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Mapping the Field and Terminology

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Constant change is here to stay (Anon)

1.1 Living with Change

We give into temptation and say that over the past 100 years, the means by which we learn has changed out of all recognition. According to the utopian view, in the developed world education has changed from being classroom-based and teacher-led, to life-long learning that is learner-focused and capable of being delivered where and when the learner wants. Training has evolved from being a one-on-one activity where an expert demonstrated his or her skills to a novice, to a flexible, packaged delivery of targeted training at the point and time of need. It is learning technology that has made this revolution possible.

There are several problems with this utopian view. First, the majority of learning technologists live in the developed world and even in the developed world most of the education system still relies on classroom-based, teacher-led learning. In developing countries, with a few notable exceptions, there has been little change in traditional educational practices. In the world of training, classroom- and workshop-based, instructor-led sessions are still the norm rather than the exception. Second (and more optimistically), this view is but a snapshot of a world in which change is accelerating. It would be naïve to assume that the point we have reached now represents the pinnacle of achievement for learning technology. Nils Bohr is quoted as saying, "Prediction is very difficult, especially if it's about the future." and the only thing that we might say with any confidence is that after the next hundred years education and training will (probably) look very different.

St Jude, who lived in the first century AD and who was martyred in Persia or Syria around 65 AD, is the patron saint of impossible causes. Many have adopted him as the patron saint of learning technology. They feel that although learning technology has so much to offer to the process of learning and performance improvement, its promise has

never been properly realized. The introduction of learning technology always involves change in an environment—education—that is traditionally conservative and highly resistant to change. One of the purposes of the education system is to guard society's culture and pass it on to the next generation.

As each new technological innovation arrives, there are claims that "this will revolutionize learning" and those who have been working in the field for many years have a feeling (to quote Yogi Berra) of "déjà vu all over again!" (Berra and Kaplan 2003). Such claims have been made for successive waves of technology going back as least as far as the kinematograph, which was predicted to replace classroom teachers through the use of educational films. Indeed, if the affordances attributed to contemporary mobile devices are compared with those for a book there is cause to wonder whether much progress has been made over the past 150 years. We must conclude that most learning technologists are not very competent in the tactics and strategy of innovation. We could argue that if the roles of learning technologists are fragmented so that there are different people designing, developing, and managing learning resources, then there should be specialists whose task it is to manage innovation and change. The reality is that most learning technologists need (or will need in the future) to understand and engage in the politics of innovation.

A key problem that particularly besets information and communications technologies (ICT) in learning is that the champions tend to be well informed about the technology itself but often less competent in the broader aspects of learning. Their uncritical euphoria takes them through the technological development and the initial creation of pilot learning resources, but then meets a more skeptical group of people who are committed to the status quo and who are very hard to convince of the merits of the innovation.

Moore (1999) uses the analogy of a chasm as a break point in the innovation curve Figure 1.1. The initial take-up of an innovation happens with early adopters, who are naturally curious and willing to experiment with something new. But then the adoption curve meets a break point. Before the innovation can spread there is a large group that Moore calls the "cautious majority" who need to be convinced. They look for other people like them to go first, to try it out, and report back on their success. But, given that they are all on the same side of the chasm, it is difficult to get a critical mass of these decision makers who will endorse the innovation.

Xie, Sreenivasan, Korniss et al. (2011) use computer modeling to show that a committed minority of around 10% is required to reverse the prevailing majority opinion. In terms of the context in which learning technologists work, that is a far larger minority than most innovations currently have. It would mean that in a given institution one in ten of the staff, randomly distributed through the institution, would be constantly advocating the use
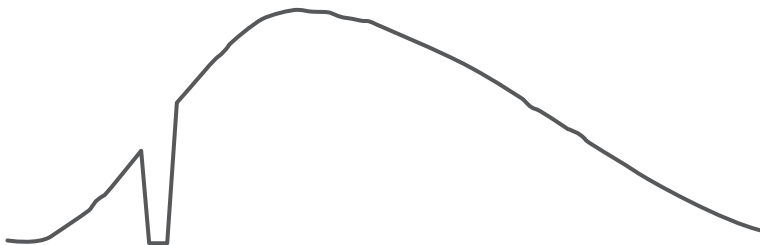

Figure 1.1   The innovation chasm.

of learning technology to their uncommitted colleagues and would be immune to any adverse influence that might cause them to lose their belief in the advantages of educational technology. Once that tipping point of 10% is reached, the model indicates that there is a dramatic decrease in the time taken for the entire population to become believers and to adopt the innovation. So, effective learning technologists need the skills of persuading and influencing to increase the size of the committed—evangelical—minority.

There are strategies that have been used effectively to "cross the chasm." In the 1970s the UK National Development Programme in Computer Assisted Learning (Hooper 1977) adopted the twin policies of matched funding and institutionalization. It was a requirement that the host institution matched the external project funding and thus demonstrated its commitment to the project. It was argued that if an institution had invested significant resources in the project, then it would have good reason to ensure that the innovation continued after the external funding ended. The strategy of institutionalization required the project to develop plans for its continuation at a very early stage in the overall project. Thus, by the time the external funding came to an end the cautious majority would have been convinced and would provide their support. Other funding agencies in Europe and North America have used similar strategies to maximize the chances of success for their innovations.

Particularly in the training content, but increasingly in academia, the cautious (even skeptical) majority ask questions about the return on the investment in learning technology. While the early adopters (to the left of the chasm) are content to use their curiosity as sufficient reason to make changes, others look at the costs of investing in the technology and in the development of new learning resources, and need to be persuaded that the longer term savings are justified. Classroom-based learning requires relatively little investment: the costs are dominated by the recurrent costs of staff, accommodation, and consumables. Disruptive change often requires significant investment, which must be balanced by the promise of future savings.

George Santayana (1905) wrote "Progress, far from consisting in change, depends on retentiveness. When change is absolute there remains no being to improve and no direction is set for possible improvement: and when experience is not retained, as among savages, infancy is perpetual. Those that cannot remember the past are condemned to repeat it."

A compelling example of this was given by Rushby and Seabrook (2008), who investigated research projects on the use of ICT in learning during the 20-year period from 1980 to 2000. They mapped the findings of this research onto the research agenda of a major UK funding agency in 2007 and found that almost all of the questions that were under investigation had already been addressed (and largely answered) years earlier—albeit with earlier versions of the technology. Paradoxically, one of the key reasons for this blindness to historical research was the technology itself. Today's researchers have become accustomed to carrying out their literature search using the internet as a primary—often the only—source. They are guided by two dangerous assumptions: first, that the technology they are investigating is so new that nothing can have been done with it before and, second, that if it is not on the internet then it does not exist. Crucially, most of the reports of this earlier research were *not* available on the internet: it was only in the final years of the 20th century that research reports and journal papers were routinely published online. And so the researchers had overlooked the earlier work that might have saved them time and resources, and might have enabled them to go further in their own work.

In this context of change this *Handbook of Learning Technology* brings together 29 contributions by acknowledged experts across the world, setting out an authoritative and contemporary view of the field. The phrase 'learning technology' deliberately reflects the book's scope to include both education and training. The terms 'educational technology', 'instructional technology', and 'learning technology' are all used but with nuances of difference in their meaning and those differences can be culturally dependent.

The chapters within the handbook take us on a journey from a discussion of what we mean when we talk about learning technology, through how people learn and aspects of the historical development of the field, then how learning technologies are used in practice in different educational and training contexts, issues in learning technologies, and finally trends and future directions with some visions of the future.

1.2   What is Learning Technology?

"When I use a word," Humpty Dumpty said in rather a scornful tone, "it means just what I choose it to mean—neither more nor less."

"The question is," said Alice, "whether you can make words mean so many different things."

"The question is," said Humpty Dumpty, "which is to be master—that's all."

Lewis Carroll, *Through the Looking Glass*, Chapter 6

The field of learning technology is a perfect example of this pluralist interpretation. Each of us—scholar, researcher, and practitioner—has our own clear and unique understanding of what "learning technology" means. A glance at the list of contents of this book gives an initial impression of the editors' view of the field. Not surprisingly we have included chapters that we believe (or believed at the time) give a comprehensive coverage.

Before we go any further, we should clear up two common misconceptions. The first is that learning technology is all about technology. Certainly, as we shall see, technology forms an important part of the field, but the technology *of* learning (as opposed to the technology *in* learning) must take center stage. The second misconception, shaped by technological advances over the past few years, is that learning technology is all about ICT. This leads to the notion that learning technology is synonymous with the use of the latest technological devices. These technologies currently dominate a growing number of learning systems but are only some of the technologies that can be, and have been, used to support learning and learners.

The Association for Educational Communications and Technology (AECT) deliberated for several years before the Definition and Terminology Committee came to a final consensus on a single sentence definition of educational technology:

"Educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources."

This definition, which was strongly influenced by Michael Molenda, has stood the test of time and is referenced (often without attribution) in most contemporary definitions that can be found on the Web and other writings. From time to time the discussion as to "What is educational technology?" is rekindled. Although it provides new insights on our evolving understanding of what the field comprises, the discussion usually concludes with an invocation of the AECT definition!

As with many carefully crafted definitions, almost every word in the definition needs to be unpacked and carefully examined. Those who want to delve deeply into this are recommended to read Januszewski and Molenda's (2007) commentary.

The International Foundation for Information Technology (IF4IT) has a similar (but perhaps more systems oriented) definition of educational and instructional technology: "The solutions that represent things, such as but not limited to, tools, technologies, products and systems, which are specifically intended and used to help education, train and learn from" (International Foundation for Information Technology 2009).

We should also consider what we mean by "technology." The *Concise Oxford English Dictionary* defines this as the "science of the industrial arts; ethnological study of the development of arts." In contemporary usage it involves the use of tools, machines, techniques, and ways of organizing these to solve a problem, improve existing solutions, and perform specific functions. Commonly we use the word to mean the tools themselves as well as their use.

Hlynka and Jacobsen (2009) note that the AECT definition contains four components:

- The initial emphasis on educational technology as a study and ethical practice moves the definition away from the focus on the technological tools which prevails in our current thinking.
- Educational technology has the purpose of facilitating learning and improving performance. This, too, belies the current focus on technologies: the tools are there to support the learning, not as an end in themselves.
- The separation of creation, management, and use reminds us of the actors in this process: those who create materials to support learning and performance improvement (the developers), those who deploy and manage the materials and processes (the teachers or instructors in formal learning environments), and those who use them (the learners). In practice there is often a blurring of these roles. For example, many teachers and instructors are also creators of learning materials and in some environments the learners are responsible for constructing their own learning resources. In informal learning, the learner may be creating, managing, and using resources concurrently. We should also note that technology includes methods of organization: as we shall see later, an important part of learning technology is the management of change and innovation in learning environments. It is here that many of the differences between education and training are most stark, although the current trend towards the industrialization of education is rapidly blurring the distinction.
- Finally, the definition refers to the technological processes and resources: processes and resources which since the AECT adopted the definition have increasingly been dominated by ICT (such as e-Learning and various applications of the internet). However, we need to remember that there are older forms of ICT and that books, video, and postal services are still used by learning technologists where they are appropriate solutions to learning problems.

The title of this book is *Handbook of Learning Technology*, not *educational* technology. However, the AECT definition works equally well if the word "educational" is replaced with "learning." Our reason for using "learning" is that some people in the field make a distinction between education and training. We thus get a number of variants: educational technology, training technology, instructional technology, learning and performance technology, and

learning technology. Our perception is that learning technology is more embracing than the alternatives. By moving away from education and/or instruction to learning and replacing student and/or trainee with learner, we avoid the perceived dichotomy between education and training. Although there are clear differences between the academic and business or industrial environment, there are also major similarities and practitioners in both cultures have much to gain from each other. Trainers sometimes say (with cruel wit) that "training is when you know what you're doing and education is when you don't." In practice, it can be argued that an important part of education is the "guide on the side" to help individuals to learn things that the "sage on the stage" does not know. But this takes us into realms of philosophy that are beyond the scope of this chapter and of this handbook. As Humpty Dumpty says (see above) learning technology is the phrase we shall use and that is what we choose it to mean!

1.3   Focusing on Learning

Despite the best efforts of learning technologists since the middle of the 20th century, learning technology has only made a limited impact on the way in which learning (both formal and informal) is conducted worldwide. We therefore need to set learning technology in the broader context of learning and of performance improvement. Learning and performance improvement are not inextricably linked: one can happen without the other! Learning does not necessarily result in improved performance and performance can be improved by the use of job aids that do not necessarily have the by-product of engendering learning. Figure 1.2 shows a simplified structure in which learning technology is a subset of learning and of performance improvement.
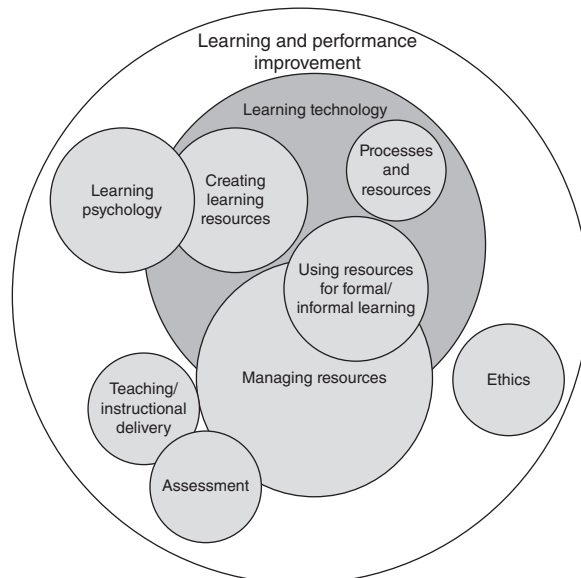

Figure 1.2   Setting learning technology in a broader context.

The boundaries are blurred because many of the topics are common to those who practice learning technology and those who employ more "traditional" forms of learning and performance improvement. Thus both need to understand how people learn and how to manage the learning process. In practice, effective learning technologists will have a good understanding of teaching and learning in a classroom where the technology is limited to books and a blackboard (both of which are, of course, examples of technology but which are so common that we no longer think of them as technological tools!). Conversely, practicing teachers and trainers need to have a working knowledge of learning technology if they are to be effective.

Any attempt to map the field of learning technology encounters a problem because it is a highly interdisciplinary field with blurred boundaries. At what point does the map move beyond the scope of what we would properly consider to be "learning technology" into areas that are, for example, the realm of the neuroscientist, the engineer or the accountant? We have always to consider what is being learned—the content of the resources, the performances that we are seeking to improve—and this can take us far beyond the core of learning technology into curriculum areas across education and training.

One of the joys of being a learning technologist is that you learn so much about other things in other disciplines. It is said that the best way to learn something is to teach it—or in our case to create materials to support learning and performance improvement. This raises the question of whether it is necessary to know something about the subject being taught in order to create effective learning resources or whether a learning technologist working in close collaboration with a subject matter expert can be equally effective and possibly more efficient.

Our constant assertion is that the focus of learning technology should be firmly on the learning rather than on the technological tools and we have tried throughout to keep the learner in the center of the picture. Thus the scene is set in the next chapter of the handbook by Jeroen van Merriënboer, who looks at how people learn. Despite its title, "What is technology," in Chapter 3 Martin Oliver maintains this focus by relating work in the field of learning technology to traditions of research where theories of technology are better developed. What his chapter does *not* do is "simply provide lists, offering taxonomies as if these solved the problem."

1.4   What are the Technologies?

We now come to what is generally considered to be the heart of learning technology, and for some people the only part worth considering: the creation, management, and use of appropriate technological processes and resources.

As we noted earlier, many consider the learning technologies to be exclusively ICT. They set aside the earlier technologies such as print, film, and linear video. Print-base technologies have been available for learners for centuries. Early scholars used illuminated manuscripts, painstakingly copied in monastery scriptoria as teaching aids. In the second half of the 20th century, strongly influenced by behavioral psychology and the work of B.F. Skinner (1953), techniques were developed for structuring print into programmed learning. This led directly to machines that used film instead of paper as a display medium and eventually to computer-based implementation of the same technique. Those who are

tempted to dismiss programmed learning as merely a step on the road towards current forms of e-Learning are encouraged to read Susan Markle's grammar of frame writing (Markle 1969) and reflect on what has been forgotten by learning technologists in the years since that book was written.

Video is also frequently seen as an important evolutionary step on the path of the development of learning technology. Linear video is often a more convenient alternative to movie film, but is also easier to manipulate. It can be started and stopped, and under computer control it can be re-sequenced to meet the dynamic requirements of specific learners. In this variant it gave rise to trigger video (see Rushby 1987).

When we turn to the use of ICT in learning, the literature abounds with three-letter acronyms. Over time, this alphabet soup has evolved to reflect the changing technologies and context.

Perhaps the earliest acronym found in the North American literature in the 1960s is computer-aided instruction (CAI). This typically referred to a form of programmed learning implemented on computers rather than using specially constructed machines or books. In Europe the preferred term was computer-assisted learning, which focused on the learner rather than the teacher. Computer-managed learning is self-explanatory and computer-based learning was felt to be more comprehensive, encompassing more facets of the learning process.

As the technology developed, some practitioners started replacing "computer" with "technology" to indicate that other aspects of ICT were involved. The proponents of web-based learning advocated the use of "web-based learning" but by the first decade of the 21st century the term "e-Learning" was in common use, supplanting the earlier acronyms. Variations on this term include m-Learning to denote learning using mobile technologies and—perhaps in desperation—u-Learning as an abbreviation for ubiquitous learning.

However, Elliott Masie, the head of the MASIE Center in Saratoga Springs, New York, claimed in 2013 that use of the term "e-Learning" was evaporating: "…Fewer corporate workplaces are using the phrase 'e-Learning' actively. Many are just calling the full range of opportunities 'learning'. Others are moving towards greater definition of the process, such as virtual classrooms, webinars (web-based seminars), e-books, MOOCs (Massive Online Open Courses) or online courses" (Masie, quoted in Little 2013). Perhaps this volume should just be called the *Handbook of Learning*?

Keeping pace with the technology used in learning is proving difficult! The rate of development of new technologies is ever increasing. Moore's law (Moore 1998), which was first published in 1965, predicted the doubling of the number of transistors on a chip every two years. It has also proved a reasonable proxy for the development in capability of ICT devices. Thus by the time of publication of this handbook, we get a growth from 1965 in excess of 2×10^{21}. This takes us into the realms of the unimaginable but is indicative of the rate of innovation with which the learning technologist must contend.

The difficulty of coping with the development of new technologies has led to two types of learning technologist: those who are primarily concerned with the technologies that can be used for learning, and those who are primarily concerned with applying those that they have mastered. This dichotomy between research and practitioners is undesirable but perhaps inevitable.

Figure 1.3 illustrates some (but not all) of the technologies that appear in the literature on learning technology. Each of these is capable of subdivision to provide a more complete picture.
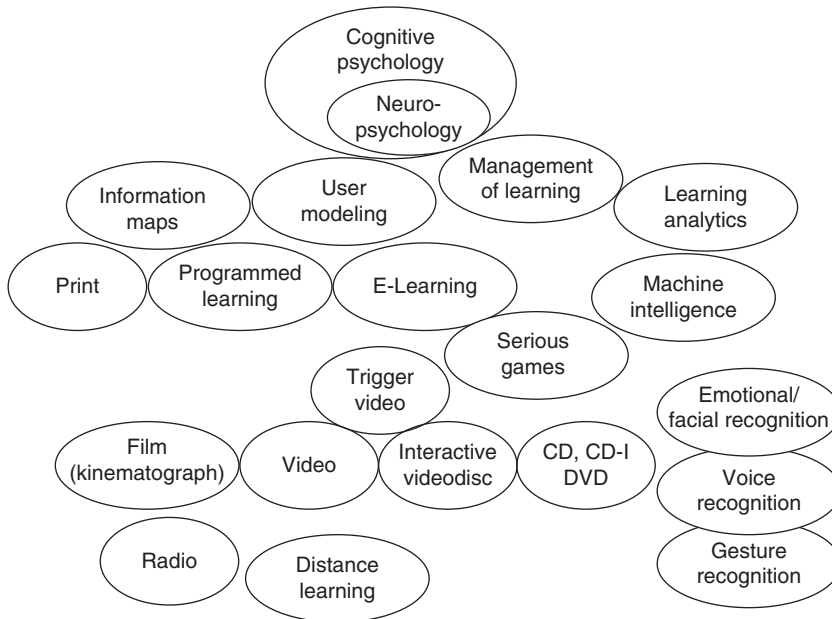
Figure 1.3 Some (not all) of the technologies of learning technology.

The next four chapters examine technology, learning, and community. In Chapter 3, Martin Oliver takes a higher level view of technology which sets these specific technologies into a more helpful context, while Peg Ertmer and Timothy Newby in Chapter 4 move us back to learning by exploring the reciprocal and synergistic relationship between technology and learning, and how theories, instructional practices, and technology tools have evolved in a reciprocal fashion. In Chapter 5, Maggie McPherson looks at the evolution of learning technologies in greater detail.

We have then included a set of seven chapters that discuss the use of learning technology in different contexts. The first chapter in the sequence is by Lydia Plowman and looks at learning technology at home and pre-school. Keith Turvey and Norbert Pachler continue with a discussion of learning technologies in K-12 (secondary) education called "Problem spaces." Moving to higher education, we have Johannes Cronje (Chapter 8) and then "Learning technology in business and industry" by Clark Quinn. In Chapter 10 Yoni Ryan and Colin Latchem explore the history of distance education, which has been in existence for at least 1400 years. Colin Latchem then explores the broad field of lifelong informal, self-directed and non-formal learning.

There is often an assumption on the part of those promoting learning technology that access to the essential technologies is available to all. Again, in some cases, the new technologies may be more available than the older ones. In parts of the world such as West Africa, the fixed-wire telephone system is frail or non-existent while mobile phone coverage is more prevalent and can be used for distance learning systems. Elsewhere the assumption that, for example, reliable high-capacity broadband access is available may be unjustified. This creates an inequality between the digital "haves" and the "have-nots." Even in countries such as the UK and the United States there are geographically large rural areas where internet access is

problematic and expensive. Dick Ng'ambi and Vivienne Bozalek discuss such issues in Chapter 12, "Learning with technologies in resource-constrained environments."

1.5   Making it Work

Together the seven chapters the use of learning technology in different contexts paint a comprehensive picture of learning technology throughout formal and lifelong learning. This is where many learning technologists practice their profession and leads us to the question of how we should define or describe that profession. In Chapter 13, Barbara Grabowski, Michael Beaudoin, and Tiffany Koszalka discuss the competencies that are required by learning technologists. They use the competencies from the International Board of Standards for Training Performance and Instruction (ibstpi) as a framework for mapping professional competence with specific tactics currently enabled by the technological revolution with regard to evolving pedagogy, emerging digital technology, and changing learner characteristics. The chapter presents the standards and current issues affecting learning technology, and blends them together to inform competent practice as a designer and instructor. The chapter also deals with the competences required by the learner. Learners are not—or should not be—passive objects to whom learning happens; they are active participants in the learning process. Engaging in that activity requires them to be competent to carry out a range of tasks.

George Veletsianos explores digital learning environments in Chapter 14. He examines four key concepts and issues surrounding digital learning environments: various organizational structures for learning environments (e.g., groups, networks, and communities), the design of meaningful and effective learning experiences, the approaches of guided versus minimally guided instruction within digital learning environments, and, finally, technology's lack of neutrality within the context of appropriated and repurposed learning environments.

Phil Green then takes the specific environment of online learning and provides, in Chapter 15, a series of very practical strategies and tactics to make learning succeed.

1.6   Study and Ethical Practice

The AECT definition set out earlier speaks of the study and ethical practice (of facilitating learning and improving performance). Ethical practice requires that we must ensure that all learners are treated fairly, and that no-one is disadvantaged by the particular learning resources or environment that are employed. The use of technology in learning has complicated the ethics of the study and practice of facilitating learning in three ways.

First, the possibility of increased distance between the learner and the teacher or trainer makes it more difficult to ensure that there is equity of access. In some respects the use of technology makes it possible to include learners who would otherwise be disadvantaged (e.g., through the use of distance learning or by using the technology to alleviate the problems of visually handicapped learners). The W3C Web Accessibility Initiative (see W3C, 2013) develops strategies, guidelines, and resources to help make the Web, and thus web-based learning resources, accessible to people with disabilities.

Robbin Chapman's chapter on diversity and Inclusion (Chapter 16) explores how digital technologies can support learning within diverse populations of learners, and contribute to the creation of equitable learning experiences, and inclusive teaching practices and learning spaces.

In other respects technology can make it easier for learners to disappear from the tutor's sight and in her chapter, "Sins of omission," Ruth Gannon-Cook presents questions related to the lack of access through "sins of omission," the absence of culturally relevant graphics and metaphors in online course design. These questions are seldom posed and there is a dearth of research on cross-cultural theories and semantic tools, such as semiotics in education. For students of diverse ethnic backgrounds (who currently represent the highest attritions from online courses) this research could unlock the door to their learning, particularly by reintroducing cultural keys that open their minds to be receptive to new learning and, ultimately, could help their retention in online courses.

The assumption on the part of those promoting learning technology that access to the essential technologies is available to all is the starting point for Marshall Jones and Rebecca Bridges. Again, in some cases, the new technologies may be more available than the older ones. In parts of the world such as West Africa, the fixed-wire telephone system is frail or non-existent while mobile phone coverage is more prevalent and can be used for distance learning systems. Elsewhere the assumption that, for example, reliable high-capacity broadband access is available may be unjustified. This creates an inequality between the digital "haves" and the "have-nots." Even in countries such as the UK there are still geographically large rural areas where internet access is problematic and expensive. This is the starting point for Marshall Jones and Rebeca Bridges, who explore equity and access in greater detail in Chapter 18.

Third, there are traps for the unwary in the control and security of technology-based learning systems, as discussed by Don Tharp and Greg Chamberlain in Chapter 19. Without proper processes there are risks that sensitive personal information about learning aspirations and outcomes can be compromised through inaccuracies or fall into the wrong hands.

1.7 Current Issues

A number of issues currently dominate the study and (ethical) practice of learning technology. The first of these is the move from instructional design towards learning design. The change of a single word heralds a major change in the way that we think about the design and development of learning materials. While the aim of learning design is very similar to that of instructional design (e.g., as exemplified in Romiszowski 1981, 1984) the way in which those aims are pursued has a different focus. The current approach to learning design relies heavily on tools and technologies that support a participatory culture and encourages the sharing and reuse of fragments of pedagogical design and course development. Yusop and Correia (2011) argue that the current job-focused and procedure-based training for instructional designers has distracted them from thinking about the broader context in which they work. Designers work within a society that both influences them and which they in turn influence. They suggest that good practice—in this case, best ethical practice—requires them to have a critical understanding of civic professionalism.

In Chapter 20 on the design of learning, Daniel Spikol addresses the struggle to balance the generation of new theories while providing innovations for everyday use in different

learning situations. He argues that learning technologists need to have a broader approach to design as a means to overcome the limitations of these challenges. Designing for learning is a different endeavor than the design of other products and services because learners have diverse needs that go beyond the needs of other types of users.

> Part of the struggle of design of learning concerns the gap between theory and practice, but this gap is related to the fact that what drives technical innovations is the creative drive of technologists and researchers to invent, like other creative professionals such as designers, engineers, or artists. The challenge for the design of learning is to find ways to integrate invention and innovation that supports the needs of people into more unified design and research approaches. Design methods that consider both the philosophy and the creation of new artifacts (tools, processes, etc.) have benefits for design-based research and interaction design since they share the goal to of improving conditions to give more preferred ones. The possibilities of making space for invention and innovation needs to be addressed to the push boundaries of learning technology while keeping in mind that acceptance of innovations requires that they provide tangible solutions that can help the future of everyday educational practices. (Spikol, Chapter 20)

The second issue, which is less apparent and perhaps therefore less researched, is the development in assessment in learning environments which are rich in learning technology. The technology (both in the hardware and in application) provides new affordances for summative and formative assessment. It enables us to move away from what is easy to carry out to processes that get us closer to what we really want to know about the learners, and the resources and processes that are (hopefully) helping them to learn.

The emergence of mobile learning, with its promise of providing learning experiences outside the traditional classroom and untethered from the limitation of a power outlet, is changing the face of research in learning technology, even if its real impact on practice in educational and training is more modest. As the title of John Traxler's chapter, "New wine and new bottles," implies there are real possibilities for making transformative changes to education and training even if most of the innovation thus far has been restricted to finding new ways of providing the same learning experiences.

The other potentially transformative technology is that of serious games. As with mobile learning, there is a sense (at the time when this was written in 2014) that "gamification" will solve many problems, particularly because it is perceived to increase learners' motivation and thus their propensity to learn. And if mobile learning and can be combined with game-based learning then: "Give a boy a hammer and everything he meets has to be pounded." (Abraham Kaplan quoted in Horowitz 1962).

Igor Mayer, Harald Warmelink, and Qiqi Zhou set out a frame-reflective discourse analysis for serious games in Chapter 22, which explores their utility in society, business, and politics. This to provide a foundation for understanding what serious games are, and how they may be used effectively.

1.8   Innovation and Change

Despite Nils Bohr's pessimism about the certainty of prediction (see section 1.1), we have to look forward and, predictably, the final section of the handbook includes a number of chapters which help us to prepare for the future that we would like to see, together with some predictions as to what may—or may not—happen.

As to persuading the uncommitted majority who remain unconvinced of the benefits of learning technologies, the potential of cost savings is addressed in detail by Jane Massy in Chapter 23, "The investment in LTs. How to evidence value for money."

The planning needed for the implementation and integration of technology into K-12 schools is discussed by David Ensminger in Chapter 24 and Eugene Kowch continues this theme in his chapter, "Surviving the next generation of organizations," which builds a conceptual bridge for next-generation education leaders by bridging some boundaries between educational technology and education leadership fields.

The factors shaping education and society are discussed by Steve Harmon and Wayne Dennison in Chapter 26. They begin with a broad overview on changes in learning and education in the future, and then look at specific strategies for preparing for these changes.

A key part of the learning technologist's work is to be aware of what has gone before in terms of the research and the technologies, to recognize the strengths and weaknesses of earlier work, and to be able to build on that work for current and future projects. This is the theme of Chapter 27, in which Paul Kirschner and Liesbeth Kester consider the future research agenda for learning technology.

We conclude with two chapters on the future, presenting two different views of what may or may not happen. In Chapter 28, Neil Selwyn describes a dystopian future while Chapter 29 in contrast describes a utopian future from Marcus Childress. Which of these is the more accurate is largely in the hands of you, our readers.

1.9   Conclusion

The chapters and the authors are the personal choices of the editors: other editors (and readers) might well have made different choices. And there are logistical constraints on the overall length of the handbook which have necessarily limited its scope. We could have made it longer: it is not clear how we could have made it shorter.

Inevitably, the field has changed during the time between the inception of this project and publication. Even before we had completed the copy-editing, we could identify some areas that are missing. In recent months the linkages between cognitive neuroscience and learning technology have strengthened and if there is, as yet, no bridge between the two (see Bruer 1997) then at least we can see the foundations on either side of the river. In the light of recent developments there should have been more on learning analytics and its impact on learning design. Perhaps we should having included more on the ethics of research into learning technology: the advent of big data is changing what is possible and thus making current codes of ethical conduct out of date. There are other topics that deserve greater mention.

We can only apologize for our lack of prescience and make a note to extend the scope if we are ever asked to prepare a second edition! A Russian proverb says that you should always leave something behind so that you will be sure of returning one day.

Our aim has been to produce an authoritative reference work that will be of interest and use to a wide audience of practitioners and researchers in learning technologies and related fields. We have encouraged a writing style that makes the material accessible both to those who are familiar with the field and those who are just starting out.

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