacher not to have to teach this. It's gonna help my teacher be more effective. It's gonna help my Rocketeer master this standard more quickly. It's gonna buy back time to do more critical thinking, more higher-level things. That's what we obsess over.'

Rocketship was making a big bet on the ability of technology, and particularly AI, to automate some learning experiences.

Underpinning this approach was the Learning Lab, a place where kids would go each day to be tutored by intelligent machines.

After the kids had finished their breakfast, Ms Guerrero and I headed over. The Lab was a cavernous 2,000-square-foot room with whiteboards on either side, a school hall X.0. In the centre two adult supervisors sat behind a circle of desks. Arrayed either side of them in six long rows facing out towards the whiteboards were 100 five-year-olds. All wore the distinctive purple uniform of Rocketship and all had a laptop in front of them and a set of outsize headphones over their ears, like miniature novices at a space-age seminary. Half were working on ST Math, an online arithmetic platform, and half on a reading program called Lexile. They were busily completing their problems, heedless of me, a looming six-foot-four visitor.

top row, then three on the bottom row, receiving another eight green ticks. She was working smoothly. Third, the problem was written as $10 - 8 = []$. She typed a 2. Green tick again. And lastly a written problem: if I take eight from ten, what do I have left? She keyed in the answer, t-w-o.

In the past a teacher would have set and administered these problems. The kids would all have answered the same ones, then swapped papers before painstakingly grading each other's work. The genius of this system was that each individual child was carrying out a set of drills that were specially tailored to their learning needs. If they had a weakness in multiplication, the software would learn of it through analysing their data, and then ensure they practised those multiplication problems in a range of different ways. If the kid was getting everything right, the software would increase the complexity of the problems. If a hint was required, or a little encouragement, it would be delivered by an onscreen avatar. No teacher was needed. Nor another kid to mark their efforts. They'd spend between 70 and 90 minutes in the Lab each day. That was a lot of problems they were getting through.

Back in Preston's office later I considered the slogan emblazoned on the purple wall of the conference room.

If a child can't learn the way we teach, maybe we should teach the way they learn.

'For us it is a time and mastery question,' he said. 'It's multiple hits. We'll teach you in class. You'll get direct instruction. Then we'll put you in a levelled group. You might have independent time with it too. Then you're going to be at the Lab, and it's going to be at your level, so you're going to get it again. You might get pulled out for tutoring in the Lab. So if you're a child who is low, you might get the same content in a different format six different times, in

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