What is the role of e-learning? Looking past the hype

David A Cook & Marc M Triola

Editor’s note: This article is part of the Dialogue series which features transcriptions of e-mail discussions focused on a current issue in the field held by two scholars who have approached the issue from different perspectives. For further details, see the editorial published in Med Educ 2012;46:826–7.

In this contribution, Dr David Cook, Professor of Medicine and Medical Education and Associate Director, Mayo Clinic Online Learning, Mayo Clinic College of Medicine, Rochester, Minnesota, and Dr Marc Triola, Associate Professor and Director, Institute for Innovations in Medical Education, New York University School of Medicine, discuss the role of e-learning in medical education.

David A Cook:
I had the idea for this Dialogue following our last presentation together in Chicago. In the 7 years that we’ve been working and presenting together, we’ve found a lot of common ground, but also some differences. I think we both agree that e-learning (online learning activities, computer-based instruction, virtual patients, mobile learning, etc.) ‘works’ in the sense that it is better than no intervention,1,2 and is most likely non-inferior to ‘traditional’ methods (lectures, small groups, paper texts) for many learning outcomes.1,3 I’ve devoted more than a decade of research and teaching activity to developing and improving online learning interventions. Yet despite my obvious interest in this instructional modality, I might be a bit less gung-ho than you about the new technologies that are continually introduced.

It seems that every year we see something new – virtual patients, iPads, virtual microscopes, massive open online courses (MOOCs), flipped classrooms, etc. – with educational potential, and a promise that each new breakthrough will revolutionise the learning process to make it easier, faster, less onerous, and less expensive for both teachers and students. I believe that this is mostly a bunch of hype. However, I realise that amidst the hype there is probably some truth. What is your perspective on this? And why is there so much hype in the first place?

Marc M Triola:
The hype has been much greater than any of us could have expected. Few could have predicted that MOOCs would feature in a recurring headline in the New York Times.4 Why is there so much hype? Students and teachers alike are excited by the emergence of new opportunities and capabilities never before possible. Educational technologies empower some of the key ethos of education: openness and access; the use of learning outcomes to inform curricula, and lifelong learning. Many aspects of our current educational system are artefacts from a different time. These new technologies represent a leap forward and the means to open education to learners around the world, no matter what their background or resources. The hype has been tremendously beneficial to higher education and has brought renewed interest, attention and even funding to educational innovations and experiments that would not have flourished otherwise.

What I find interesting is that most of the hyped benefits, including those you mention, are about delivery, cost and access to education, and not about changes in learning outcomes or even quality. The new technologies give us unprecedented opportunities to scale, and the burden is on us to ensure we are using them appropriately to scale quality. People want education to succeed and want younger learners to thrive. To that end, the hype represents hope.

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doi: 10.1111/medu.12484

© 2014 John Wiley & Sons Ltd. MEDICAL EDUCATION 2014; 48: 930–937
DAC:
Your comment that hype represents hope intrigues me. I believe you’re correct. Yet I can’t help but wonder if that hope is misplaced. Since the dawn of recorded history in education, educators have expressed a desire for more effective, more efficient approaches to deliver education (or help students learn). Unfortunately, it seems that no such magic bullet exists. Clark’s seminal review in 1983 documented the repeated efforts of educators to confirm the advantages of successive generations of new technology – the radio, television, and finally the computer. The upsurge of interest in online learning and other e-modalities thus represents only the latest entry in a long line of dashed (or only partially realised) hopes.

This is well illustrated by the five phases of the ‘hype cycle’: the ‘technology trigger’ is followed by a rapid rise to a ‘peak of inflated expectations’ (read that as hope), but when reality falls short of dreams there is a decline to a ‘trough of disillusionment’. Only as users better understand the proper role of the new technology (in particular, the fact that it will not solve all of their problems!) does the upward ‘slope of enlightenment’ occur, eventually settling into a ‘plateau of productivity’ reflecting a stable role determined by the balance of benefits and costs.

The year 2012 was the Year of the MOOC, but by early 2013 the hype had begun to pass and a new technology – the flipped classroom – emerged to take its place at the vanguard of educational technology. But this too shall pass: I wonder what the ‘hot’ educational technology of 2014 will be?

Then again, within the hype there must be some truth. You’ve already cited several potential benefits offered by these new technologies. Can you elaborate?

MMT:
I don’t mean to imply that educational technologies can represent either a magic bullet or a panacea. The time-tested lessons from the studies you mention are that effective education requires good teachers and lots of hard work, no matter what the modality. However, computer-based instruction possesses some unique benefits that preceding technologies lack. It is these benefits that will usher in a new era of education. I refer to these as the ‘Five As’.

1 **Analytics**. The first and most powerful is Analytics. E-learning applications can collect detailed information on when and where learning happens, on each learner’s characteristics, and on their performance over time. Analytics – the evaluation of all of these learning data – will allow us to enter an era of true educational epidemiology that creates the evidence base from which to break the hype cycles and inform the most effective use of technology-enhanced instruction.

2 **Access**. The second A refers to Access. Web-based MOOCs, iPads, e-textbooks and even services like Twitter now give people all over the world anytime access to educational materials. This does not guarantee improved learning, but increased access sets the stage for a global transformation in the reach of education.

3 **Adaptivity**. The third A is for Adaptivity, the ability of e-learning applications to change in response to each student. This is akin to the apprenticeship model of medical education, in which customised instruction is tailored to the needs of each learner and driven by ongoing evaluation of performance.

4 **Assessment**. The fourth A refers to Assessment. Technology offers us new methods to assess learners in a more continuous fashion and to do so over time.

5 **Agility**. The last A is for Agility. Technology enables educational programmes to implement new curricula faster and more broadly, and to connect learners and teachers in new ways.

You have looked at the evidence around educational innovations over the past half-century. Are the impact of and rate of growth in computer-based instruction the same as they are for other popular educational strategies such as objective structured clinical examinations (OSCEs) or team-based learning?

DAC:
I like your ‘Five As’ and agree that these reflect key potential advantages (although most of these have yet to be fully realised). I organise the advantages slightly differently when I contemplate the added value of e-learning.

1 **Flexibility**. Flexibility suggests the capacity to overcome barriers of time, distance, pace and scale. This includes your benefits of access, adaptivity and agility. I would specifically note that although computer-driven adaptivity has thus far been very difficult to implement in practice, learner-driven adaptivity (in which the learner controls the pace and sequence of instruction) is inherent to many e-learning programs.
activities. Also, some online courses allow flexible enrolment – learners can start, progress through, complete, or even repeat a course on their own schedule, and student numbers can grow with only modest increases in demands on instructors.

2 **Control.** Instructors can standardise course quality and content, ensure that objectives have been met (e.g. through repetition until mastery), and scaffold the topic, sequence and complexity of teaching cases and materials to ensure optimal representation of a topic without redundancy.

3 **Analytics.** I agree with your explanation.

Growth and impact are difficult to judge empirically. Two systematic reviews have clearly documented the rapid growth in e-learning.12,13 I’m not aware of similar articles comprehensively evaluating the growth of the OSCE or team-based learning. However, I just did a quick PubMed search on these topics and looked at results by year. Searching for [objective structured clinical exam OR objective structured clinical examination OR osce] I found a total of 1348 articles published to 2013, of which two articles appeared in 1979, 14 in 1990, 45 in 2000, 86 in 2010, and 149 in 2013. By contrast, a search for ([online learning OR computer-assisted instruction OR Internet] AND medical education) yielded 9478 publications, of which one was published in 1965, 14 in 1979, 53 in 1990, 388 in 2000, 684 in 2010 and 585 in 2013 (and 3365 articles were published since 2008). It wouldn’t be appropriate to directly compare these results because it is likely that I missed some OSCE articles, and I’m sure many of the e-learning articles aren’t really relevant. But it is clear that e-learning is a rapidly growing topic in medical education.

Impact is even harder to judge, but it seems that e-learning has begun to infiltrate nearly everything we do as educators. Computers are used to support instruction in countless ways that go far beyond stereotypical stand-alone online modules and formal discussion board conversations. We now see teachers and students creating and using YouTube video clips, informal discussions via e-mail, Facebook or Twitter, virtual patient cases, instructional podcasts, online games, Web archives of face-to-face lectures, and Web-based repositories of educational materials. Activities that would have been viewed 15 years ago as incredibly innovative (and resource-intensive) have now become, in many instances, an unconscious (and easy) part of a teacher’s daily routine.

I’ve long predicted14–16 that the day will come when teachers use e-learning in the same way they currently use chalkboards – namely, as a natural extension of their innate abilities, selected because it meets a specific immediate instructional need and with little conscious thought that it is a ‘technology’. Such uses of e-learning illustrate the hype cycle’s ‘plateau of productivity’,6 and can be attributed in large part to the emergence of technologies that allow the creation and distribution of certain types of learning material with virtually no training or cost.

But e-learning isn’t always cheap, and cost is often ignored or omitted from discussions of educational interventions.17–21 What do we know about the cost of e-learning?

**MMT:**

We know surprisingly little about the cost of education as a whole, regardless of modality.19 Previous evaluations of costs in medical education suggest that the most expensive part of a curriculum is often the instructor’s time.22 Real but rarely quantified costs of traditional education also include the opportunity costs associated with pulling faculty members out of clinics or laboratories to teach in classrooms, which decreases productivity in those revenue-generating spaces. E-learning allows us to ‘time-shift’ faculty members; for example, they can record their lectures during downtime and not disrupt their clinical availability. Similarly, faculty staff could create e-learning ‘artefacts’, such as recorded lectures, that can enable them to teach (albeit virtually) many different groups or sections without requiring additional time.

Implementations of e-learning solutions, programmes and technology offices have been universally associated with greater costs.23 There are pragmatic costs associated with the software and hardware required to develop content and applications.24 Yet perhaps the most important investment involves human capital. Skill development is an essential yet often overlooked and under-resourced area: both faculty staff and students need training in the best and most appropriate use of these new tools. E-learning solutions are maturing rapidly, and the costs of both hardware (tablets, computers) and software are dropping exponentially. With these changes, the human cost of maintaining currency and fluency amidst the constant churn of new apps, new cloud-based services, new hardware and new communication tools will likely become the most prominent cost component. In terms of price, e-learning is likely to have the same growth points as ‘traditional’ education: good teaching requires lots of time and effort, regardless of the modality.
DAC:
I haven’t found much data on the cost of education, either. This seems to be a glaring gap in our evidence base.\textsuperscript{21,25} I agree, however, with your prediction that human capital (time and training) will comprise the greatest expense. In addition to the articles you cite, I’ve found one article in medical education\textsuperscript{26} and a handful in education broadly\textsuperscript{27–29} that compare the cost of computer-assisted learning and non-computer instruction. Although these studies are imperfect, they suggest that computer-assisted learning actually requires more instructor time and carries greater overall cost. However, such cost analyses – although important – should be interpreted carefully because they may fail to fully account true costs (on both sides of the balance sheet) and because the technologies (and hence the costs) are in a state of constant flux. Many e-learning activities that would have been prohibitively expensive 10 years ago can now be implemented quite economically.

It also strikes me that many e-learning interventions may be far more costly than they need to be. Educators often seem to use cutting edge (read that as expensive) technologies because they are available rather than because they add value commensurate with the higher cost. Similarly, I’ve seen many courses that employ visually appealing enhancements that add little educational value. I am not talking about enhancements to improve educational effectiveness, but those that enhance primarily the cosmesis. It seems that effectiveness and cosmesis are frequently confused, and I wonder how often the same effectiveness might be achieved at a fraction of the price.

Am I making this up? Or have you also observed this? If so, can you identify a few points at which we could trim the cost of e-learning without making substantial sacrifices in effectiveness?

MMT:
Let’s circle back to MOOCs as these represent an area of significant e-learning investment by schools. A few schools have estimated the costs, including of time and budget, of producing their courses and found them to range anywhere from US$50 000 for a course developed by the school to US$250 000 for a course developed by the MOOC provider.\textsuperscript{30,31} Many of these MOOCs are adaptations of existing classroom-based courses. The goals in translating them into online formats do not refer solely to educational effectiveness (e.g. greater knowledge gains). The goals of MOOCs are often much broader and touch on many of the Five As, especially Access, Assessment and Analytics. Schools may be willing to accept higher costs for e-learning modalities in order to achieve goals that include the ‘non-pedagogic’ aspirations of broad access and impact.

To respond to your specific point though, we are definitely entering an era in which the tools to create and disseminate powerful e-learning resources are cheap or even free. The ability to create screencasts, similar to those of the Khan Academy (www.khanacademy.org), or interactive e-books is now available for free on any Mac. Tools like Google Hangouts allow live interactive ‘classes’ online with slides and video. Increasingly, the technology will mature and become cheaper, and will eventually fade into the background as it comes to represent a reliable strategy for education and not a novelty. As we enter that era, the costs of education will refer to what they have done historically: the time and effort involved in curriculum design, in crafting excellent content, and in working directly with learners.

One thing that strikes me as unique about health professions education is the nature of what we teach. Medical school cannot, and should not, become a purely online or e-learning experience. So much of what we teach touches on nuanced topics of communication, professionalism, provider–patient interaction, etc. These areas are extremely challenging to cover as an ‘online module’, although there is some growing work in this realm. One of the great things about the current hype and proliferation of e-learning experiments is that they represent a sort of multicentre trial that will help us determine what ‘works’ online in medical education and what does not. This is not a fixed answer as technology and educational strategies evolve, but it will be important for us to survey this landscape to glean from these experiences a set of best practices.

You have looked extensively at the peer-reviewed literature in this area and the relatively few randomised trials of e-learning through the years. How do we also capture this broader world of e-learning to inform our next move? Can we measure the ‘effectiveness’ or return on investment of MOOCs, learning management systems or recorded lectures?
DAC:
Measuring return on investment requires that we define two key variables: ‘return’ and ‘investment’. Unfortunately, at present neither is very well understood or very well operationalised in education. As we discussed earlier, the true cost (i.e. the investment) of e-learning is rarely known with certainty. Implementing some e-learning instructional designs is already quite inexpensive as you note; others continue to be quite expensive even when they use new supporting technologies like authoring tools. However, even as the cost of the technology itself plummets, the time invested by faculty staff in many instances remains stable or goes up. I’ll return to this important point in a moment.

‘Return’ can be measured in various ways – many of which we have already discussed in this Dialogue. We usually think of return in terms of learning (e.g. knowledge, skills and attitudes) or changes in behaviours at the bedside. However, all of the other advantages – flexibility, control and analytics – can also be counted as ‘returns’. Yet it is difficult to quantify such advantages. Clinical researchers face this challenge in medical cost-effectiveness analyses: what is the dollar value of improved patient satisfaction or quality of life, or decreased incidence of a given complication or death? In e-learning, we find it difficult to assign a value to advantages such as ‘enhanced access’ and ‘improved analytics’. I’m not saying we shouldn’t try – quite the opposite, in fact. Over time, accepted standards have evolved for clinical cost-effectiveness research, and this is a vital next step in the e-learning research agenda. However, the conceptual frameworks, designs and standards for educational cost-effectiveness research are still in fledgling stages, and evidence is virtually non-existent. This means that at present we must use non-quantitative approaches to weigh the advantages and disadvantages of e-learning and to determine the proper roles of specific modalities and approaches. Fortunately, the human mind is well suited to making qualitative judgements when tasked to do so. Thus, my present approach when prospectively planning a course is to carefully consider questions such as:

- What problem am I trying to solve?
- What approaches (e- or otherwise) might help to remedy that problem?
- Which of these can I most easily implement using available technology infrastructure and human resources?
- What disadvantages might accrue if I use that approach (e.g. decreased learning effectiveness, student engagement or faculty support)?

From a research perspective, it is helpful to deliberately collect both quantitative and qualitative information about the ease and cost of implementation, and both expected and unexpected consequences of use. Then, looking back, we can identify key factors that contribute to success or failure in a given context (topic, learner group, educational setting) and share these with others. As such mixed-methods (qualitative and quantitative) evidence accumulates, we will be better poised to identify in advance the situations in which e-learning will be most likely to add value, and this in turn will define optimal roles.

As noted above, e-learning can paradoxically increase demands on instructor time. The time required to organise content may be similar to (or perhaps less than) that required to organise a lecture or small-group discussion. However, e-learning development often involves collaboration with content non-experts, pilot testing, iterative refinement, and the creation of low-value enhancements that substantially increase the total time investment. I see two potential solutions to this problem.

Firstly, instructors can use templates for course design so that key elements of appearance, function and instructional approach can be copied from earlier effective courses. Courses should also be developed in a way that facilitates the updating of content when new evidence emerges or when students identify an area requiring some clarification.

Secondly, instructors may need to adopt a paradigm of ‘good enough’ instruction. The concept of ‘disruptive innovation’ suggests that truly disruptive technologies are usually inferior to the existing standard (although still good enough), but cost substantially less. This greatly improves the return on investment (much lower investment, slightly lower return) such that in the long run the new (lower-cost) technology displaces the old. Quality usually subsequently improves through enhanced efficiency and economy of scale. How can this apply to education and e-learning? I believe we need to let go of what is ‘possible’ or ‘ideal’, and focus on what is good enough. I might be able to create a more polished, inviting website, but if the current site meets minimal standards for functionality, perhaps it will suffice. Learners might enjoy a fun animation, but animations often add little effectiveness and cost a lot, so perhaps I should skip this. Filming a video with a formal script, professional lighting and sound, and expert editing would be ideal, but using my iPad to record and iMovie to edit...
and post to YouTube is fast and free. Employing a trained instructional designer and pursuing a series of pilot tests might improve the course, but if I use templates (as above) and focus on low-cost but effective instructional activities, I can probably forego these expenses. Facebook’s conversation tool may not be designed to facilitate learning-focused discussions, but it is free and if my students access Facebook twice daily anyway, using it may represent a net gain. I’m not suggesting we encourage inferior instruction. I’m suggesting that if we can get 80% of the results for 15% of the cost, we will actually increase our educational productivity (through time-shifting and other advantages discussed above).

What do you think? Am I off my rocker? How else can we improve the value or clarify the role of e-learning in medical education?

MMT:
I think your points are valid and touch on many of the opportunities and challenges of e-learning. Although e-learning has been around for 60 years, the velocity and ubiquity of its use have really gained critical mass only in the past decade. So many of the things you mention in your previous response are related to the relative newness of this approach. They will get better and things like well-designed templates will become more readily available and the norm.

Clearly, more work is needed to better clarify the role of e-learning in medical education. E-learning educational interventions pose some unique hurdles for medical education researchers. By their very nature, e-learning solutions can provide more detailed data in electronic form, empowering trials and hypothesis testing. The paradigm of greater access – of e-learning solutions broadening the boundaries of the classroom far beyond a specific class or even school – necessitates a different set of data to understand effectiveness and changes in knowledge, skills and attitudes. Experiences with MOOCs highlight the challenges of handling huge numbers of students who reflect a wide range of ages, educational contexts, approaches to learning, and levels of engagement in course activities.

So what is required to enable us to move beyond the hype of e-learning and into the plateau of productivity? I see at least three requirements. Firstly, the technology itself needs to be inexpensive, ubiquitous and easy to use. This is no small order, but the situation is rapidly improving every day.

Secondly, we need faculty development in the use of current tools and ongoing training in emerging technologies. This development should address the educational approaches first, and the ‘how-to’ of e-learning second. Having strong technology competencies among our faculties and schools will be key.

Finally, I believe the most important thing we need is a more robust evidence base. We have reviewed the 50 years of literature on this1–3 and recognise that the pace of research is falling far behind the pace of e-learning innovation and implementation. Funding for large-scale longitudinal research projects, as well as school-level commitments to fund the pilots you describe above, is critical. Now that we are accruing large electronic databases37 of student performance and details about curricula, we may also need new approaches to tackling the ‘big data’ of educational research.8 We are entering an era in which learner registries and population-level studies are eminently possible.9,10 To transform the promise of e-learning into reality, we need ambitious and progressive thinking on how to share data across programmes and institutions, how to protect our learners while using their performance data to guide their progression, and how to leverage outcomes into best practices.

DAC:
That’s a good note to end on. I’ll add one additional point to your three: namely, we need to maintain a realistic understanding of what e-learning can and cannot deliver. I have yet to see a face-to-face activity that cannot, with some creative thinking, be replicated in an online format. But just because it’s possible doesn’t mean it’s a good idea: sometimes it’s expensive, or awkward, or simply unnecessary. The impressive advantages noted above guarantee that we will use e-learning with increased frequency and effectiveness for years to come. However, these advantages might come with a higher, not lower, price tag once we factor in faculty time. The following quote is as true today as it was a decade ago:

[Computer-based learning (CBL)] is not a panacea. Aspirin does not cure all ailments, and CBL does not cure all educational problems. It will not work equally well in all settings, and with current technology it is likely suboptimal in many contexts. Rather, CBL is a powerful tool, to be used with wisdom and judgement to enhance the learning process.34
Contributors: this paper is a transcript of an original e-mail correspondence between DAC and MMT.

Acknowledgements: none.

Funding: none.

Conflicts of interest: none.

Ethical approval: not applicable.

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