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Technology in Teaching and Learning

DAVID A. TURNER
Treasurer, World Education Fellowship

Abstract

This article is a personal reflection on the changes in educational technology over the past fifty years. It puts those changes in the context of wider advances of technology in society, as well as a longer historical context. In taking that wider view, it suggests that we need to take a fresh look at the challenges of technology in teaching and learning in order to gain perspective on what has, and what has not, changed.

Keywords: Educational technology, Teaching and learning, Artificial intelligence, Digital divide

Introduction

As we face education after the pandemic, we can see that there have been very great changes in the last three years. Most obviously, there has been a huge expansion of distance learning / on-line classes, with major improvements in such tools as Zoom and Teams that support synchronous learning. These come alongside the tools that have been around for some time for asynchronous learning, such as bulletin boards, blogs, videos and managed learning environments. These may have become easier to use over the last three years, or we may have had more time to play with them, but there has been a massive growth in the availability of support materials. These range from video material prepared by universities for their own courses, through material provided by other interested groups such as TED talks and the Royal Society for the Arts, to general provision of material on YouTube and similar platforms. If anything, the problem is that there is just too much material for one person to keep up with, and finding valuable resources can be challenging.

But if we have embraced this technology as necessary to meet the needs of the moment, now might be a good time to reflect a little, to make sure that what we keep is of value. Most importantly, we need to keep in mind the fact that there are fashions in technology, and there have been false starts and dead ends in technology (think only of Betamax). We need to see the technology in a longer time frame in order to evaluate which items are likely to be around a few years from now. Not the least important aspect of this is whether teachers themselves are not now redundant, as there is so much recorded educational material available, or might soon become so as artificial intelligence (AI) improves. There must be educational administrators around the world who are thinking that there are 'efficiency savings' to be made from using recorded lectures instead of teachers.

For all these issues, there are instructive lessons from history.

The Long View

Most of those who are in the educational system today will not remember a world without Google or Wikipedia. So it is appropriate to review some of the changes that have happened in recent decades, and what has become available. I certainly do remember attending a seminar on higher education that I attended in central London in

1998 or 1989 when I heard for first time about the new search engine that would transform the way that the internet could be used. But that was by no means the only technological change that impinges on education today.

When I was at school, the ball point pen represented the cutting edge of technology. And, of course, we were forbidden to use it, as it would undoubtedly lead to a deterioration in handwriting and general literacy. Much the same arguments as are used today to bemoan the negative influence of word processors and spell-checkers on today's students. And probably the same arguments as were used when pens and paper replaced chalk and slates for the generation before. Some complaints about technology are perennial, and are simply waiting for a new technology to come along so that they can be recycled.

By the time that I was an undergraduate student, the technology had moved on, and, besides, I was in an environment where education was adopted, even for educational purposes. It is true that in those days a computer was the size of a small house, and was less powerful than my current telephone, but the lecturers had thought of using films to illustrate their lectures and even using audio tapes for giving us laboratory instructions.

But the general point that I wish to make is that the technology was not as easy to use as it is today, and this is perhaps nowhere better illustrated than in the area of high technology itself. As part of my programme I spent a short time in an apprentice training school (those were the days when an apprenticeship lasted five to seven years), where I was introduced to the non-destructive testing of mechanical components. X-rays and ultrasound were used to detect flaws and cracks in castings, in order to predict which were likely to fail before their design lifetime had elapsed. The use of ultrasound was really in its infancy, but by watching a fuzzy picture in a black and green screen, it was sometimes possible to detect a crack a few centimetres below the surface in iron casting.

A few weeks ago I had an echo-cardiogram, which uses essentially the same technology, except in this case there was a clear, three dimensional image on a screen which could be rotated, or differentially coloured, to highlight features of interest, showing a heart beating in real time. Most of that change is the result of improved computer power, and that has affected all aspects of our lives, from an abundance of precision engineered consumer products to improved healthcare. If anything, education has been a little slow joining this bandwagon until the recent impetus to cope with social distancing.

A few years after my first encounter with ultrasound, I started teaching in a secondary school, where the resources for technology were less – normal for a state funded school, but less. Photocopiers were relatively new, and also expensive. Preparing handouts for classes was difficult, and depended on a range of technologies that were messy and/or less effective, which most teachers today will never have heard of. There have been huge changes in technology, and they are not limited to the development of computers, important though computers have been.

Many of those changes have been positive, and very helpful for teachers. It is easier to download a video clip, or stream a video, than it was to book a film from the local area film library, set up the screen and projector, and make sure that physical film did not break. Similarly, teachers (and their students) have access to on-line resources that make it much easier to answer those difficult questions that often arise in the course of the best prepared lessons.

But not all the obstacles to technological change have been the result of the technology itself. I remember an institution where computers were seen as the province of academic research, and dedicated wordprocessors were required for secretarial staff and administrators, because they should not be allowed to encroach on research work. With hindsight those socially constructed boundaries that prevented the adoption of the most appropriate and flexible technology look rather foolish, and we need

to ensure that we do not get stuck in some of those dead ends.be avoided altogether without slowing down the change.

Of course, innovations are likely to throw up many of those dead ends, and they cannot be avoided easily. I have already mentioned Betamax, but one only has to look at the variety of formats for floppy disks that we have seen, the variety of hard disks, the various formats of video disks, and so on. Inevitably, if we innovate, we must expect to make some mistakes, and we also need to be prepared to accept those mistakes and move on. We do need, however, to try to make sure those diversions from mainstream development should be as cheap as possible, so as to minimise waste.

One of the major changes that we have had to take on board is the timescale for which we are planning. I have a very lovely pair of carrying cases that I had made specially to accommodate 5¼ inch floppy disks, now rendered obsolete by the changes in technology that I have referred to. Learning to live in a state of rapid flux is going to take some important changes in attitude for all of us.

Selecting the Right Technology

It is important, however, that the technology should not drive the changes. I saw this graphically demonstrated in one of the first jobs I had in higher education. I was working with a group of international students who were very eager to learn about the latest technology, at that moment the overhead projector (OHP) (a now rarely seen box that contained a bright light, and when a transparency was place on top of it, the image was projected onto a screen). I arranged for a lecturer from the audiovisual department to come and demonstrate what was on offer for our students.

On that occasion, I was treated to the most delightful display of how to create a visual impression using cut-outs of coloured cardboard, coloured felt-tip pens, Blu Tack, and a whiteboard. I was impressed by how a teacher with a clear message could communicate that message with appropriate visual aids. Unfortunately, the intended audience was less receptive, and was still inclined to ask about the workings of the OHP.

This is not a new conundrum. Writing in the 1930s, Joseph Lauwerys, professor at the (then) University of London Institute of Education and prominent member of the World Education Fellowship, examined the use of the latest technology in schools. The technologies in question were radio and film.

Not surprisingly, at that time there was considerable enthusiasm for what the new technologies offered. Every child could hear their set texts in literature read by professional orators, or by the author himself/herself if they were better able to project their own texts. They could watch scientific experiments performed by professional scientists with access to substantial resources. They could roam the globe with commentators who could present the flora and fauna, the geology and the industry of far away places, where the principles of geography and biology were most graphically represented. In short, the classroom experience of children need not be ‘limited’ by the poor performance of the teacher who happens to be locally available. All that is needed in a good teacher is the ability to tune in a radio and set up a film projector.

This dilemma has not disappeared with the eclipse of radio and film projectors. Why would my students not prefer to be introduced to the principles of education by the late Sir Ken Robinson? Or introduced to the mysteries of human motivation and decision making by Dan Pink and Dan Ariely? My own performance cannot be compared, and surely my students deserve the very best. Needless to say, at these suggestions one can almost hear the whirr of calculators as accountants reckon up the saving that can be made by deskilling teachers, and employing projectionists. New technology offers an apparent advantage of ‘teacher-proofing’ the curriculum, of escaping from

those 'limited' classroom environments, and of giving every child the very best exposure to knowledge that is available.

It is here, where there is a real dilemma that we need to be very careful. Teachers are not merely transmitting pre-digested knowledge for students to soak up. On other days we know this to be true, when we worry about whether children are seeing enough teachers who are male, or female, or from their own neighbourhood. A teacher embodies a way of life, a commitment to learning and to knowledge that cannot be replaced by any number of films, radio programmes of YouTube channels. And that is rather different from embodying the ability to read from a script, or to turn on a film projector.

Wisely, Lauwerys concluded that we should use the new technologies to support the classroom activities that we always wanted to be able to do, but were unable to do before the arrival of the new technology. And sadly, he noted that in the first instance, mostly the new technologies were used to do the things that we had always been able to do, even before the arrival of the new technology. And that, consequently, there was not much advantage in adopting the new technology. The new technology should be used as a supplement and addition, not as a replacement. And that refers *par excellence* to the notion of replacing the teacher.

There may be a need to rethink exactly what a teacher does. The art of the formal lecture may be consigned to history, as the teacher can call upon the freely available presentations that can be found on-line. But the teacher remains as the commentator, critic, and voice that offers at least one way of integrating information from various sources. In truth, teachers have always played this role to some extent. I can remember teachers in my school who delighted in telling us when a textbook was wrong, or when some recent event or new discovery had rendered an opinion obsolete. But when the teacher also had the responsibility for being the main source of information in the classroom, this critical function was less prominent. Now that students can easily access other sources of factual information, teachers can move into that interesting space of offering an alternative interpretation.

This is really quite a radical shift. Textbooks, curricula, indeed school systems in general, are designed to present a synoptic view of the world: there is a fixed and accepted truth, and this is presented in an unproblematic way. But now there is an opportunity for there to be multiple voices in the classroom. The teacher may still be the loudest, but he or she can bring in supporting acts, and the teacher may agree or disagree with them, or perhaps more importantly, take a more nuanced stance. And students can bring in support for their own counter-arguments.

One thing that became very clear over the course of the pandemic was that schools had not been doing anywhere near enough to equip people with the critical abilities to sift through competing narratives. The spread of fake news and erroneous ideas, even erroneous ideas that are respectable in the mainstream, cannot be countered by simply mandating their removal from social media. There is just too much of it. We need to help our students differentiate believable stories from unbelievable ones, and with any luck we may be able to encourage them not to spread the nonsensical stories even wider.

Artificial Intelligence

One can hardly leave the subject of technology and teaching and learning without considering AI. Even (as I write) we have seen developments with the release of Microsoft's ChatGPT and Google's Bard, which offer, in theory, and possibly even in practice, to do students' homework for them. Should we be worried about this?

At one level, AI has been with us for a long time. Even as I type this, the computer is checking my spelling, and possibly also my grammar, and offering suggestions when it thinks I have made a mistake. But that is fairly primitive, and does

not prevent my students from handing in work that is scattered with errors in spelling. And in the classroom, we have seen adaptive programmes, which set harder exercises if the student is answering well, and set easier exercises if the student is struggling. But that is fairly simple stuff compared with what AI can now offer. Chatbots may represent a step change that really moves us into a new stage of development. The question is whether we should fear and resent the change, or whether we should embrace it and adapt. Naturally, we will fear and resent the change first, and I will think that spell checkers and chatbots are ruining my students' ability to write, in much the same way as my own teachers thought that education would go to hell in a handcart if we were allowed to use ball-point pens. But after that initial, knee-jerk reaction, we will still need to come to a more measured conclusion.

The AI programs that we are looking at the moment are based on an inductive method. They look at what has worked in the past, and they use the methods they have developed to predict what is likely to be necessary in the future. It puzzles me that we should put so much faith in a system that was discredited by David Hume three centuries ago. However, notwithstanding that, it seems to me that AI is relatively good at solving problems that are widespread (that there are multiple instances of) and where the success criteria are clear. The programs can then be trained and improved using feedback from the successful cases to reinforce decisions likely to increase success. But in education, the problems that we face are usually individual or one-off, and the success criteria are very far from being clear. It is not obvious that AI will be applicable to all aspects of education.

We can see this logic of AI applied in predictive text, where the program uses the first few words I have typed to predict the words that are most likely to come next. Predictive text is known to produce suggestions that are not just wrong, but can even be laughable. But even if AI is developed so far that it can avoid being laughable, the logic of the process is that it will tend toward the mediocre and the average. I have asked my students whether they aspire to produce assignments that lack originality and are mediocre. They assure me that they do not, but perhaps that is just what they think I want to hear.

But more importantly, if I set assignments that can be satisfied by writing that is unoriginal and mediocre, then I deserve to have students that turn in work that has been written by a Chatbot. In much the same way, we have seen a moral panic about cutting and pasting, where students have taken work from the internet and stitched it together to make a passable essay. However, I think we need to reflect on the responsibility of teachers here, if they ask for assignments that can be written in that way.

I had the good fortune to work for some years alongside Tyrrell Burgess whose philosophy was always that the student / learner is the only person who can be responsible for integrating the knowledge that they gather from various sources. This is not something that the teacher can do for their students. This seems, however, not to be widely understood. I often read that formative assessment provides information for the teacher, so that the teacher can adjust their instruction to the needs of the student. I rarely read that formative assessment provides the student with the information they need to support their own learning.

I follow Burgess in asserting that the student must be at the centre of their own learning, and therefore should be at the centre of any assessment process. If I cannot set assignments that require that central engagement of my students, then I deserve to receive assignments that reflect the experience of a Chatbot. The presence of Chatbots may be a stimulus to changing patterns of assessment, and the removal of forms of assessment that simply rely in repeating the right answer. Such changes may be beneficial in the long run.

In fact, I was going to try to get a Chatbot to write this paper. But long experience with computers has taught me that the first time one uses a new program, it takes so much learning that it is quicker to use a pencil and paper. And I was working

to a tight deadline, and did not think that I had time for that. Maybe my next paper will be written by Chatbot.

Digital Divide

One obvious source of concern has been access to educational resources, and especially what has been called the 'digital divide', meaning that wealthier students can access on-line lessons while poorer students cannot. Those concerns rang across the difficulty of accessing affordable internet connections, the number of internet capable devices that are in the household, and access to personal space at home where a student can concentrate on their on-line lessons in privacy. All of these are important concerns, and come together under the general heading of digital divide. It amounts to the fact that access to education costs money.

But, again, it needs to be noted that differential access to educational materials is not new. I have been very lucky. I have attended educational institutions that were well equipped and staffed by teachers who were well qualified. I have lived most of my life within an hour's journey of world class universities, including the third largest library in the world. My access to printed materials has been very much easier than for the vast majority of humanity.

The growth of the internet has changed access considerably. I may have had access to an encyclopaedia when I was a child, but it was not as extensive as Wikipedia. The move on-line has changed access dramatically, and not only at the more popular end of the spectrum. There are on-line, open access academic journals (even though they may have to take their place alongside the output of some rather dubious predatory publishers). There is increased access to classical publications through such portals as Project Gutenberg. There is also more questionable access to copyright material through websites that share such materials.

And not only is there greater access to printed material. There is free and open access to lectures and workshops in world class universities. There are simple explanations of a wide range of issues, from theoretical studies to technical applications. And these are now available around the world.

Of course, that is not to say that the digital divide is not important. However much material is available on-line, it is wasted if one does not have a device and a connection that provides access. But there always has been a divide; it may have changed from being a geographical divide to become a digital divide, but it has always been a divide, and lack of money has always been the main obstacle to overcoming that divide. If we recognise that, we can start to discuss whether the new divide is better or worse than the old divide. I do not have an answer to this, because, frankly, we have not been collecting data that would inform the answer to that question. As a result, I opine that the new divide is probably less bad than the old divide. Others opine that the new digital divide is the most serious problem with the new technology. And while that debate is important, it is extremely difficult to advance that discussion when there is little information on the old divide.

To move to the more general point, this is one of the difficulties that we face in making the best use of educational technology. There is a downside to the adoption of most new technologies. Having spotted the downside, whether that is the digital divide, the supposed impact of screen time on concentration, or the detrimental impact on handwriting, we tend to veer toward a moral panic that the new technology is damaging. But most new technologies also have an upside. If that were not the case, such new technologies would not find many advocates. (There may be exceptions to this general principle, but I am not going to try to identify them here.)

But a rush to judgement is an obstacle to a balanced debate about whether the advantages of a new technology outweigh the disadvantages or not. And it is that balanced evaluation that we need now, to ensure that we keep the best and discard bad

practice, especially if it has become so naturalised in the educational environment as to appear unquestionable.

Conclusion

In the last three years, the problems of social distancing have provided a strong drive towards increased use of technology in teaching and learning. This has accelerated some trends that have been around for years, but the change of pace has highlighted certain problems. These have included the correct selection of technology for the appropriate purposes. But it has also raised questions about the possibility of cheating in on-line assessments, and of students disengaging if they are not under constant surveillance.

But the issues of introducing new technologies are not new, and there are lessons that can be learned from earlier new technologies. One important lesson is that, usually, new technology is employed to do what has always been done, only a little faster or with less effort. Only with time do the new possibilities opened up by a new technology become apparent. But this is exactly where teachers and curriculum designers need to focus their attention: what is it that we have always wanted to do, but could not do before, that the new technology allows us to do? It is important to note that the first phrase in that question should prompt an examination of what we have always wanted to do. It starts from our educational aims. The wholesale introduction of new educational technology, on a scale that is really unprecedented, should lead us to a radical rethink of what we are trying to do in education, and quite possibly the role of the teacher.

If we are honest, the serious problems that we now see in education, of student disengagement, of cheating in assessments, and of differential access to educational materials, have long been present in the education system. They may have got a little worse, or the use of on-line learning may have made them more visible to more people (especially parents), but they are not new. They have arisen from the way that we have always taught.

Rethinking our educational purposes should make us think very seriously about whether we need to be doing things the way that we have always done. It is not clear that we ought to be teaching children subjects that they have no interest in, although whether we should make the material more interesting or should focus on the subjects that the children are already interested in is another question. But we have more opportunities for individualising the curriculum than we have ever had before, at the same time as we seem to have more knowledge that appears to be necessary for everybody. The balance between student choice and compulsory content is put before us in a very stark form, and we should not avoid the opportunity to discuss it.

Similarly, we need to think about the kinds of assessment that we are using, if those formats promote cheating. After all, the whole point of cheating, in all its forms, is to persuade teachers and examiners that the student knows something that the student himself / herself knows they do not know, or at least do not know as well as they ‘should’. Only in exceptional circumstances will the students be cheating themselves. Assessment is established as a conflict between the student and the teacher, and consequently this is also the nature of much of the education system. We need to think about how we got to this place, and what we are currently doing that reinforces it.

Fortunately, many of the methods we might try to get out of these difficulties have also been around for a long time. We need to make sure that we do not let the opportunity created by the current rush to introduce educational technology pass, without examining the purposes we hold most dear in education. We need to emphasise the education in educational technology.

Correspondence
Professor David A. Turner
University of South Wales, UK
Email: david.turner@southwales.ac.uk