Augmenting learning

Mars Phoenix *The snow I see above (a couple kilometres above) is water snow. And yes, @S_in_washington, I'm having foggy mornings too*

Is there water on Mars? Today's learners don't need to check a book – they can receive the latest updates on their computer or handheld device. What's more, they can query this data by chatting to a robot on another planet. 'If there is water and snow, is there fog?' enquires a curious reader in Washington. 'Yes, there is', replies Mars Phoenix from the other side of the Solar System. A remote world becomes more comprehensible, and thousands of people all over this world learn something new, something that inspires new questions, interest and enthusiasm that continue even when the robot falls silent, a victim of the Martian winter.

Those interactions are examples of 'augmented learning'. Augmented learning uses electronic devices to extend learners' interaction with and perception of their current environment to include and bring to life different times, spaces, characters and possibilities. It offers possibilities for the transformation of learners and their learning contexts.

Augmented learning makes use of many aspects of augmented reality, in which information, models or live action provide a useful or entertaining overlay on the real world. However, the assumption that such overlays are able to augment reality implies that we normally perceive an unmediated, objective reality that is independent of those who observe or augment it. This is an implicitly empiricist perspective that does not recognize many of the filters through which we already perceive and construct the world. Although 'the real world' is so embedded in our language that the term is often used in this book in preference to 'the physical world', we argue that augmentation of the human experience is not simply an incremental process involving the addition of extra data or sensory experience. Rather,

augmented learning involves the use of a wide variety of electronic devices to provide experiences and opportunities to spark a transformational process that has the potential to influence our identity and capabilities.

This book explores the implications and challenges of this form of learning, which takes place at the frontiers of reality, and the ways in which we can understand it, structure it, develop it and employ it. It investigates what we can do now that we could not do before and asks whether these new possibilities could fundamentally affect how people approach and benefit from learning. For example, can augmented learning create the social, affective and cognitive conditions that will allow individuals and groups of people not only to approach learning in a meaningful way but also to engage with it more deeply?

If so, the impact of these transformations on education and learners will be profound. This book explores the possible consequences of this change in different contexts, considering the learning experience of different groups and individuals who are already engaging in augmented learning. In order to do this, it focuses not only on research into learning in the 'real world' that is augmented by use of the virtual but also on learning in virtual environments that is augmented by use of the 'real'. It combines this wide range of research with consideration of augmented learning taking place in a variety of formal and informal educational settings, including some of the possibilities currently being shared on the Internet.

The book focuses on the multiple ways in which the virtual and the real are currently being mashed up, creating new learning possibilities, tools and environments. In order to do this, it provides a detailed overview of the newest possibilities in education and shows how technological developments can be harnessed to support inclusive and collaborative knowledge building through formal and informal learning. In order to set the scene, this introduction explores why augmented learning is possible, the emergence of this new set of

cultural tools, the implications of new technologies for learning and pedagogy and the affordances that these new cultural tools offer to both learners and educators.

Augmented learning and cultural tools

We are familiar with the idea of using tools to shape our interactions with the world. Physical tools such as hammers, tractors, pencils and computers are taken for granted and online tools such as search engines, email applications and cloud computing sites are now seen as commonplace within our everyday lives. However, the ubiquity of such tools acts to mask the influence of the use of such tools on ourselves.

At the start of the 20th century, the influential educational psychologist Lev Vygotsky identified the ways in which our thinking about the world – cognition – and our emotional responses to the world – affect – are shaped and influenced by 'psychological' or 'cultural' tools. These are social devices that are 'directed toward the mastery of [mental] processes – one's own or someone else's – just as technical devices are directed toward the mastery of processes of nature' (Vygotsky, 1997, p85). These 'helping means' (Holland & Valsiner, 1988) include concrete artifacts but also such as intangibles as scientific concepts, types of activity and use of language.

To illustrate the impact of such tools, we can consider the culturally mundane practice of learning to read, and the way in which this skill acts to change how individuals understand and hear speech (Olson, 1994). Since the time when writing was first used, its influence has been noted, including the concern that it might 'create forgetfulness in the learners' souls, because they will not use their memories; they will trust to the external written characters and not remember of themselves' (Socrates, 327BCE)

Humans learn to speak without learning to read. Their subsequent acquisition of the cultural tool of reading provides them with a model for reflecting on their speech (Lucariello, Hudson, Fivush, & Bauer, 2004). Consequently, readers and non-readers identify different

numbers of sounds, and different sounds, in the words that they say. This is the case with people who use different writing systems, even where all groups share a common language (Olson, 1994). A writing system is therefore not a simple transcription of speech sounds. It is an augmentation that provides new ways of reflecting on and perceiving the natural world. At the same time, it is clear that writing makes it possible to engage in abstractly sequential, classificatory, explanatory examination of phenomena or stated truth and thus 'enlarges the potentiality of language almost beyond measure, restructures thought' (Ong, 1982, p7).

In the Vygotskian paradigm, this type of transformation only occurs in 'technologically advanced societies' (Crain, 2005, p199) in which learners have access to new ways of representing and reflecting on the world around them. Cultural tools do not help learners to capture an objective, independent reality; rather they help to construct learners' perception and understanding of reality. Tools such as language, numbers, maps and diagrams modify

> the entire course and structure of mental functions by determining the structure of the new instrumental act, just as the technical tool modifies the process of natural adaptation by determining the form of labour operations (Vygotsky, 1997, p85).

Vygotsky's visionary psychology argues that humans are able to use culturally constructed tools to control their psychological processes because they

> cannot only modify the environment physically, but they can also modify its stimulus value for their own mental states (Holland & Valsiner, 1988, p288)

At one level, this sociocultural stance is useful when considering electronic devices, including traditional augmented-reality technologies, and thinking about how these can transform our experience of the world. These technologies provide new ways of reading the 'natural world' and consequently provide new influences on, and opportunities for control of, human development. At another level, this stance also informs discussion of the circumstances under which reality can be considered to be augmented, and suggests that a wide view of

augmentation is needed in order to understand human experiences and human interactions in this new technological context.

Cultural tools can be considered at different levels of granularity. The possibilities of writing, for example, can be broken down into different subsets such as different languages, grammar, fonts, handwriting or poetic structure. They can also be examined as a whole, presenting the wider cognitive changes offered by the medium

> With writing, the mind is forced into a slowed-down pattern that affords it the opportunity to interfere with and reorganize its more normal, redundant processes (Ong, 1982, p40).

In this introduction, we set out an overview of the set of tools that can be used to support augmented learning, before focusing on specific tools and instances of their use in subsequent chapters. This set of tools includes some, such as the Internet, that are already ubiquitous, and others that are still under development. It includes the various forms of augmented reality, virtual reality, augmented virtuality and diminished reality that apply to all our senses, including touch, hearing and smell (Azuma, 1997; Azuma et al., 2001).

This set of previously disparate tools is potentially important for learning because of the extended interaction with and perception of our environment that these tools open up together. In many cases, though, we can currently see the potential but not strong evidence of practice, so why not simply wait to see how this area develops before considering their possibilities for learning?

Why consider augmented learning now?

Vygotsky noted that the processes and psychological methods used to control human thinking and experience can become ‘fossilized’. Once this has occurred, we use them automatically and are no longer aware either that we are using these tools to moderate the ways in which we think, or that they mediate our experience of the world. It is only before

this fossilization takes place that we have the opportunity to examine cultural tools and understand their influence without having first to struggle to perceive them.

> Groups take up new mediating devices, some of which become central to shaping the information and the processing of information in the society […] There is a period in development and in history when the task or activity and the mediating device are not amalgamated and the dialectic between the mediating device and the task may be studied (Holland & Valsiner, 1988)

This book examines emerging practices that employ a new set of tools. The relationship of these tools to human learning has not yet become fossilized; the practices associated with them are only just beginning, but their implications are already understood to be enormous. In 1993, Papert observed

> Already, children are made increasingly restive by the contrast between the slowness of School and the more exciting pace they experience in videogames and television. But the restiveness is only a pale precursor to what will come when they can freely enter virtual realities of animals in Africa or wars in ancient Greece… reading will no longer be the unique primary access road to knowledge and learning, and it should therefore no longer be the dominant consideration in the design of School. (Papert, 1993)

And, more recently, Castronova predicted

> I see a hurricane coming. It's called practical virtual reality… Practical virtual reality emerged unannounced from the dark Imagineering labs of the video games industry, got powered by high-speed Internet connections, and exploded across the globe, catching us all by surprise (Castronova, 2007)

It is at this point, as these tools and practices first appear in our educational landscape, that we can examine them, exploring the dialectic that is developing between them and our learning practices. In future, technologies that augment our perceived realities are likely to become ubiquitous and unnoticed, no more extraordinary than the ability to affix a lens to

our eye to aid our sight, or to listen to a string quartet play Mozart while we are standing in a bus queue in the rain.

Already, early augmented changes in the learning landscape are everywhere. Through Twitter, Gunpowder Plotters reenact in real time their conspiracy to blow up the Houses of Parliament in 17th-century London; within an open book a three-dimensional Juliet bends down from a balcony to share a sonnet with her Romeo; a group of teenagers who have never met in real life sit in the virtual caves of Lascaux to discuss art and archaeology. From this perspective, books, pens and paper appear to be destined for the scrapheap, forced aside by a deluge of new possibilities and technologies. And yet, by and large, new technologies for learning fail to stand the test of time. Some, such as the reading accelerator or the Skinnerian teaching machine, make little long-term impression; others, including the slide rule and the videotape, experience a dramatic fall in popularity, being replaced by newer technologies.

New technologies and learning

While new technologies come and go, the conventional image of learning remains that of children sitting at furniture designed for the individual use of writing materials, aligned for a clear view of a board at the front of the classroom. Large boards and individual writing materials were widely available when compulsory schooling was introduced, and variants of these technologies continue to shape our learning environments and our understanding of what learning could and should involve. Large parts of our curricula are devoted to developing expertise in the reading and writing skills necessary for their use, public examinations for young children focus on their expertise in these skills, and schools are judged on the extent to which they develop this expertise. A child who reaches the age of 11 unable to form letters to a good standard is conventionally judged to be a failing child, the

product of a failing school. A child who reaches the age of 11 unable to type to a good standard is still the norm.

Insert *Figure 1.1 A young girl's vision of the future of educational technology* about here

These limitations arise from our tendency to see new things in terms of old paradigms. Figure 1.1 shows a young girl's view of an ideal educational future (Sheehy & Bucknall, 2008). In this vision, technology allows the girl to change her learning environment, making it a beautiful and relaxing place, but her view of education is limited to direct transmission and individualized testing, with the results of her tests beamed immediately to the government. Her image highlights the risk that learners and educators will unthinkingly assimilate the possibilities for augmented learning and changes to the learning environment into existing practices, thereby perpetuating pedagogies and political practices from the industrialized age of information transmission via the blackboard.

There are several other factors at work here. As every educational practitioner knows, financial constraints, outside pressures and classroom management all have a part to play when it comes to choice and use of technology. Educators are constrained by a lack of time to understand the potential of new technologies, a lack of resources to acquire and make full use of new technologies, and a lack of ways in which to decide which technology will prove to be crucial and which will be outmoded within months or years. In the case of augmented learning, individual learners and educators find inspirational, exciting ways to engage with it, but have difficulty sharing their expertise widely because the ground rules and practices of augmented learning are still being created and negotiated.

Another important reason for the rapid rise and fall of new technologies in education is that any technology only remains new and exciting for a short period of time. After that, learners

and teachers are unlikely to use it unless it clearly offers some genuine improvement in the transmission or construction of knowledge. Without a strong pedagogical backbone, new technologies are unlikely to stand firm for long.

New technologies and pedagogy

Salomon (2000) identified a series of problems with the use of new technologies in education. Apart from the tendency to assimilate these technologies into existing instructional practices, he found there was a widespread view that technology is an end in itself, with a consequent focus on the medium rather than on how and why it is employed. He linked these problems to three assumptions: the assumption that knowledge and information are identical, the assumption that knowledge is gained by transmission and the assumption that the role of new technologies in education is to help with this process.

In the context of learning with information-saturated new technologies, such as the Internet, the distinctions between information and knowledge identified by Salomon (2000) are crucial. Information is discrete, clear and can be transmitted without the need for contextualization. It can be regarded as a series of facts, which can be transmitted, learned by rote and tested in multiple-choice questionnaires without any need for understanding. Knowledge, on the other hand, requires interaction because it is constructed in meaningfully connected networks. The construction of knowledge requires not only sharing and collaboration, but also ambiguity, conflict and uncertainty. Those who view education as information transfer will use new technologies for storage, drilling, testing and accessing information; those who seek conceptual change will seek to make use of the interactive qualities that they offer.

The assumptions about information and knowledge that were identified by Salomon make it clear that we cannot be technologically deterministic about the influence of new tools on learning. No matter how exciting, radical or carefully designed a tool is, it is unlikely to

produce a significant shift in learning and teaching unless it is associated with a fresh understanding of how these take place. No single pedagogy has a monopoly on the use of new technologies, as Conole (2000) argued when she examined key pedagogic theories and their relationship to technology.

Behaviorism is teacher controlled, and involves learning through association and reinforcement. It makes a positivist assumption of a common reality from which learning objectives can be abstracted. This approach employs multiple media to convey information, and provides feedback to learners through e-assessment tools.

Cognitive constructivism focuses on the processes by which learners build their own mental structures when interacting with an environment. It encourages hands-on activities oriented towards design and discovery. This approach uses new technologies to develop active and authentic learning environments

Social constructivism emphasizes interpersonal relationships and the joint construction of knowledge within a context. This approach uses multiple forms of asynchronous and synchronous communication to promote diverse forms of dialogue and interaction.

Situated learning (building on social constructivism) views learning as social participation, with a focus on communication and collaboration. This approach makes use of the networking capabilities of the web to support the formation and facilitation of a variety of learning communities.

New technologies can support and inspire shifts towards new educational practices, such as networked learning, mobile learning and online social learning. However, in isolation, these new practices necessitate neither a shift in pedagogical stance, nor a shift in attitude towards teaching and learning. Educators and students can easily use the tools that might otherwise enable augmented learning to support existing pedagogical approaches, like the

young girl on the beach in Figure 1.1, thus producing no significant shift in the learning landscape.

Affordances of new technologies

In order to understand how new technologies can be used to produce shifts in learning and teaching, it is important to identify the affordances of those technologies. Affordances are here taken to be the perceived and actual properties of a thing, 'primarily those fundamental properties that determine just how [it] could possibly be used' (Norman, 1998, p9). Affordances are not necessarily those intended by the designer, neither are they necessarily positive; they bring both opportunities and challenges. The affordances of a fire extinguisher, for example, include not only its designed utility in cases of conflagration but also its unintended utility as a heavy weight for wedging open fire doors.

Conole and Dyke (2004) list ten affordances of information and communication technology (ICT), identifying both their advantages and their associated problems, with the aim of understanding how these technologies can be most effectively used to support teaching and learning. These affordances are relevant to many learning situations, so let's look at their advantages and problems in the context of a familiar technology-enabled environment for informal learning, the family car.

When driving, we benefit from the **accessibility** that ICT provides, and its **multimodal and non-linear** aspects. Together these give us the ability to choose between a vast array of information options, including the dashboard, radio, media player, in-car phone and GPS. So many information options, in fact, that we may choose to limit access when doing something difficult, for example by turning off a podcast as we approach a difficult junction. With the radio set to broadcast any travel news, we learn about the state of the main roads across the country and modify our behavior accordingly.

Communication and collaboration help us judge the reliability of that travel information. A national station tells us that five people have rung in to report a serious jam on the motorway ahead; switching to a local station gives us the latest report from the local police. When collaborators are spread too thinly between communities, though, we have only limited access to collaboration, and nobody warns us about the flock of sheep that holds us up on the minor road that leads to our destination.

We expect **immediacy** – hourly opportunities to learn about the international news, minute-by-minute information from our GPS about the road we are on, the junctions ahead and the position of even the most recently erected speed cameras. At the same time, immediacy can mean intense pressure from work and friends to keep up to date with events happening elsewhere, via our mobile phone (also known as a cell phone or a smart phone) and recordings. It also produces **risk, fragility and uncertainty** due to the **speed of change**, because available information shifts and changes continually as new updates come in, making it difficult to develop a clear picture of the things we need to know.

Switching to a music channel may help us to escape a stream of information and provide opportunities for **reflection** about problems we are trying to solve and the information we have gathered. If we choose instead to switch to a podcast, we benefit from **diversity**, which gives us access to a wide range of different experiences from around the world.

Despite these benefits and their possibilities for learning, we may feel depressed because our real-world experience does not live up to the experiences of others that we learn about via the radio or podcasts. We may also feel that our choice of equipment on which to learn by listening to podcasts, or to access GPS, is unnecessarily constrained due to increasing **monopolization**. We may even have listened to recent news stories and to accounts of companies selling individual data, and be concerned about our GPS devices being used for **surveillance**, to regulate and control us (Arthur, 2011).

Meanwhile, in the back of the car, our children are likely be in their own personal learning environments. Headphones allow them to experience a different soundscape and a different emotional state to others in the car, while the lack of a need to concentrate on the road ahead allows them to do a variety of things, such as developing their expertise in 3D games, or using 3G connectivity to program and control a robot on a different continent. They might even pick up an e-reader to learn about the developments in in-car technology that will soon extend the driver's learning opportunities further: night vision, ability to see round corners, augmented reality heads-up navigation systems, haptic devices and biofeedback.

Many of these affordances have been available in our houses for some time, and apply to ICTs that are now obsolete, as well as those currently under development. The wireless telegraph, the gramophone and the crystal set offered them in a limited form and there has been plenty of time for such affordances to be incorporated within our educational systems. They can also be seen as affordances of Web 1.0 – the Internet that was primarily read only. When Web 2.0 replaced the read-only web with a read-write environment, spanning all connected devices and linking multiple data sources, which can link users in an 'architecture of participation' (O'Reilly, 2007), new possibilities were opened up.

Affordances of Web 2.0

These new possibilities have been identified by Knobel and Lankshear (2007) in the context of Web 2.0 and literacy. This research did not only focus on the affordances directly related to the use of new technologies but also drew on the ethos of Web 2.0:

> active collaboration and participation, leveraging collective intelligence via practices like eliciting user annotations, distributing and willfully sharing expertise, decentering authorship, mobilizing information for relatedness, hybridization, and the like (Knobel & Lankshear, 2007, p20)

The affordances that Knobel and Lankshear identified as characteristics of new literacy practices are presented as a progression from, and a contrast with, those that went before

- **Participation** rather than publishing
- **Distributed Expertise** rather than centralized expertise
- **Collective Intelligence** rather than individual possessive intelligence
- **Collaboration** rather than individuated authorship
- **Dispersion** rather than scarcity
- **Sharing** rather than ownership
- **Experimentation** rather than normalization
- **Innovation & Evolution** rather than stability & fixity
- **Creative Rule-breaking** rather than generic purity
- **Relationships** rather than information broadcast.

Identifying the affordances of new technologies and of Web 2.0 helps us to see the new possibilities that they open up, and the new pitfalls that they put in our way. As educators and learners become aware of these affordances, they are able to change their practice. For example, asynchronous online discussion can seem both stilted and impersonal. Once we are aware that it does not support the rapid change of ideas, but does provide time to reflect, to be more explicit and to order content and issues, we can target our use of it to support learning more effectively (Garrison & Anderson, 2003).

To benefit fully from the affordances identified by Conole and Dyke would require shifts in our curricula to take into account the shift from a society in which information is scarce and learners need help in accessing it, to a society in which information is ubiquitous and learners need help in making sense of it. To benefit fully from the affordances of Web 2.0 identified by Knobel and Lankshear and others (see, for example, Gee, 2004 on the characteristics of 'affinity groups') requires shifts in power and structure and a move away from the traditional educational model in which the teacher is always the expert, towards a model in which the teacher is a facilitator and also a co-learner.

These affordances may sit more easily with informal learning, in which the goal, tools and methods of learning are defined or developed by the learner, than with formal learning in which the teacher controls these elements (Vavoula, 2004). In the absence of a formal, externally imposed learning framework, informal learners tend to use whatever techniques, resources and tools best suit their learning needs and personal preferences (Tough, 1979). New technologies and Web 2.0 offer novel ways for them to connect and interact with each other, to create and share knowledge and to learn. When they move into compulsory education environments, though, they are currently likely to find that many of the tools they use for collaboration and learning have been blocked or banned (Ferguson, Faulkner, Whitelock, & Sheehy, 2011). Current assessment structures, the need to maintain a duty of care, legal issues, and the need for staff development currently constitute real barriers to the effective employment of Web 2.0 affordances within K–12 (Crook, Fisher, Graber, Harrison, & Lewin, 2008).

The challenges of utilizing Web 1.0 and Web 2.0 affordances to support learning are already great, but they will soon be increased by new possibilities. No sooner had Web 2.0 become a technological buzzphrase, than it was joined by ‘Web 3.0’ and ‘Web 4.0’. Web 3.0 is usually taken to refer to the Semantic Web, an extension of the current Web, in which information is given well-defined meaning, better enabling computers and people to work in cooperation (Berners-Lee, Hendler, & Lassila, 2001). Web 4.0, the Symbiotic Web, is a more hazy possibility, associated with humans and machines acting in symbiosis, the human body becoming part of the Internet, and people having the ability to ‘upload themselves’ in some way. More prosaically, we can understand this as referring to a time when we do not perceive ourselves as separate from these tools, just as we do not perceive ourselves as separated from language.

It is possible to tentatively identify the affordances of these futuristic new tools and possibilities. Augmented mediation of our experience is relatively recent – however, earlier forms have been noted, studied in detail and conceptualized in terms of 'social presence'.

Social presence

Social presence is 'the perceptual illusion of non-mediation' – the feeling that a mediated experience is not mediated (Lombard & Ditton, 1997, p9). As a result, people respond as if the medium is not there. This may be because the medium appears to be transparent, providing a window on events, or because it is perceived as a social entity rather than as a technology. Presence is an illusion that results from the interaction between a medium and its user, and therefore varies between individuals and between contexts. Social presence thus helps us to understand the affordances of augmented learning, because it is the experience of social presence, delivered by electronic devices, that creates and will become a defining feature of the experience of augmented learning.

As we have indicated previously in our discussion of 'fossilization', these newly emerging technological lenses onto our world are only now shifting from being perceived as intrusive, to becoming transparent and near invisible. Language, numbers and images already mediate much of our learning, and this mediation is so pervasive that even when it is brought to our attention, as in the Magritte painting 'Ceci n'est pas une pipe', we have trouble in recognizing that we are seeing paint on canvas, or even a representation of paint upon canvas, rather than a pipe. Mediation also goes unnoticed when the medium is incorporated into our body – we recognize the lens in the telescope or the microscope, but not the lens we wear in our eye. Increasingly, technology is used to supplement our abilities and senses. Given the right technologies we can see in the dark, listen to bats, fly from the top of buildings or use computers to supplement aspects of our brain's functioning. As we incorporate these technologies within our bodies, or extend our bodies to include these

technologies, we shift from a human to a transhuman state. Augmented learning has the potential to employ our future transhuman abilities and capabilities.

Let us consider the characteristics of social presence (Lombard and Ditton,1997) and set them alongside examples of augmented learning. This allows consideration of how these characteristics can be interpreted as the affordances of augmented learning – which uses electronic devices to extend learners' interaction with and perception of their current environment to include and bring to life different times, spaces, characters and possibilities.

Social richness Presence may be characterised by a medium that appears sociable, warm, sensitive, personal or immediate. Augmented learning can make use of our ability to talk synchronously with people on the other side of the world, to share the real-time experience of an Edwardian holidaymaker as presented on Twitter or the daily diary of a soldier in the midst of the First World War as it plays out in the form of a blog. It can employ the teamwork and sense of purpose we share with others in virtual environments, or the feeling of adventure and the joy of discovery that we share with others who are present in the same place, but at different times.

Realism Accurate representations allow us to interact with increasingly realistic objects, events and people. In the virtual world of Second Life ™, avatar Aura Lily used information collated by one of Napoleon's artist engineers to construct the ancient Egyptian Temple of Isis and other buildings on the island of Philae (Ferguson, Harrison, & Weinbren, 2010). The aim is to give visitors 'the feeling of being on Philae back in the time when the paint was still wet on the Temple walls'. The builds do, indeed, look brand new. Visitors can walk around and explore these representations and understand them as spaces where real people lived their lives, rather than the crumbling remains of an ancient civilization. The representation thus offers, in some ways, a more authentic experience than the surviving ruins can do.

Augmented-reality GPS tours of the real town allow users to walk around and explore environments than have been given augmented visual historical overlays.

Transportation Augmented learning can create the sense that you are here, or that I am there, or that we are together. This occurs when learning in virtual worlds, when versions of reality are combined in machinima, and when soundscapes or representations transport learner and educators to other places and new environments.

Immersion is associated with perceptual immersion, which gives the learner the feeling they are in another place, and with social immersion, which provides a feeling of involvement. It is this characteristic which keeps readers returning to the blog of two homeless Sims characters, that prompts them to leave flowers and mementoes on the virtual graves of avatars, and to compose epitaphs for robots.

Parasocial interaction occurs when people respond socially to social cues presented by characters within a medium, even when this is not necessary and no response will be forthcoming. Talking to cartoon characters and shouting at televised soccer matches are common examples. Virtual-world avatars can prompt parasocial interaction even if they are bots guided by artificial intelligence rather than by individual humans, which makes them useful for training and simulation purposes. Games for handheld devices such as *Nintendogs* (first released by Nintendo in 2005) are designed to provoke parasocial responses, and this feature makes such games popular when they are introduced in classrooms. Emotional engagement prompts us to think about characters even when they are absent, and to learn to anticipate their needs, as children do in the case of electronic mini-pets such as *Tamagotchis* (first released by Bandai in 1996).

Medium prompts social response In the case of parasocial interaction, humans respond to cues from characters; we may also respond socially to mediated cues from things that are clearly not sentient. All over the world, plants are tweeting about their current status and

happiness, and thus prompting people to water them. The spacecraft Voyager 2 has around 24,000 Twitter followers learning about our solar system via this medium, many of whom send it messages, despite the craft being 33 years travel from earth and having as its byline, 'I can barely hear you, let alone see you…'

We view social richness, realism, transportation, immersion, interaction and social response as important affordances of augmented learning. They build on the affordances of ICT, and they work alongside, and extend, the affordances of Web 2.0 – participation, distributed expertise, collective intelligence, collaboration, dispersion, sharing, experimentation, creative rule-breaking, relationships, innovation and evolution.

The affordances that educators identify within augmented learning are constructed through their own discourses and aims, and in relation to the context of the augmentation. The affordances they create foreground the things that they value. For example, one might see the 10 affordances of ICT, from Conole and Dyke (2004), as foregrounding directions of influence and power relations between different forms of knowledge, therefore highlighting *relational affordances*. In the Web 2.0 context of developing new literacy practices, Knobel and Lankshear's (2007) affordances foreground 'meaning making' and we therefore see them as *semantic affordances.* The affordances that we identified, building on the ICT (Conole & Dyke, 2004) and Web 2.0 affordances (Knobel & Lankshear, 2007), highlight presence and subjective experience, and could therefore be seen as *experiential affordances*. Later in the book, we introduce a fourth set of affordances relevant to the contexts of learning curriculum topics through augmented-reality technologies. Being able to draw on these different 'sets' of affordance allows us to create a more nuanced discussion of a diverse topic.

In the chapters of this book, we explore the implications of these affordances for learners, schools, educators and communities, and for both formal and informal learning. In each

chapter, we bring together theorized accounts, case studies, possibilities for the future, and the experiences of both learners and educators.

Chapter 2: Augmenting schools

In the next chapter, we consider what is meant by 'augmented reality' and explore the implications – both positive and negative – of its use within schools. Is this engagement mainly driven by the desire to use a cool new technology, or are educators employing the affordances of the medium in order to reap sustained pedagogical benefits? We examine issues and barriers to its use, and look at its affordances in this context

Chapter 3: Augmenting teaching

We then move on to consider how augmented learning – and particularly educational uses of augmented reality – is currently being embedded within schools and universities, and consider the educational merit of various developments. We introduce a method of assessing the affordances of augmented reality systems and applications in education and demonstrate how this can be applied in different cases.

Chapter 4: Augmentation with the virtual

The focus in previous chapters was on the use of augmented reality within education. Here we examine a specific aspect of augmentation, the virtual, and look at how it is used in this context. Virtual environments, tools and communities are all used to support learning by bringing to life different times, spaces, characters and possibilities. Some of these uses appear new and unusual; others are already considered to be accepted practice in educational and professional settings.

Chapter 5: Augmenting informal subject-based learning

The focus shifts here from formal to informal learning, with an emphasis on learners setting their own goals and choosing how to work towards those. This chapter focuses on two related subject areas, history and heritage, and shows that augmentation can be used to inspire, to provoke engagement, and to extend experience. At the same time, it offers opportunities to reflect on and re-interpret our view of the past so that augmentation does not only change the nature of how we study; it also changes the nature of what we study.

Chapter 6: Augmenting learning using social media

Informal learning does not take place in a vacuum; learners need to have opportunities to access expert advice, to encounter challenges, to defend their views and to amend their ideas in the face of criticism. Here we move on to explore the role of social media in augmenting learning, showing how augmentation provides a nucleus around which learning opportunities can coalesce.

Chapter 7: Augmenting collaborative informal learning

The development of mobile technologies that use Global Positioning System (GPS) data to pinpoint geographical location, together with the rapidly evolving Web 2.0 applications supporting the creation and consumption of content, offer great potential for people to engage in informal learning activities that are linked to location. Mobile technologies may support informal learning in a variety of ways. They can provide contextually relevant information; a user can explicitly search for information via online connectivity, or the device can sense its physical location and deliver appropriate information. Here we explore how location-aware mobile technologies, augmented by Web 2.0 social spaces and making use of the affordance of social richness, have enabled the collaborative community activity of Geocaching and how this leisure pursuit has transformed a simple 'walk in the countryside' into a rich, collaborative informal learning experience for its participants.

Chapter 8: Augmenting learners: educating the transhuman

As augmenting technologies develop, they will increasingly form an integral part of our identity. This will affect us all, but is likely to have a particularly profound impact on those who are currently considered to be disabled or to have learning difficulties. We carry out a critical analysis of augmented environments and discuss the ways in which future inclusive education may be reconstructed both by and for transhumans.

Chapter 9: Conclusions, and where to start

We conclude with a consideration of the promise of augmented learning, and the ways in which it may develop in the future. The book ends with a framework for considering the affordances of augmented learning and with an opportunity to try out that framework and consider how it can be used to address learning challenges.