THE SHAPE OF THINGS
AND OF THINGS TO COME

It is little short of a miracle that modern methods of instruction have not already completely strangled the holy curiosity of inquiry. . . . I believe that one could even deprive a healthy beast of prey of its voraciousness if one could force it with a whip to eat continuously whether it were hungry or not.

Albert Einstein, Autobiographical Notes

In this chapter, we identify current trends in learning, make some tentative predictions about what will happen next, and proffer some wild speculations about what might happen if the world were a less complex place and there were fewer constraints on the effects and affordances of social systems on education.

We head toward the end of this book with some observations and speculations that probably reveal as much about us and our philosophical stances as they do about the future. It is fair to say that many generations have felt their educational systems were failing them. Near the beginning of the twenty-first century, this is as true as ever. However, not to be deterred, we would like to suggest that there are some significant differences between the current era and earlier times, and that a significant number of them relate to the growth of cyberspace, both in terms of opportunities and threats.

THE PROBLEM WITH INSTITUTIONAL LEARNING

We are in the midst of an ongoing revolution. Whether it is a continuation of the industrial revolution, the start of the knowledge revolution, the green revolution, some blend of these, or something else entirely, what we can say with assurance
is that in these first decades of the twenty-first century, the rate of technological change is greater than ever before (S. Johnson, 2010; Kelly, 2010). This is an inevitable result of the increase in the adjacent possible that our technologies bring, which engender more technologies that change how we connect, perceive, and value people and things in the world.

As a direct result of technological change, the world is getting better, and it is getting better faster than ever before (S. Johnson, 2012; Ridley, 2010). By almost any measurement—wealth, health, life expectancy, pollution, crime, violence, education, accessibility, discrimination, population growth, exploitation, inequality—many societies in the world shows significant, and in several cases, exponential improvement when viewed over a period of decades. However, this improvement is not evenly spread. There are huge local fluctuations, and it would be misleading to suggest that everyone in the world has experienced every benefit. But, on average, the world is getting better and better at a faster and faster rate.

The learning revolution is a part of this improvement, both benefiting from and driving change. Increasingly, learning is being separated from the formal institutions that we have created to facilitate it, not just through visible and hyped technologies such as MOOCs. Knowledge (or at least information), once centrally held in libraries and universities, corporations, and isolated individual groups, is more available than ever before. As it has always been—but at a far greater scale thanks to cyberspace—knowledge is held within the network of people and the artifacts that they create. More importantly, that knowledge is accessible on demand. We can offload the need to know facts and details to the networked totality of cyberspace because we know we can access it when we need to. Rather than being the result of lengthy study, we can learn things we need to know in a short period, often only seconds from identifying that need. Whether we need to know who has written what about networked learning (and, through collectives, whose thoughts are most valued by the crowd), how to fix a leaking tap, or how to produce overtones on a saxophone, we can turn to the crowd and its reified knowledge for answers. This does not mean that the need for lengthy study has gone away, and we need to hone our skills in both discovering and evaluating the knowledge that we find in cyberspace, but it does mean that knowledge is more easily attained that it has ever been, and it is getting easier by the second. And yet, for all this massive increase in learning and the ability and opportunity to learn, we continue to run institutions as though it had never happened.

This is not just a problem about learning. It is also a problem about the purpose and structure of learning. We are less likely than ever to stay in the same
place, highly unlikely to stay in the same career, and many of the “careers” that we embark on would be unrecognizable to our parents, let alone our grandparents. Children born today will have career paths we can barely imagine at the moment. What marks this trend is an increasing need for creativity, flexibility, analysis, and synthesis skills in the use of information. Yet our educational systems have been phenomenally slow to change their approach in response to these issues. Indeed, many changes are extremely regressive, as governments try to prove they are doing something to deal with the gaping holes in education visible to all by measuring the measurable (e.g., SAT scores, or the number of hours spent on centrally specified tasks) and controlling what should not be controlled (e.g., setting standardized lessons and outcomes for curricula). There is, and has always been, a tension between the role of education as a means of reproducing cultural norms for stability and as an instrument of change.

There is a pervasive, if sometimes fuzzily formulated, recognition of the value of education to society. This leads to top-down and bottom-up demands for an increase in the numbers of people entering higher education that makes their traditional processes and infrastructures creak at the seams. It is not surprising, therefore, that institutions turn increasingly to mass-production methods in an attempt to cope with the demand. However, we are seeing a neo-liberal reluctance to fund formal education systems from public revenues. Thus, as universities become more expensive for students to attend, and these institutions fail to meet their bloating needs, they adopt a particularly retrograde form of instructivist learning: industrial-sized lectures, mass media use, and MOOC (massive open online course) formats, with regulated outcomes and fixed modes of delivery. But this approach is, if more than a century of research in constructivist learning has taught us anything, fundamentally wrong. An industrialized methodology is exactly the opposite of what is needed if we want to nurture the skills of new generations, infusing them with a love of learning. They must have the ability to be self-directed and self-motivated learners in order to cope with ever-more rapidly changing (and perhaps more dangerous) times.

-saving institutions from irrelevance

Before the twelfth century, people used to visit scholars in order to learn (Norton, 1909). They sat around while the great masters (who were always men), shared their wisdom, wherever they happened to be located. These students were, of course, quite rich—going to spend a few years at the feet of scholars was not
something the average peasant ever dreamed of, and grants were few and far between. At around the same time, city burghers in Bologna and Paris saw the benefit of having many rich students populating their streets for years at a time, and helped to establish Europe’s first universities. At first, there were two distinct models of university: the university of masters, with Paris as the prototype, which set teachers up as arbiters of all things; and the university of students, stemming from the processes used in Bologna, where students determined what was taught and who taught it. Over the centuries, the Parisian model came to dominate. A concentration of self-moderating scholars soon led to things like

- The housing and collection of books into libraries;
- Buildings to house and teach students and faculty;
- Administrative procedures to manage ever more complex processes;
- Formal awards and testing methods to validate both institutions and their learners,
- “Efficient” methods of teaching like lectures (and the infrastructure to match);
- Restrictive subject ranges born of economic and physical necessity (communities of scholars needed critical mass);
- Large, complex bureaucratic infrastructures to maintain and organize the educational machine to handle timetabling, student registration, award-giving, hiring, and firing;
- Overseeing bodies (often governmental) to ensure quality, consistency, and so on;
- Restrictions on entry to ensure students’ capability, class, and finances to succeed.

A few centuries later, in the late eighteenth century, the written exam was born in the form of the Cambridge mathematical Tripos, which came to supplement or replace the traditional *vive voce* oral presentation and defence of a thesis. This innovation spread fairly slowly over the next century, driven largely by economic and standardization benefits: written exams were cheaper than oral tests to mark and administer. Beyond that, there were few major innovations. Except for minor technological innovations such as slates and quills, and later ballpoint pens and whiteboards, the occasional restructuring (e.g., Humboldtian universities) and the incorporation of subjects other than the original three of theology, law, and philosophy (including, after some hundreds of years of being treated as a manual trade, medicine), there was little change. The teaching methods and organizational structures used in most institutions today would be instantly recognizable.
to Abelard, one of the early medieval education pioneers. Nearly every technological innovation in education since medieval times has been an attempt to overcome some of the unwanted consequences of the basic technologies that remain unchanged.

Even modern open and distance universities that should not have to conform to patterns that emerged out of their physical and historical context, replicate structures designed to fit scholastic life in medieval Europe. And so we continue to see the dominance of a group-mode model, including the evolved trappings such as courses, semesters, libraries, deans, faculties, convocation ceremonies, medieval gowns, classes, grades, exams, scholarly covens, doctors and master’s degrees, and an incipient hidden curriculum of class and gender (Margolis & Romero, 1998).

Higher Education has spawned a wealth of industries: copy houses, essay mills, textbook publishers, gown makers, schools that “prepare” students for university, companies that filter based on qualifications, government departments dedicated to grant awards, professional societies to defend their disciplines, tourist industries to employ the mass of students every summer, student unions, faculty associations, institutional furniture suppliers, whiteboard and computer manufacturers, and so on. It is very well integrated into our social and economic lives. More than that, the central credentialing role continues to serve as a filter for many jobs in academia, government and industry.

But sometimes, technologies can do more than repair the damage done by others. Sometimes they open up new adjacent possibles that allow us to replace the whole system, because the paths they clear ahead of them lead somewhere better. C. Christensen has called such innovations “disruptive” (2008; C. Christensen et al., 2008). The Internet is one of those technologies. Right now, we in academia are mostly using it to shore up the old technologies and entrench them deeper with tools that automate medieval ways, like LMSs and web analytics to drive performance according to limited criteria.

Sets, nets, and collectives do not fit comfortably in this medieval model of teaching. If we are to reap their benefits on a large scale, then institutions must adapt, and in many cases, radically change. We propose a number of changes to help break this cycle.

**Variable-Length Courses**

This book has shown how courses are far from the be-all and end-all of intentional learning. They are, however, so central to the design of educational systems.
that it is easy to forget the enormous effects they have on the shape of institutions. Courses are the main temporal unit that determine the ebb and flow of activity within a university. They are units of work allocation to teachers, administrative units for payment of fees, assessment determinants, constituents of a final award, and dictate class sizes and structures, among other things.

Courses are, for the most part, fixed denomination currencies that, for reasons of organizational efficiency, are divided into a very limited range of unit sizes. In Europe, especially after Bologna Accord (Sanders & Dunn, 2010), and much of the rest of the world, there are credit transfer points that make it relatively easy to compare one course with another by considering the expected study time involved, including teaching activities, personal study, and assessment activities. Typically, such credit points relate to a notional 10 hours of study, so a typical 10-credit course would, with some notable regional variations, normally equate to around 100 hours of study for an average student expecting an average grade. This is, in principle, a flexible approach that might allow a course to be created of any size. However, in most cases, this does not happen. Courses are normally divided into chunks that fit traditional term lengths: a single-term course usually accounts for 10 or 15 credits, a double-length course accounts for 20 or 25, and so on. It is extremely rare for courses to provide less than 5 credits and unusual to find courses worth more than 30 or 40. Smaller chunks are much harder to administer for a group-oriented model: it leads to complexities of timetabling, credit transfer, and difficulties identifying appropriate prerequisites. In short, smaller chunks make the bureaucratic technology of educational institutions creak at the seams, massively increasing costs. At the other end of the spectrum, courses that are too large make things more difficult for students because failure is far more devastating and transferability is more difficult because of the increased risk of parts of a course overlapping with others. Much of the reasoning behind the sizes that are chosen relate to traditional academic term lengths, which are determined on the one hand by religious holidays (in historically Christian cultures, Christmas and Easter) and on the other by the expectation that students need to return to their homes to help with the harvest during summer months. This has little to do with pedagogic, disciplinary, social, or psychological needs in modern societies. Educational systems contribute in a large way to the continuation of such seasonal breaks, accounting for rhythms of work and vacation that reverberate through entire societies.

In North America, for historical reasons, things are much worse. North American institutions use credit points relating broadly to the amount of teaching
rather than the amount of learning: this very bizarre inversion means that two apparently very similar 3-credit courses, the norm for a single-term course, may equate to anywhere between 100 and 200 hours of study, depending on subject. A single credit in an American institution thus equates to anything from around 30 to 60 hours of study. This equates to a more standardized 39 hours of teacher instruction which, of course, is irrelevant in an asynchronous online environment, and gives no clue as to the amount of time spent learning. The combination of fuzzy and inconsistent expectations and coarser granularity makes the system even more bureaucratically dense and less flexible.

Whichever system is used, its value is not for the student but for the bureaucratic machinery of higher education, with lengths determined not by any pedagogical or organizational rationale, but by a pattern of holidays relevant to medieval times. Among the biggest problems that arise from this kind of chunking is that, from the perspective of acquiring any given competence, there are no fixed limits on how long it might take. For most people, a skill such as learning to tie a shoelace can probably be acquired in minutes, but for some it remains a challenge for years. For some people, becoming a proficient programmer may take years, while others may become productive in days. Literacy in many arts or sciences may take a lifetime to acquire, but different levels of literacy can be reached in minutes or hours.

**COMPETENCE-BASED ASSESSMENT**

For over a century, the most popular approach to assessing competence in university courses has been the previously unseen written examination. The popularity of this form of assessment has much to do with the fact that they are perceived to reliably ensure the person who claims to have learned something has actually done so, and they are relatively cheap and easy to mark in small numbers, or at scale. Unfortunately, they achieve neither goal. Exams are expensive because they do not contribute to the central goal of learning. In fact, it is considerably worse than that: they actively reduce motivation to learn because they impose extrinsic rewards and punishments, thus massively reducing intrinsic motivation (Deci & Ryan, 2002; Kohn, 1999).

Given their strong extrinsic role of punishment and reward, it is unsurprising that over 70% of high school students admit to cheating in exams (McCabe & Trevino, 1996). Measures to reduce this level of cheating are extremely expensive, and it is a never-ending arms race that cannot be won by educators. If exams were
accurate discriminators of skills then this would be less of a problem but, except in some very limited contexts, they are not. With the exception of a few trades such as journalism, the competence of writing or problem-solving using a pen or pencil, with no access to the Internet or to other people, without a computer, in silence, with extreme time constraints and under extreme stress to perform, is seldom if ever again required. Exams reward those who work well under such pressures and punish those who do not, even though these pressures are almost never going to exist in any real-world application of skills and competence. At best, they lead to the development of gaming skills that students use strategically to pass examinations, not to gain scholarly competence.

What is required is accreditation that shows what you can actually do, not whether you can pass a test on fixed-length courses; accreditation that is transferable to wherever you need to go next, that is precise, that does not bind you to one institution, and that allows you to receive recognition for what you are provably able to do, whether the context is academic, professional, or personal (Berlanga et al., 2008; Koper & Specht, 2006). Partly due to the unreliability of university assessments in identifying the skills and qualities of candidates, and partly because it is easy, an increasing number of employers are either ignoring or reducing the weighting of formal qualifications when hiring new employees. Hiring managers consult sites such as LinkedIn and even Facebook, especially where skilled professional work is needed, leveraging networks and associated collective tools (such as reputation tagging) to identify those with appropriate and appropriately verified skills.

BADGES

To partly formalize learning achieved in sets and nets as well as groups, increasing attention is being paid to the use of badges. Badges are symbols or indicators received for demonstrating some competence, skill, quality, or interest. The Scouting movement and other organizations of its ilk have used the physical variant of the idea for many years. The modern update of badges involves the use of images that indicate one’s accomplishments: these are as simple as participation in a forum or as complex as receiving a doctorate. Each is certified by an issuer (the “badger”), so they cannot be easily faked, and tied to a person’s identity so that they cannot be reissued to someone else. Badges may be set to expire after a certain time for volatile skills. While anyone can issue them, some issuers will have higher reputations than others. They have many benefits beyond simply signalling
The Open Badge project (openbadges.org) identifies a range of uses, observing that badges can:

- Signal achievement
- Recognize informal learning
- Transfer learning across spaces and contexts
- Capture more specific skills than traditional degrees
- Support greater specialization and innovation
- Allow greater diversity
- Motivate participation and learning outcomes
- Allow multiple pathways to learning
- Open doors
- Unlock privileges
- Enhance your identity and reputation
- Build community and social capital
- Capture the learning path and history
- Recognize new skills and literacies
- Provide a more complete picture of the learner
- Provide branding opportunities for institutions, organizations, and learning communities

(Adapted from the Open Badges FAQ (n.d.) at https://wiki.mozilla.org/Badges/FAQs#What_are_the_benefits_of_badges.3F)

There are many ways that badges provide a way out of the institutional course stranglehold without necessitating a massive change to traditional ways of doing things in one fell swoop: a badge can represent accomplishment of a course as easily as it can any other competence. It is notable that many of the benefits are of great potential value in groups (e.g., allowing faster establishment of norms, expectations, and trust based on past accomplishments and known skill levels), nets (e.g., providing social capital, enriching projections of identity, and easing entry into different networks), sets (e.g., providing attributes to identify sets and subsets, and assisting in trust management), and collectives (e.g., discovering trends, identifying patterns of reputation and clusters of related skills). Badges are thus not just signals of accomplishment but act as mediating objects for social engagement outside group contexts. They offer a potential means of enabling networked and group learning to move beyond formal educational boundaries and enter into mainstream and lifelong learning.
However, on a cautionary note, there is a risk that badges may be seen, like traditional assessments, as extrinsic rewards. The wealth of evidence that such rewards are almost always deeply demotivating, especially when related to complex skills or creativity (Kohn, 1999), means that it should always be made clear that badges are simply credentials, evidence of achievement, not things to be striven for in and of themselves. We have some concern, especially when they are used as motivating objects, that there are big risks they could lead to unintended and unfortunate systemic consequences, much as the use of grades, gold stars, and awards in classrooms and the workplace have demotivated and hobbled generations of learners. We hope that they will eventually be seen as nothing more than evidence of ability, not as a substitute for success. Unfortunately, their prominent use in large-scale teaching systems like the Khan Academy and large MOOCs suggests otherwise.

At the time of writing, the specifications for badges are still in flux and, though used in a number of formal institutions and organizations, it remains to be seen whether they will become ubiquitous. However, they or something like them represent the technological means to enable the revolution in assessment and accreditation that is necessary if education as a formal process is to survive by moving beyond the rigid course format. Badges provide the means to transition between top-down accreditation and bottom-up recommendation. In principle, they can be aggregated and reassembled to fit different needs and purposes, signal specific competences rather than broad disciplinary knowledge, and equally used to describe still-broader facets of individual accomplishments. It is possible to envisage uses beyond the purely academic that may be of great value to potential employers, such as, for example, recognition of creativity, stickability, stoicism, or sociability. We can already see instances of such broad recognition having value in, for example, LinkedIn endorsements, which do not only show subject skills but also personal qualities. It is easy to imagine a PageRank-like collective process that uses networks to judge the reliability of such assessments and, just as Google currently provides greater weight to academic pages than to commercial pages, so we might see greater weight given to certain badges relative to others. This may, over time, lead to a self-organizing system of accreditation in which universities carry no innately greater weight than individual academics, employers, social networks, or sets of people with relevant skills.
Changing Patterns of Publication and Distribution

Libraries provided a strong rationale for establishing an institution before the advent of the Internet, and were often central to the institution and its functioning. Books, journals, and other resources were too expensive for individuals to buy for themselves, and it made sense to centralize them. The word “lecturer” derives from the fact that a single individual would read texts to classes of scholars in the Middle Ages because books were too rare to share. This is no longer such a strong imperative. In the course of writing this book, we have barely touched a piece of paper. While some books (particularly those published more than a decade ago), are still only available in paper form, the vast majority of the papers and books we have referred to existed on our computers as electrons and patterns on a screen. Libraries are still valuable, largely as a means to negotiate terms with closed publishers to gain access to electronic versions of papers and e-books, and we have used our own institutional libraries extensively in researching this book. However, the papers and books themselves are, for the most part, held by the publishers or freely available on websites. The library has become a junction in a network, not a repository of knowledge.

Beyond the library, in several cases we have been able to make use of our networks to contact original authors to receive not only their work but also engage in dialogue about it. This is the thin end of a large wedge. In many cases, work is published in blog form, and we can engage in and benefit from discussions with many others about it. We see this as an increasing trend that may eventually transform or even oust the traditional processes of peer review. Literature, especially academic literature, is enlivened by the dialogues that develop around it. Like medieval glosses, scholarly works are explained, illuminated, criticized, and extended by the conversations around them and these may provide equal or greater value to that of the original work that is being annotated.

Blog posts are typically seen as a less worthy form of academic publication because they lack peer review. However, the truth is sometimes almost exactly the opposite. The problem with this point of view is that it assumes that a blog post is simply a new way of presenting information that is like a newspaper or journal article. It is not. A “publication” is not just the blog post, but also the diverse dialogue that is associated with it: a blog post is the work of a crowd, not an individual. A post from a popular blogger in academia is not a standalone work like a traditional academic paper but an extended process, in which the comments are often as important as the post itself, where errors are examined,
implications observed, and contrary views expounded. Often, through trackbacks, the blog becomes part of a network of shared knowledge that explores an issue in depth. The article that spawned such reified dialogue may itself be part of a larger network of connected posts. For writers of books such as this one, targeted at a largely academic audience, this presents a problem. How can one cite such a connected jumble, whose character is constantly changing and whose essence is discursive, where good and bad is mixed with sublime and awful? This is not the same kind of publication as an academic paper to which references have been made in other papers, despite apparent morphological and topological similarities.

There are two main reasons for this. Firstly, the pace is different: the slow rate of reply through academic publication of the traditional kind, where it is not uncommon for an article to take two years or more to reach publication, means that the dialogue is cumbersome and the original author may well have moved on to another topic by the time he or she might have replied to a response that appears in a follow-up peer-reviewed journal paper. Moreover, on many occasions the nature of academic rewards suggests that there is little motivation to respond: academics may not wish to tread old ground, and will have moved on to other considerations. Secondly, the conversation through academic journals is spatially discontinuous. A blog forms a centrepiece around which discussion and critique evolves in situ, whereas academic papers engender responses in different journals, conferences, workshops and presentations across the world, with few easy ways to link them together as a coherent dialogue. There are few places where the chasm between traditional modes of communication and the new forms that social software enables are so starkly highlighted.

Beyond simple blogs, collectives can provide powerful means of filtering and shaping these kinds of dialogue to provide a meta-review of the reviewers. On sites such as Slashdot, the use of the collective, through technologies such as rich metadata and karma points, can shape a large dialogue to reveal posts that are highly valued by the community for different needs, creating more reliable, richer, and more diverse co-authored resources than the best traditionally authored texts. An early system for computer-supported collaborative argumentation, D3E, formed the basis of JIME (Journal of Interactive Media in Education) in which conversation and disputes around papers provided rich peer review that was often as valuable as the articles under review.

While the existing author model persists, such systems are unlikely to see persistent use. It is notable that the JIME experiment was eventually abandoned, though recently revived in a different and less adventurous form, and efforts to
make an educational equivalent of Slashdot have foundered, largely due to its
gEEK-friendly design that appears arcane and complex to people of a less technical
orientation. Less geEK-oriented approaches such as that used by the StackOverflow
family of sites have been far more successful, but have yet to see much transfer to
academic environments. However, even more formal processes, such as those that
sustain PLoS One, are increasingly open and inclusive: PLoS One has a panel of
over 3,000 expert reviewers, and the reviews generated are aids to understanding
for not only the writer but the reader of the article as well.

FLATTENING ORGANIZATIONAL HIERARCHIES

Institutional hierarchies and associated bureaucracies were once thought to be
a necessary evil that had to be tolerated so large groups could work together
efficiently. On the whole, they still work moderately well when the world does
not change too fast. They are highly evolved social species, usually formalized
group forms that have solved many of the problems of coordination on a scale
necessary to support large populations. Without such technologies, we would
be limited to the hunter-gatherer demes humans are so well adapted to live in
(Caporael, 1997). However, they come at a cost in time, effort, and space. One
big reason for this is transactional distance. Each level of a hierarchy separates one
sub-community from another. This limits the capacity for dialogue between those
in different organizational units and requires dialogue to be replaced with struc-
ture—formal reports, memos, announcements, and the like—that condense and
impose structure upon what may have been less formal dialogues, with the truly
informal being lost or diluted in committee meetings and other formal channels
of information exchange. This channelling and condensation up and down the
hierarchical structure is a necessary feature that makes such hierarchies possible.
Those at the trunk ends of the tree would not be able to cope with the mass of
detail from the branches without such methods, and those at the branches would
be overwhelmed if they had to pay attention to everyone else in the organization.

However, it does not have to be that way. The capacity of cyberspace to sup-
port larger set-like tribes as well as groups and nets, especially with the aid of
collectives that can provide the filtering and channelling formerly delivered by
formal condensations of reports and top-down edicts, creates opportunities to
rethink how and whether such hierarchical technologies are needed. Just as indi-
vidual learners can learn effectively in nets and sets, so can a whole organization.
In a tumultuous world, there is a need for structures that are flat, distributed,
and agile, adaptable to changing needs, interests, and groups, yet still capable of effective and efficient coordination. Large, hierarchical organizations inevitably introduce rigid and slow-moving structural elements that preclude rapid change.

BREAKING DISCIPLINARY BOUNDARIES

Part of the hierarchical structure of educational systems is based on subject and disciplinary divisions. These academic tribes and territories are deeply embedded (Becher & Trowler, 2001). They start in earliest schooling, with lessons, classes, and teachers becoming more and more specialized as academic careers progress. To an extent, this is inevitable. There are natural path dependencies that mean when we take one path we cannot take another, and so we become more and more focused in the direction of our interests. As we take such paths, we develop cognitive toolsets that are appropriate to different ways of seeing the world: the toolsets that we need for the appreciation of literature are quite different than those we need for physics (S. E. Page, 2008).

It is not a surprise, therefore, that communities of interest form around more and more refined disciplinary areas, where cognitive toolsets are similar enough to enable richer communication about a subject. These disciplinary divisions are reinforced by hierarchical group structuring: the schools, divisions, faculties, and similar expressions of difference with which we are all familiar. Because these are constructed as groups, and because groups thrive on exclusion and difference, it is equally unsurprising that the systemic effects of disciplinary clustering reinforce that clustering. It is embedded at such a deep level in everything from research funding to teaching practice that it is hard to imagine it could ever be otherwise. It is hard to be a renaissance person in a system that is fundamentally divided at its most basic architectural roots. Unfortunately, the world of real problems does not respect disciplinary boundaries.

A world of constant change demands ever-increasing creativity. Creativity thrives at the boundaries and borders (Wenger, 1998) and is driven by diversity (Florida, 2005; S. Johnson, 2010; S. E. Page, 2008; Vaill, 1996). If we create boundaries that are hard to cross, the potential for timely evolution, at least of the individual, is thwarted. This is a more complex issue than individual growth, however. It can be argued that the parcellation caused by such divisions allows for greater system-level diversity and so, if there are opportunities for those from different disciplinary foci to work together, they will bring richer cognitive toolboxes to the problem. As S. E. Page (2008) demonstrates, a diverse group will usually
outperform a less diverse one, even when the less diverse group is composed of experts, for most problem-solving and creative activities. So, while disciplinary areas reduce individual cognitive flexibility, they can increase it for society as a whole. The problem is one of balance: it makes no sense to completely demolish subject boundaries, because that flattening would reduce overall capacity and creativity, and anyway, would be impossible: people do have diverse and incommensurate interests in areas of study, and that is as it should be. Nevertheless, it makes no sense to sustain subject boundaries to the extent that crossing borders is too difficult for individuals. The solution lies in recognizing that these are not groups, but sets of people with shared interests. People will always focus on what interests them, and path dependencies mean they will always cluster in particular sets. If we are to make greater progress toward creative and agile educational institutions, then deliberate flattening is required, which means getting rid of inappropriate group forms.

If people wish to form groups for particular purposes, for instance to perform some substantial research or to further the study of teaching in their set(s) of interest, then that should be possible. Those groups may be composed of people with similar cognitive toolboxes, but they may not. However, groups should not be created out of sets simply through tradition or for bureaucratic convenience. Is there a case for groups of mathematicians who work together on problems or as teachers? Yes, absolutely. Is there a case for departments of mathematics? There may be far less compelling reasons for this, almost all of which revolve around a circular assumption that they exist within a hierarchical bureaucratic structure where such a department is needed (for administration, funding, research recognition, and so on). But, as we have already suggested, such structures no longer make the sense that they used to make. As a result of this disaggregation of boundaries, new organizational models that recognize and facilitate knowledge production within cross- and multidisciplinary sets of interest and focus (e.g., environmental issues, urban construction, education) may be created as needed, when needed.

**CHANGING THE PATTERNS OF TEACHER REWARDS**

Legend has it that the open sleeves of gowns worn by professors are pocket-like because students would drop money into them if they were satisfied with a lecture. Had universities developed along the lines of the student-led Bologna model, a variation on this approach might persist today. However, for most of those in academia, payment comes in the form of a predictable pay packet. In
North American systems, though not commonly elsewhere in the world, those wishing to become full-time permanent professors must endure a curious trial by fire known as attaining tenure. This requires them to jump through a series of hoops to show that they are well-rounded (and conventional) academics who can teach, research, and participate in the university and broader community. Once they’ve achieved tenure, all can and some do rest on their laurels. As a process, it leaves much to be desired. However, the world over, it is the norm for a Humboldtian model of research, teaching, and community service to be fossilized into the structure and organization of an institution. This has some unfortunate consequences, such as the fact that students are often taught by researchers who cannot teach, and that research is often performed by teachers who are not great researchers.

The notion that every academic should be an all-rounder accounts for much of the dissatisfaction expressed by those in the profession—high workloads, low teaching standards, and mundane or pointless research. It is one of the structural forces that propel academia along its well-trodden furrows and away from potential change. It is particularly strange in an institution like Athabasca University, the authors’ academy, which distributes the teaching role among many such as learning designers, editors, graphic designers, and technologists, and employs people in roles such as coordinator and tutor that are primarily concerned with teaching and its coordination. Individual academics still need to support the three pillars: teaching, research, and community engagement, despite the fact that they are no longer individual academics in the traditional academic sense. As we move more fully into the sets and networks where learning happens, these restrictive roles will seem stranger for everyone.

For some, and we are among them, the three pillars of academic life are fulfilling: all of the roles are interesting, valuable, and enjoyable. For others, this is not the case, and as a result, many who would play one or two of the roles well are deterred from engaging in the profession, or leave it early. In the US, the mean length of an academic career is less than 11 years (Kaminski & Geisler, 2012). Some institutions have dedicated themselves to research or teaching at the exclusion of the other, but this too has dangers. Research informs and motivates learners, and teaching at a high level is difficult without a passionate and ongoing interest in the subject being taught, stimulated by active research. Some forms of research can appear pointless if they are not disseminated and explored through teaching.

No research has value without a community context, where work is grounded in, driven by, or meets the needs and wants of society. Once again, the way out
of this dilemma lies in sets and nets. Problems arise because of the group-oriented view of a university, with fixed roles and rigid organizational demarcation. Academics are nearly always involved in cross-cutting cleavages, their sets intersecting with others across the world, their networks extending far beyond a single institution, and these connections are not only encouraged, but facilitated through institutional formalisms like conferences, journals, and workshops. However, within institutions themselves, the lines are often more distinctly drawn. Author Dron, for example, only found out that a colleague in the next office shared a research interest because he was a member of the same globally distributed set, a subject-oriented mailing list.

With greater organizational flattening, those with different interests and skills, whether in research, teaching, or community engagement can connect more easily. Our own Athabasca Landing demonstrates the value of this, connecting people in sets and nets who would otherwise have no knowledge or interest in what others are doing, and allowing good practice in research and teaching to spread organically throughout what is otherwise a hierarchy. Once this step is taken, it becomes easier to balance strengths and weaknesses. If some of one’s learning is mediated by those who teach well, some is inspired by those who research interesting things, and some is embedded in the social and business life of the community, then classes and subject divisions are simply obstacles that prevent the best use of resources.

This brings us back to how academics are paid and rewarded. While we do not have a quick and easy solution to the problem, it seems worthwhile to consider not the breadth of skill in an academic, but the diversity of skills across a networked institution, including the people, the technologies, and the structures that enable that knowledge to be spread and organized. As long as we retain isolated groups connected hierarchically, then well-rounded individuals are a necessity. However, if we assume a network and sets, supported by collectives, then it is the collective intelligence of the system that matters, not the skills of a single individual. To some extent, of course, this is already the case. Anyone who hires a team will make a point of choosing a diverse range of people knowing that they will contribute differently. Yet, a team is a group, and an institution, though inevitably carrying some of the trappings of a group, veers more toward the set or net in its social form.
ADAPTING TO LEARNERS

In an ideal world, we would provide methods of learning that are fitted to the subject and people learning them, not the needs and capabilities of institutions teaching them. This is what learning in sets and nets, with the aid of collectives, allows. It opens possibilities for people to learn differently. The role of the institution becomes more like that of the modern networked library, a hub to connect people with other people and resources that will help them to learn.

THE MONKEY’S PAW

“The Monkey’s Paw” is a story by W. W. Jacobs about a talisman that grants wishes which always come true with horrific consequences. This resonates deeply as a metaphor for technological change. While we have observed many systemic and path dependencies in the current system of education, there is no doubt that widespread changes would lead to equally unforeseen and potentially negative consequences. If we made these changes across the board, then the monkey’s paw would no doubt work its usual mischief. For example, breakdowns in disciplinary boundaries might lead to increasingly shallow insights, albeit with greater breadth. The loss of examinations would impact a range of businesses and social structures that depend on them, and make it easier for some types of incompetence to be enabled that were previously restrained. But this particular set of wishes has held sway for too long, and it is no longer fit for its purpose.

BEYOND THE INSTITUTION

For some years now we have been asking academic audiences at education and online learning conferences and venues where they turn first when seeking to learn something new. With almost no exceptions, the answer is a search engine (nearly always Google) and/or Wikipedia. Such audiences are, perhaps atypical, and at this time these remain starting points, not for most, the end-point in their search for knowledge, but it does help to demonstrate the massive penetration of social software, especially that which supports sets, networks, and collectives, in the service of learning. We are not speculating about the future when we talk about educational uses of social software in this book, but describing the present. In the past, such an audience would have turned first to libraries, books, reference works, and so on, and perhaps to courses and programs for more ambitious learning.
activities. Such things still have a place, but even here cyberspace is making massive inroads. In the course of writing this book, we have barely contributed to the destruction of a single tree, let alone the small forests that we both consumed when writing our Ph.D. theses. These exemplars of set, net, and collective applications show the enormous existing impact of learning with others beyond the traditional groups of formal education.

MOOCS AND SELF-STUDY RESOURCES

MOOC (massive open online course) is an acronym coined by Dave Cormier to describe an open-to-enrol free course with many participants. Current popular examples of platforms for MOOCs include Udemy, Udacity, edX, and Coursera, but the market is shifting rapidly, and we are seeing a proliferation of competitors as this book goes to press, such as Open2Study, WorldWideLearning, and FutureLearn. How many of these will stand the test of time remains to be seen, but there is clearly a growing demand for MOOCs. Coursera alone has grown faster than Facebook or Instagram, garnering more than 1.8 million students in just over a year (Cadwalladr, 2012). These represent only the visible edge of a massive movement to self-directed and institution-free learning.

There are two distinctive forms of MOOC emerging. One, the original bearer of the name that is championed by people such as George Siemens and Stephen Downes, is based in a connectivist model of learning, and the other takes a more industrial and instructivist approach, using behaviourist/cognitivist models of teaching. These have been referred to, respectively, as cMOOCs and xMOOCs (Siemens, 2012). Both xMOOCs and cMOOCs typically, though not universally, follow a paced model of learning: courses have start and end dates.

In xMOOCs, it is normal for those wishing to take a course to sign up and engage in many individual learning activities and some group discussions (usually with an instructor) that are closed to non-members. The cMOOCs typically also ask for enrolment, but this is mainly for coordinating a looser network. They seldom have formal groups of any kind: clusters of learners connect, form their own networks, and link up to the broader network, typically through a hub that aggregates networked content explicitly linked or tagged. This does not mean that there are no groups involved, as they may be used with or in formal classes. When creating the first MOOC to bear the name, for instance, George Siemens and Stephen Downes used a closed course run within an institution so that others could participate, offering accreditation to paid-for students and open
participation to anyone and everyone else (Downes, 2008b). David Wiley had done this a year or so previously, but on a smaller scale.

A further subdivision of the genre that sometimes gets lumped with the others is the more flexible, bite-sized tutorial approach exemplified most prominently by the Khan Academy, that may also be found in many places such as Instructables (www.instructables.com), eHow (www.ehow.com), HowStuffWorks (www.howstuffworks.com), LifeHacker (www.lifehacker.com), Ted Talks, and countless others. We christen these kMOOCs (Khan-style MOOCs). They are almost entirely instructivist in approach, but their small size makes them more easily assembled by different learners and, unlike most xMOOCs and cMOOCs, they do not follow a paced model that requires learners to move in lock-step with one another. The Khan Academy alone has helped over 10 million students (Cadwalladr, 2012). There are similarities between kMOOCs and the goals of proponents of re-usable learning objects (RLOs), but unlike the RLO, these “courselets” are inherently social, with commentary, remashability, and engagement built in from the ground up. Interestingly, these courselets are aggregable, appearing in set-oriented categories and including both top-down and collective-generated recommendations of what to learn next. The combination of fine granularity, social engagement, and collective guidance suggests that such methods may have a great future.

While much discussion is currently taking place about appropriate models and the different virtues or vices of these approaches, we observe that the reality for many learners differs surprisingly little between the three models. Large and small networks, sets, and both face-to-face and online groups have emerged around all of these courses, supplementing and enriching the learning experience provided by the course itself, whether or not this was intended in their original design. This is a benefit of scale: with enough people learning at the same time, the traditional group form of course-based approaches becomes at best tribal in nature, filled with multiple networks, smaller groups, sets, and clusters. In the case of cMOOCs, a rich network is an essential element of the experience, but in the rest, it has happened as networks coalesce and form into study groups, online and face-to-face, or sets that form around topics, posts, or themes in the larger MOOC. Given the scale, even in a paced MOOC such as those developed for Coursera there are always people (often strangers) who form tribal sets to help one another. As Koller, co-founder of Coursera, puts it,

We built in the opportunity for students to interact with each other in meaningful ways and have one student help another through the hard bits so
they could work together to achieve a better outcome for everyone. There was a real community built up where students felt incredibly motivated to help each other and answer each other’s questions to the point that in the Fall quarter of 2011, the median response time for a question posted on the forum was 22 minutes. Because there was such a broad worldwide community of students all working together, even if someone was working at 3:00 a.m., chances are that somewhere around the world, there would be somebody else who was awake and thinking about the same problem. (Severance, 2012, p. 9)

For the unpaced, small-chunk kMOOCs, the set that gathers around an individual tutorial, often instantiated in asynchronous comments, can be rich and pedagogically valuable, exploring and explaining the skills or concepts of the static tutorial, much like a blog post. In some cases, MOOCs have formed a structural backbone and content for traditionally taught classroom-based or online courses. The reason this can happen is that, despite intent in the case of some xMOOCs, without the binding group form of the institution, a single social form no longer formally binds learners.

Much has been made in the popular press of the relatively high attrition rates in MOOCs of all descriptions, but we think this is a not much of a problem. Relatively low completion rates are only a failing from the point of view of the purveyors of MOOCs, not from that of their participants, who often sign up on a whim, and may have little interest, time, or commitment to sustain their ongoing participation, at least when compared to the large commitment made in a traditional paid-for course. Freed from the coercion in conventional institutional courses, it is no surprise that MOOCs may be treated much like any other free resource on the Web. People get what they need, if the timing is right, and leave if they do not get what they want or if their curiosity is satisfied in the first week or two. There is one major benefit of this attrition rate, however. In part as a result of what are perceived to be high non-completion rates, the average length of xMOOCs appears to be getting shorter. This increasing focus and consequent diminution of group-like character means that they are becoming more and more aggregable, enabling learners to take ever more control over the learning process and integrate them into other social forms for learning. As course lengths become shorter, it would not be surprising to see xMOOCs becoming part of the “content” of network-oriented cMOOCs as well as formal closed-group classes, just another resource for learning specific skills or competences on a broader learning journey. This further emphasizes their set-like nature.
Central to cMOOCs and widely used in many other situations is the concept of a personal learning environment, or PLE (Attwell, 2007). The PLE can take any technical form, from a collection of documents and links in Evernote to a purpose-built space in an environment like Elgg, which provides a dashboard designed for this role. Echoing Rainie and Wellman’s concept of networked individualism (2012), this personal space acts as a hub to a world of connected people and objects that are of value in a learning context. We have built our own extension of the concept, the context-switcher used on the Landing (Dron et al., 2011), in order to allow for the variegated, discontinuous, and multifaceted nature of learning. Within any tab of an Elgg dashboard people can store files, link to blog posts, show RSS feeds, posts from particular groups, Twitter searches, and items tagged with metadata that may be of interest, supporting sets, nets, and groups in equal measure. However, the same functionality can be achieved in many alternative ways, even using something as simple as a paper notebook, though such tools make it considerably harder to aggregate and organize the dynamic flow of information from the network.

Related to the personal learning environment and often combined in the same toolset is the e-portfolio. Like PLEs, e-portfolios can be used to aggregate learning resources, and though the typical use case is to present these aggregations to others, they may equally be used in the learning process as tools for organizing and sense-making, as well as social networking. Elgg and Mahara are good examples of the genre, both straddling the PLE/e-portfolio border due to their capacity to selectively reveal things to different people in different ways, including entirely privately. As we move creakily toward an open and interoperable future, standards such as TinCan (scorm.com/tincan/) will enable us to assemble evidence of learning from diverse sources, probably augmented by badges of proficiency, which we may use to make sense of our own diverse learning and assemble it in different ways for different needs. In the language of TinCan, learning management systems become learning record stores (scorm.com/tincanoverview/), repositories of evidence and tools to manage learning journeys rather than tools for teaching.

WHAT WILL THE FUTURE OF FORMAL LEARNING LOOK LIKE?

The time has come to move on from the present and into the near or not-so-near future. It is difficult to predict if, let alone when the kinds of things we talk about...
in the next section may happen. This is not just because we do not have enough facts (and we don’t) nor because we cannot anticipate disruptive new technologies that have not yet been imagined (we can’t), but because this is an increasingly networked world, a complex adaptive system encompassing much of the planet in which cascades of change can happen very suddenly and with little warning (like the appearance of a black swan; Taleb, 2007), at least until viewed in retrospect.

We think that a tipping point is on the near horizon, but it may be decades away. Like all good prophets, we hedge our bets and tread with caution. What happens may bear no resemblance at all to what we predict, and we will definitely be wrong in places. Most notably, the momentum of medieval values in universities is huge and heavy: though the format may change here or there, there are massive organized forces that have, for centuries, proudly sustained equilibrium. A fundamental change to how we learn and accredit learning will certainly be resisted by the varied interconnections between educational institutions and the rest of society: from governments to tourist industries, banks to small businesses, schools to old-boy’s-club networks, our institutional forms are attached throughout the system. Academia will defend its position for the best possible reasons, and the worst. It is interesting that, whenever such issues are discussed within institutions, the default position is always “how will we deal with this threat?” or “how will we survive in this new environment?” without ever considering whether “we” the group should survive. Groups want to survive. The group forms that have sustained academia this far will not give up easily. With those provisos, we present our projections for what may be coming next.

Just-in-Time
As we already see for the small things of life, learning will happen more and more when it is needed, enabled by mobile technologies and beyond these on to forms of social learning that will increase as we become more trusting of and dependent upon the crowd and its productions. The focus will increasingly be on connecting the dots, sense-making, and taming the torrential stream of knowledge that is available to us.

Situated
Learning will occur in context—place, organization, project, and so on. Places to gather for specialist and large tools will still be necessary, though increasing use will be made of simulacra, immersive environments, and remotely controlled devices and experiments, and the tools of many trades are becoming smaller,
cheaper, and more affordable. Genetic sequencing, for example, that a mere ten years ago took weeks or months and required massive and expensive equipment, can now be done with a chip and carried in a briefcase, with a turnaround measurable in hours. For many things that do require physical presence, learning will be carried out in situ, at the place where it has value.

Personalized
We already engage in personalized learning every time we do a Google search (your results will likely not be the same as mine) or look something up on Wikipedia, or find a lesson in the Khan Academy. In the future, collectives and curated sites will allow us to learn more easily what we want to learn, and to gain appropriate accreditation for it. Learners will be in control of how, what, and when they learn.

Disaggregated and Re-aggregated
The course, for which we will perhaps retain the term if not its denotation, may be anything from five minutes to five years in length. Accreditation will be through badges or similar certification systems. It is likely that the badgers themselves will be badged, perhaps using a collective that filters reputation rankings from multiple sources in order to identify the value of the provider, or that uses a PageRank-like algorithm to provide a weighted rating of value derived from the crowd's opinions and actions. Interestingly, some of those achieving high rank will be individuals, some companies, some institutions, and perhaps, some collectives: karma ranking in Slashdot or endorsements from LinkedIn may well become a more important currency than certification by institutions or learned bodies.

Some providers will be individuals, some will be companies, and some may be universities. The collective may rank some individuals more highly than all the universities combined. Universities will compete to gain attention from such superstar accreditors, who may be employed part time or on a contractual basis by them. Institutions whose credibility rests on a path dependency stretching back to medieval times will no longer dominate the formal learning space. There will be diversity of provision. Publishers and libraries, pushing into markets to replace those lost as a result of the non-rival nature of their wares, will become providers and accreditors that compete directly with universities and colleges. This is already happening—Pearson University, for example, follows just such a model. Indeed, even individuals will begin offering credentials certified only by their individual reputations as David Wiley, one of the main instigators behind open badges, has
already done. All will be swamped by the wealth of freely available, paid-for by advertising or sale of associated products, and app-based learning tools.

Teachers may or may not be employed by single institutions. For many, their particular skills may allow them to work in many places, paid according to the work they do. Others may prefer the security and benefits of a single institution: there will be scope for diversity. Physical location will seldom play a strong role, though some researchers and teachers may still be drawn to physical facilities and toolsets offered by institutions.

**Distributed**

No longer will institutions be virtual monopolies that lock individuals in to a limited set of fixed-length courses for the duration of a program. If institutions like universities do exist, they will be both hubs for other services and service providers for individuals and other hubs. Learners may choose institutions much as they choose cable network providers, for the range of channels they provide, though unlike these, there may be other more social and academic benefits, especially the presence of an academic community, the opportunity to engage in organized groups around topics and, at least in some cases, to provide expensive, dangerous, or complex facilities like laboratories, meeting areas, or large-scale computing devices. Face-to-face institutions will ubiquitously provide something similar to flipped classrooms, where learners engaged in learning from the distributed web of cyberspace may gather and explore what they have learned, perhaps using approaches like action learning sets (Revans, 1982) to provide motivation, depth, and diversity to their learning.

**Disciplinarily Agnostic**

Universities and colleges have, in the past, deliberately prepared students for particular occupations. While it is true that many subjects are non-vocational and have broad application, this is often because of their coarse chunking, which is a good thing if you are seeking generality. With the disaggregation of courses, people will acquire far more diverse skillsets, and continually build on them as needs emerge. The use of badges that relate to specific competences will allow a much more nuanced and realistic perspective on the skills that have been attained, and will make it simpler to cross disciplinary boundaries, as accreditation will no longer be bound to a single school or college.
Old School Tie-less
Because most individuals will no longer be directly affiliated with institutions, there will be little opportunity for groupthink and the lack of diversity often entailed by, for example, a Harvard or an Oxford education. While there are benefits for alumni of institutions, especially in terms of social networks and elite status, it is precisely the shared culture of thinking that gives academic value. The lack of diversity may, however, reduce the potential for acquiring rich cognitive toolboxes. Because formal learning will be occurring in a patchwork of sets, nets, and groups, learners will be exposed to a greater range and diversity of perspectives, heuristics, and ways of understanding the world. This will be beneficial to adopting a creative and multi-layered understanding of the world.

Open Research
When we, as researchers, publish a paper, a blog post, a research finding, or a comment on a blog, our readers will be able to award us badges. We will be awarded social capital for what we do, not by citations (that may frequently be critiques of our points of view) but by actual commendations. A PageRank-like algorithm will drive a collective that gives weightings to our commenders and thus calculates the value of our commendation. We see the potential beginnings of this operating already in the much wider base of citations used to calculate impact in Google Scholar, as opposed to more traditional World of Science citation rankings, albeit without the use of explicit commendation (Harzing, 2010). There are already crowdfunded research projects and education initiatives. This will become more common, allowing for a greater diversity of projects, including those that fail to attract funding at present because of their lack of obvious application—the long tail of the crowd (C. Anderson, 2004) has many interests. It will also benefit those that fall between research councils and cross broad disciplinary boundaries.

Wilder Speculations
There are many technologies on the horizon whose growth is influenced by increased communication and connectivity and whose repercussions are difficult to imagine. Genetic engineering, medicines, and increasing knowledge of health and safety may make us smarter and able to live longer. This is a trend that has continued unabated for over 100 years and shows no sign of stopping. A job for life when that active life may continue for 100 years is not a likely outcome. We will work longer, in more rewarding and varied ways, and we will take longer to
grow up, have children later, and be exposed to ever richer and more challenging stimuli that make us smarter still (S. Johnson, 2006). Lifelong learning, formal, augmented, and informal, will be a way of life for all.

The primitive augmented reality tools like Google Glass or location-aware apps on our cellphones will become lighter, smarter, more responsive to our context and eventually disappear, becoming contact lenses, implants, or less invasive augmentations to our own bodies (Waterfield, 2012). More than ever, we will know about the world without having to keep that knowledge in our heads. These technologies will be networked. We will have instant access to the crowd, bringing new and powerful challenges to our sense of identity, our privacy, and how we deal with massive cognitive overload, but also remarkable opportunities to know one another better than ever before, to tap into the knowledge of the crowd, to learn from and with one another. Collectives will play a large role in helping us to cope with this, along with smarter AI that will understand context, language, and perhaps what we think. Man–machine interfaces already allow us to control machines, exchange thoughts and ideas, and even to know what others are thinking and dreaming, though not, at least for a while, as spookily as the popular media would have us believe. It is already an anachronism to learn by rote things that we can know in seconds by looking them up. As our tools for searching become integrated with everything we do and see, the ability to remember passages from Shakespeare or to know how to service the engine of our vehicle will seem quaint: they won’t go away, because we love to learn and love to explore, but they will become unnecessary, as much as the ability to operate a horse-drawn plough is unnecessary but, for some, rewarding still. What we will need to know is how to use this immensity of knowledge, how it fits together, what is useful and what is harmful, what is valuable and what is dross.

We think it highly unlikely that the pointless arms race with exam cheating in large-scale written examinations will continue under these conditions, and we confidently predict the end of this steam-age barbaric anomaly. It is not that the cheaters will win, but simply that everyone will realize, as they should already, that there is less than no point. The means of demonstrating competence will be authentic, targeted, and embedded in the social networks and traces that we leave as we learn. The skill of assembling such traces to demonstrate our competence to others will be crucial, and no doubt augmented by the crowd. Reflection and the skills of analysis and synthesis will be pre-eminent capacities in this not-so-distant future. Similarly, if there are still teachers of children, which we think may in some capacity exist, then they will not be the primary sources of information:
children will have access to that as easily as they do. Instead, teachers will become not so much guides as co-travellers on the learning journey, helping children to accommodate their vastly enriched and interconnected worlds. If they run into difficulties, help will be just a thought away.

Most universities will not, ultimately, survive in their current form, though some will almost certainly be kept alive as we keep alive old farming traditions and hand-weaving. We will probably look at them wistfully and think that life was so much easier, so much finer, so much more refined in those days. And we will be wrong. The arguments between advocates of online and face-to-face learning will be largely forgotten, much as we have mostly forgotten the arguments between proponents of scrolls and supporters of bound books. All learning will be both online and situated in an ever-shifting context.

Though we have great hopes for technologies that enhance and augment our cognitive abilities, we do not hold out the hopes of Kurzweil (1990) and others that the singularity, the point at which machines become smarter than us in every way and start to create still-smarter machines, will allow us to transfer ourselves into machines, nor vice versa, at least not using any conceivable technology at the moment. However, the potential for change at that point, however it may play out, is unknowable and vast. We recommend the reader to the vast body of speculative fiction on that topic for better ideas than we can come up with, almost all of which are wrong—if only we knew which ones! With that, we have reached the end of what we can reasonably extrapolate from current trends and inventions.

CONCLUSION

We have traced social learning from the dim past, dwelt long in the present, and ended in the future. It has been a long story, but it is one that will continue at an exhilarating rate, branching in diverse ways that will continue to challenge and ennoble us, while humbling us. As crusty old academics writing skeumorphically within the system we suggest is fading, in a format designed for a technology whose sun is setting, we will enjoy what we can of the ride, but will view it perhaps as outsiders, like the dinosaurs watching the asteroid streak across complacent skies.