

INTRODUCTION



The history of the future

Books will soon be obsolete in the public schools. Scholars will be instructed through the eye. It is possible to teach every branch of human knowledge with the motion picture. Our school system will be completely changed inside of ten years.

Thomas Edison, quoted by Smith, F. J., 1913

People have been predicting that technology will transform education for over a century. And yet, with relatively few exceptions, education has remained untransformed. Books are not obsolete. The school system has not been radically changed in the way Thomas Edison predicted. Children still attend school buildings and sit at desks in ways that are similar to their counterparts in the 19th Century. Compared to the change and disruption that technology has brought to practically every other part of our society, education is an outlier.

This has not been for lack of effort – or money. Many developed countries have made big investments in education technology, but data from the Organisation for Economic Co-operation and Development (OECD) shows that these have led to ‘no appreciable improvements’ in educational achievement.¹ In developing countries, many big philanthropic technology projects have been similarly unsuccessful.²⁻³

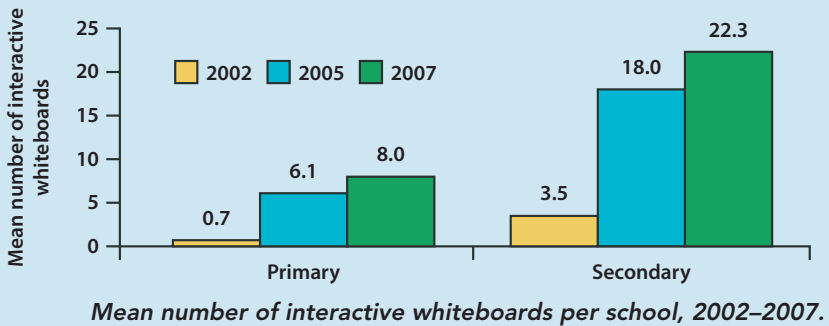
Why is this?

I first got interested in this question when I began teaching in 2007. Although I had only left school myself four years earlier, those intervening years had seen huge investments in interactive whiteboards in English schools. I’d never seen an interactive whiteboard when I was a student, but by the time I started teaching they were in almost every state school in the country.⁴

England's investment in interactive whiteboards

England invested heavily in technology in schools from 1997 onwards. By 2002–3, the government was spending £510 million a year on its ICT in Schools initiative, and interactive whiteboards were an important part of this strategy.⁵ In 2004, the then Education Secretary, Charles Clarke, announced a fund of £25 million for schools to purchase interactive whiteboards.⁶

It's estimated that in 2004, schools in England spent £50 million in total on interactive whiteboards.⁷ The result was a dramatic increase in the number of whiteboards in classrooms, as can be seen from the graph below.⁸



Viewed in isolation, these whiteboards seemed like magic. I remember the first time I saw one in action, I couldn't quite believe they were real. You could write on a whiteboard, have your words or diagram appear on the screen and on the linked computer, and then save all your jottings for a future lesson. Various different linked software packages and pre-planned lessons let you exploit the interactivity in different ways.

However, once I was in the classroom, despite my best intentions, I rarely used any of the most sophisticated features, instead using the whiteboard to display pre-prepared slides and presentations. I wasn't alone in this,

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one education academic lamented the way that teachers (like me) used interactive whiteboards as ‘very expensive data projectors’ and noted that:

... in nine out of 10 schools I visit there is only one cable plugged into the teacher’s laptop, and that is the projector. The whiteboard cable is out.

Angela McFarlane, quoted by Lepkowska, D., 2007

However they were being used, they weren’t having the hoped-for impact on attainment. One major review of their use concluded that:

... although the [interactive whiteboard] may alter the way that learning takes place, and that the motivation of teachers and pupils may be increased, yet this may have no significant or measurable impact on achievement.

Higgins, S., Beauchamp, et al., 2007

How could such a big investment in such cutting-edge technology end up producing such disappointing results? Speaking to colleagues and others in education, I would often hear variants of two arguments, neither of which I found satisfactory.

One was that teachers were conservative and change-averse and when they got new technology, they would default to using it in ‘old’ ways, like I had. This argument never felt very persuasive to me because I and my fellow trainees were new to the profession and not accustomed to any particular teaching approach. If we had ended up using whiteboards in traditional ways, it was not out of habit but because other methods had proved unworkable or unsatisfactory in some way. For example, a lot of the advice about how to use interactive whiteboards recommended giving individual students the chance to come to the front of the class and use the whiteboard themselves. But it often felt to me that doing this was not of as much value for the rest of the class, and indeed, a review of whiteboard use showed that these kinds of activities did lead to ‘a loss of pace, and boredom of more able pupils.’⁹

The other argument I would hear is that education is immune to technology, that it's simply too 'human' or too 'personal' to allow for computers to have much of a role. This explanation never seemed that compelling either. Technology has a big role to play in other very human and personal areas like dating and healthcare. It felt unlikely to me that education was so unique that it could not be affected by technology. At least, if education really was the one area of human endeavour where technology could not have much of an impact, I would want more of an explanation than just 'it's too human'.

England's investment in interactive whiteboards has been described by a later government minister as an example of the government 'imposing unwanted technology on schools'.¹⁰ Still, it was markedly more successful than some other high-profile and expensive projects, as we will see in the following case study.

Tablets in Los Angeles

In 2013, the Los Angeles Unified School District (LAUSD) announced a deal with Apple and Pearson (a leading educational publisher) to equip every student in the district with iPads that carried a Pearson curriculum.¹¹ The LAUSD is the second-largest school district in the US, educating over 700,000 students, and the contract would ultimately have cost \$1.3 billion. Barely a year later, the deal collapsed. The iPads' security software was easy to delete, the pre-installed curriculum was unfinished and riddled with errors, and teachers had been given little training in how to use the tablets and curriculum.¹²

Perhaps the most chastening aspect of this failure was the stature of the organizations involved. As *Wired* magazine reported:

If one of the country's largest school districts, one of the world's largest tech companies, and one of the most established brands in education can't make it work, can anyone?

Lapowsky, I., 2015

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So why has education technology failed in the past, and is it destined to keep failing in the future?

This book will explore these questions and try to come up with some more nuanced answers than 'obstinate teachers' or 'education is special'. As we can see from Edison, making predictions is a dangerous game. It's easy to be overoptimistic and make predictions that don't come to pass. But it's also possible to be too pessimistic and dismiss good ideas.

A few years before Edison's prediction about books and film, many eminent scientists thought that human flight was impossible.¹³ And indeed, in the 1890s, it probably would have seemed more likely that the new technology of radio waves could transform education than that passenger flight would transform travel. At around the same time, parapsychology and clairvoyance were burgeoning new fields of enquiry that seemed to have a promising future. Sometimes, popular, plausible and commonsensical ideas turn out not to have the impact we would hope for, whereas less plausible ones can be transformative.

It's easy to laugh cynically at new inventions, and it's equally easy to fall gullibly for them. As a result, deciding to be either 'pro-' or 'anti-' technology is not helpful. In this book, my aim is to move away from such dichotomies. Sometimes, I will be critical of popular and plausible arguments, but at other times, I will entertain ideas that seem more fanciful. I hope that by looking at the history of past education technology failures, at the nature of education, and at the way technology has succeeded in changing other fields, we can avoid some obvious errors and make success more likely.

This feels particularly urgent because over the past five years or so there has been a surge of interest in education technology, with a wealth of new approaches promising to make a difference. At the same time, the debate about the value of education technology has intensified, with almost as

many viewpoints as education apps. Some teacher union leaders welcome investment in technology, while others fear it could reduce the need for teachers.¹⁴⁻¹⁵ Some teachers feel it could reduce workload; others say it's increased it.¹⁶⁻¹⁷ There are parents who worry about their children staring at screens all day, and those who worry that their children won't be able to get a job unless their schools embrace technology.¹⁸⁻¹⁹

Before we consider these competing arguments, let's take a step back and look more broadly at education in general. Regardless of technology, does education need to change? Is our current educational model fine, does it need tweaking, or is it in need of more radical upheaval?

Does education need to change?

The 20th Century saw a global expansion of primary and secondary education which brought with it many benefits. Children spend more of their time in school, and global rates of literacy have never been higher.²⁰⁻²¹ Still, in both developed and developing countries, challenges remain.

To get an insight into different countries' education systems, we can look at the data from Programme for International Student Assessment (PISA) tests. The PISA tests are run by the Organisation for Economic Co-operation and Development (OECD), and every three years they assess thousands of 15-year-olds in dozens of countries on their achievement in mathematics, science and reading. The results consistently show that even in developed countries, significant minorities have weak skills, which makes it hard for them to participate in modern society.²²⁻²⁴

In 2012, the OECD carried out a new assessment designed to measure adult skills, and also to compare different generations across time. In Korea, adults in the 55–65 age range performed poorly, but those aged 16–24 did much better.²⁵ But in England and the United States, 'improvements

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between younger and older generations are barely apparent'. This may partially be explained by historical reasons: many Korean adults in the 55–65 age range will not have had any formal education in the aftermath of the country's civil war. But that can't completely explain the lack of improvement in England and the US.

In developing countries, of course, lots of children do not even have access to education and those who do may not have access to quality education. The literature on global educational achievement often measures how many children are enrolled in school and for how long. Of course, it's important to know these statistics, but they can be misleading, because a year's worth of schooling in one country is not the same as a year in another. The education economist Eric Hanushek has shown that when you factor in educational quality, 'the education deficits in developing countries are larger than previously thought'.²⁶

Other data shows some worrying patterns. Throughout the 20th Century, scores on IQ tests increased steadily, a phenomenon known as the 'Flynn effect' after the scientist who discovered it.²⁷ In recent years, there have been signs that the Flynn effect has stalled or even gone into reverse.²⁸ The reasons for the existence of the Flynn effect, and for its reversal, are not clear, and they may be the result of factors outside education.

However, this lack of understanding is part of the problem. We know relatively little about what makes good education and how we can reliably improve it. In other areas of life, such as economic growth or life expectancy, we are accustomed to seeing steady, if small, annual increases that add up to big differences over time. In education, that engine of improvement appears to be missing.

The OECD research cited at the beginning of this introduction showed that investments in technology don't lead to appreciable improvements

in outcomes. Other research by the OECD shows that beyond a certain level, increasing general investment in education doesn't lead to improvements either: there is no clear correlation between spending per student and education outcomes.²⁹ And some of the most popular school-improvement tactics turn out not to have as much impact as you might think, either. Reducing class sizes, for instance, is beloved of politicians, but has limited impact on student attainment.³⁰ In Chapter 2, we will look more closely at why this is, and we will explore how different methods of more personalized instruction can support or impede student learning.

What will improve education?

Before we can think about using technology in education, or indeed making any expensive intervention, we need to step back and ask some broader questions. Much education research is focussed on describing the features of successful school systems. This can be interesting and useful in some ways, but it also has limitations. It is hard to know whether the prominent features of a particular system cause that system to be successful, or whether the causes of success are deeper and less visible. E. D. Hirsch, the educationalist, uses an analogy from medical science to make this point. Originally, medical researchers assumed that malaria was caused by damp, low-lying air, because many of the people who got the disease lived near swamps. Only later when the disease was put under a microscope did they discover it was transmitted through mosquito bites.³¹ Similarly, with education, we need to think about cause and effect in a deeper way. Instead of just looking at the features of successful schools and school systems, we need to ask more fundamental questions: *how do humans learn?* and *what causes learning to happen?*

Once we have some answers to those questions, then we can start to think about *how* technology can help us achieve our educational goals. That's the aim of this book. In Chapter 1, we'll look at what the science says about

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how humans learn. Chapters 2–5 will each focus on a popular education technology strategy and see how it measures up against the science. Chapters 6 and 7 will then establish some principles for how technology can reliably help education.

Education technology is an enormous, global and fast-moving field, and this book is not an exhaustive survey of it or a catalogue of the best learning apps. Rather, when I discuss a particular programme, it's because it illustrates some general principles or illuminates a wider debate.

The focus of the book is on primary and secondary school education, with some diversion into tertiary education where there are signs an approach might transfer well to schools. I've looked at different approaches from across the world, but there is an inevitable bias towards the UK, the system I know best.

I have also deliberately focussed on the educational programmes of some of the major US technology companies and their charitable arms, simply because these organizations have enormous resources and global influence. Their general support for a particular approach is of significance, even when their specific interventions may be small and limited to the US.

One of the central themes in the book is the gap between what we know about human cognition, and what often gets recommended in education technology. In the last 70 years or so, scientists have discovered enormous amounts about how the human mind works. Much of this research has been inextricably intertwined with research into artificial intelligence and information technology, as researchers realized that to understand how to develop artificial intelligence, they had to understand how human intelligence worked.³²

But while this research has led to the dramatic developments in technology which have transformed so much of our world, the same research is incredibly little-known in education. The greatest irony of all is that education technology has perhaps been the faddiest part of education. Far from establishing sound research-based principles, technology has been used to introduce yet more pseudoscience into the education profession. But therein also lies the greatest hope: if we can reconnect both education and technology with the research underpinning them both, there is enormous promise for a genuinely successful revolution.

