1

Introduction to E-learning Research

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The publication of the *SAGE Handbook of E-learning Research* marks a significant point in studies in e-learning. Although there has been considerable development in teaching and learning, as well as in learning design, there is as yet no coherent view of what constitutes research in the field nor of how best to undertake it. The present volume takes stock of progress in e-learning research, addressing a range of issues from student experience to policy and provides a foundation for further research and development.

By e-learning research, we mean primarily research *into*, *on*, or *about* the use of electronic technologies for teaching and learning. This encompasses learning for degrees, work requirements and personal fulfilment, institutional and non-institutionally accredited programmes, in formal and informal settings. It includes anywhere, anytime learning, as well as campus-based extensions to face-to-face classes. E-learning includes all levels of education from pre-school to secondary/high school, higher education and beyond. The potential for this area is broad. For this handbook, the focus is primarily on e-learning in the formal setting of degree-granting institutes of higher education. However, with many kinds of e-learning and computer-assisted teaching entering all arenas of education, from schools to workplaces, examples from other arenas of education enter into and carry important information for the discussion.

As a working definition of e-learning, the following from the Higher Education Funding Council for England (HEFCE) can serve as a starting point:

> The use of technologies in learning opportunities, encompassing flexible learning as well as distance learning; and the use of information and communication technology as a communications and delivery tool, between individuals and groups, to support students and improve the management of learning.
>
> (HEFCE, 2005: 12)

However, this definition is not an end point, and at points in the Introduction and throughout the *Handbook* we will take issue with some aspects of this initial definition. In particular we take issue with the way the HEFCE definition appears to portray technology as simply a delivery mechanism, and fails to address the co-evolutionary nature of technology and its use. The *Handbook* chapters together help provide a more nuanced and elaborated definition and appreciation of e-learning.

Since the mid-1980s or so we have seen the rapid evolution of Computer-Assisted Learning (CAL) and Computer-Assisted Instruction (CAI) into Course Management Systems (CMS) and Virtual Learning Environments (VLEs). From early forays into the use of computers to assist, or indeed provide the entire basis for learning with particular topics to more recent activities involving VLEs and other custom-designed interfaces, the computer has held a fascination for teachers, lecturers, learning designers and learners alike. At times claims have been hyped: it has been variously claimed that computers would revolutionize learning, bring about the end of the book, put an end to institutionalized learning and/or improve the quality of learning. Rarely have these claims been properly tested. At other times its impact has been overly downplayed, as in the many studies that find 'no significant difference' between face-to-face learning and online learning outcomes. Rarely do these studies look at the more transformative effects of e-learning, such as creating a distributed community, and learning new genres of communication and collaborative work practice. We now appear to be at a stage of development where we can gauge the impact of the computer on learning in a more measured, critical way, as well as taking a more comprehensive view of changes accompanying e-learning. It is in the spirit of such critique, realism, and expanded view that the present volume has been conceived.

This introduction begins the discussion of e-learning research which is continued in subsequent chapters. The introduction addresses definitional issues, taking time to explore the 'e' and 'learning' in e-learning, then theoretical and methodological issues, before presenting a model of co-evolutionary processes of technology and learning.

In choosing to use the term 'e-learning' we have turned away from other names that might equally have been useful, such as computer-assisted learning, technology-enhanced learning, instructional technologies or online learning. To us, these terms fall into the trap that many previous studies of the relationship between technology and learning/education have fallen into, of assuming that learning exists independently of technologies and that in various ways technologies enhance it. The causal assumptions behind terms such as 'technology-enhanced learning' are ones we critique in this introduction.

'E-learning' as a term is a hybrid. Like many compounds, the two elements have worked together to create a new hybrid. Nevertheless, it is made up of two parts: e + learning. The 'e' of e-learning has a longer history than many will assume, including long-term efforts to capture voice and images, and to store and then transmit those recordings. With each capture – from records to CDs, film to DVD, conversation to text chat – there are trade-offs in quality, interactivity, and transferability: trade-offs that mark both the pros and cons of technology mediation. The following section takes us through some of this journey, giving historical and theoretical perspectives on electronic media.

But first we give an example based on the use of one technology – electronic whiteboards, implemented primarily in secondary/high school settings – that shows the kind of work that needs to be done to bring experience with technologies together into a research framework.

AN EXAMPLE OF RESEARCH ISSUES: ELECTRONIC WHITEBOARDS

Symptomatic of the problems facing researchers in e-learning is the case of electronic interactive whiteboards – touch-sensitive screens that work in conjunction with a computer and projector – and their efficacy in learning. The issue is that there is little substantial research on the topic (though see Smith *et al.*, 2005), and yet many schools have installed them in place of blackboards or other forms of large-scale projection in a classroom. Reports are anecdotal, based on perceptions of pro-technology innovators and even of the technology vendors, with reviews of their use describing and justifying, *post hoc*, the use of whiteboards in the classroom. Whiteboards are examined in isolation, without considering their place in the social and technological context of the classroom, or of the evolution of technology and practice over time.

Most of the studies of whiteboards have been small-scale and descriptive, the most in-depth and evaluative being those by Glover and Miller (2001) and Goodison (2002; see also Gerard and Widener, 1999; Levy, 2002). Glover and Miller (2001) report on the views of both students and staff on the impact of interactive whiteboards in a secondary/high school. They discuss and describe the use, teaching and learning implications, problems and potential of whiteboards. They find that the attitudes of teachers towards the use of interactive whiteboards are particularly critical: where teachers adapt their pedagogy, the use of whiteboards has more impact; where they are used as a surrogate blackboard, the impact is less significant. Whiteboards are described as increasing efficiency, enabling teachers to draw on a range of ICT resources fluently and with pace; as extending learning and creating new learning styles stimulated by interaction with the whiteboard (BECTA, 2003b). Because of the role of the teacher, Glover and Miller conclude that training in the use of whiteboards is key to the transformation of classrooms and of the learning experience for

young people. Goodison (2002) used interviews to collect data on the views of primary/elementary school children on the use of interactive whiteboards. Goodison found that whiteboards played a significant role in facilitating classroom instruction, social learning and student engagement with technology. However, it was not clear from this work what effect or impact the electronic whiteboard had on learning. As with many such articles, the results are presented as a positive finding about whiteboards.

In the UK, the British Educational Communication and Technology Agency (BECTA, 2003a) has been appropriately cautious about the research on electronic whiteboards. It acknowledges that they were a relatively recent technology with little research literature relating to them in refereed academic journals. BECTA (2003b) concludes that much of the evidence about the impact of whiteboards on learning is anecdotal, conducted by schools or school boards and local authorities, and carried out on a small scale. That the research is largely qualitative is not a problem, in that such a study could provide key insights into the way an electronic whiteboard is used. But as most of the studies are of the *perceptions* of use (elicited via questionnaires and interviews, anecdotes and personal testimony), and as most of those reporting their perceptions are excited – like pioneers – by the new technology, it is probably too early to say that there is much reliable or substantial research evidence to hand. In a more recent review (BECTA, 2006) the indication is that the installation and use of interactive whiteboards in the UK have spread rapidly, with 93 per cent of primary schools and 97–8 per cent of secondary schools reporting that they had installed such technology (some under political pressure from bodies like the Office for Standards in Education). This review also notes that there has been a pilot evaluation of the use of interactive/electronic whiteboards in mathematics and literacy lessons in primary schools (Higgins *et al.*, 2005), with a more large-scale evaluation of the Department of Education and Skills Schools Whiteboard Expansion program due in 2006/07. The most recent presentation on the latter evaluation at time of writing was by Somekh and Haldane (2006), who report on behalf of a larger project team that they used multi-level modelling of attainment of individual children, based on gains in national test scores, questionnaire surveys, observations of interactive whiteboard training, and digital video classroom observation from ten case study primary schools. They suggest that the interactive whiteboard can act as a mediating tool between teacher and pupils; that its size can excite and motivate children; that it has potential for special needs use; that it can speed up learning as well as provide an archived record of use. Questions are also raised about the nature of interactivity. It could be that this particular Department for Education Skills (DfES) evaluation, when completed, will provide a foundation or benchmark for further study and research on the topic; or, as BECTA (2006) puts it, a 'robust assessment of the impact of interactive display technologies which we currently lack' (p. 11).

Other information on whiteboard use comes from the vendors themselves. In a 'review of classroom case studies and research literature' from the US, the UK and Australia, SMART Technologies (2004) – the self-described 'industry leader in interactive whiteboard technology' (online) – conclude that interactive whiteboards affect learning in several ways:

> They serve to raise the level of student engagement in a classroom, motivate students and promote enthusiasm for learning. In at least one case, the addition of an interactive whiteboard positively influenced student attendance. Interactive whiteboards support many different learning styles and have been successfully employed in hearing and visually impaired learning environments. Research also indicates higher levels of student retention, and notes taken on an interactive whiteboard can play a key role in the student review process. In addition to student learning, observations also indicate that designing lessons around interactive whiteboards can help educators streamline their preparation and be more efficient in their ICT integration.
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> (2004: 3)

The problem with such a review is, of course, that it is not independent. And, again, it is the positive results that are highlighted. Thus, it is unclear what educators may take from such a review in order to make informed decisions about the adoption of such tools. But it is also clear that the technology itself, as well as its use, develops over time. Somekh and Haldane (2006) suggest that teachers were largely confident in the use of the tool because of their daily use of it, which cannot be said of practice even five years earlier in a range of ICTs.

This example shows the potential and the need for various kinds of examinations of e-learning and its technologies. There is room for systematic and independent research reviews on e-learning topics, ones that balance a pro-innovation view with the realities of large-scale implementation. Chapters in this *Handbook* serve as reviews for a number of topics relating to e-learning. There is also substantial room for small and large-scale primary research studies using techniques such as direct observation, control and experimental groups, and longitudinal dimensions. As in the example above, the focus is too often on the new computing technology as a single entity, introduced and used in one way at one time. This ignores implementation and adoption effects, the use of other complementary technologies, and the reciprocal, co-evolutionary nature of the relationship between technologies and learning. These are the kinds of issues addressed when research steps in to make sense of e-learning as a system- and societal-wide change in teaching and learning.

We turn now to beginning the task of addressing e-learning and e-learning research. We start by providing context for the current wave of e-learning technologies, reviewing important trends in recording and dissemination of materials that form the historical background for the 'e' in e-learning, before joining it up again with 'learning'.

THE 'E' IN E-LEARNING

What is the 'e' in e-learning, and what does it mean for learning? The 'e' in e-learning joins many common hybrids such as e-mail and e-commerce in signifying enactment through electronic means, typically interpreted as computer-based. Essential components of all 'e' enterprises are the computer hardware and software, but also the networking infrastructures that make it possible to collect and distribute data, information and knowledge to people at different times and locations. Devices that permit access to these data streams now no longer need to be the fixed desktop computer. The mobility and multimedia capabilities afforded by laptops, palmtops (also known as Personal Digital Assistants, PDAs), mobile phones, and media players (e.g. MP3 players), shatter our notions of where and by what means 'e' activities can take place. Thus, in considering e-learning, we include a range of electronically networked Information and Communication Technology (ICT) via which learning can take place.

While we often find e-learning reified as a particular course management system, its flexibility lies in the way new technologies are quickly appropriated into the e-learning toolkit. This is possible because of continuing efforts to cross hardware platforms. At its basis, e-learning technology, like all other e-enterprises, depends on *hardware* to process digital or analogue *signals*; *software* that can encode and decode, collect, store and forward, and present communications in visual, textual and/or audio *modes*; applications and *systems* that bring together tools to support data storage and retrieval, course management, computer-mediated communication, and collaborative virtual environments. As we will discuss below, equally important in this technological mix are the people who use the systems – teachers, instructors, administrators, students – each bringing to the e-learning enterprise their ideas of how teaching, learning, and communication should be enacted.

Educators have long been appropriating technologies into the classroom, from radio and television, records and record players, video reels and projectors, to today's computers, CDs, DVDs, podcasts, and more. What the digital revolution has done is free the information and its carriers from the classroom, making the information available in ever increasingly mobile ways. What is often forgotten is how each of these technologies performs a slightly different way of coding and decoding data and information, at times enhancing one mode of communication over another, but each changing where and when we receive information and communication. The following presents a brief historical background to emphasize that computing technologies represent the current culmination of many years of electronic encoding protocols and devices, each with its own limits and affordances. Later, we pick up again the notion of affordances to discuss contemporary computing technologies.

Coding and decoding signals

The historical shift from analogue to digital technology has revolutionalized the resources for learning by making material available that is high-fidelity, and which can be repurposed, easily reproduced (within copyright constraints), and reviewed in a number of different modes via a number of different types of hardware. E-learning, as we define it in this volume, could hardly be imagined without the digital shift. The vast majority of electronic information, in the broad, technical sense of the word, is now transferred in digital form. In the UK and US, for example, there are plans to switch the entire broadcasting of television to digital format (by 2010 in the UK and 2009 in the US).

The translation of a message via digital coding generally makes for less interference and thus better quality of the communication. Indeed, since such recordings can be made without even travelling through the vibrating air, e.g. from a digital piano direct to the recording device, they represent more 'purely' the origin of the sound. However, such 'purity' can come across as clinical, without the attendant sounds that accompany live music, such as the performer's breathing or the audience reaction. The analogy for e-learning is that an instructor's words, flawlessly typed into text for distribution to students, can fail to convey the enthusiasm they express verbally, the pacing they use to present the text, and the gaze they use while speaking. However, an advantage of digital coding is that the original message can be reproduced on an infinite number of occasions, without the deterioration that takes place in the course of translation through repeated use of the kinds of materials that tend to be used with analogue recording, like vinyl or tape. Similarly, the instructor's words remain available, distributable and reproducible long after the lecture presentation has taken place. Thus, at the recording and transmission level, there are differences in the kind of message and translation of communication that occurs, and that are likely to have an impact on e-learning.

Digital recording is now not only easy to do, but easy to disseminate. Neither tapes nor CDs need to be distributed to remote sites; nor is specialized equipment (beyond the computer) needed to decode the recording. There are a few caveats. First that non-specialized and widely available recording and playback equipment provides a generic representation without the fidelity available in dedicated, high-end technologies such as those for audio, photography, or film. However, one might argue that this has always been the case, since high-fidelity recordings have for a long time been played back on simpler, less expensive, stereo equipment. In the Computer Age, this issue may be more important because of more widespread, low-fidelity, data recording devices that combine with wide dissemination, e.g. cameras in cell phones, audio recording in laptops, and movie capability in digital cameras. Media production is changing from high fidelity/low number to low fidelity/high number. Dissemination is changing from specialized and controlled to widespread and grass-roots.

Second, newer translations from full-screen to smaller handheld or mobile phone interface truncate and reinterpret text and visual representations (both in sending messages, e.g. by Short Messaging Service (SMS), and in receiving them, e.g. in receiving Web pages on very small screens). Whereas dedicated technologies formerly ensured that decoding was approximately the same for all receivers (within the range, say, of the size of a television screen, or quality of record-playing audio equipment), current message receivers may be using markedly different decoding schemes. This is an issue not just for formerly analogue messages. Information produced and published on the Web may appear differently depending on the colour palette of the computer screen, the Web browser in use, the size of the window and the operating system of the computer. What *you* see on retrieving from the Web is not necessarily what we see from the Web.

Third, the ubiquity of computer access and the expectation that 'everyone, everywhere' can have equal access to digital signals must be questioned: we are not yet at the stage where broadband capabilities are equally available. Service arrives late to low-population areas; wireless may be taken for granted in some cities and on some campuses, but this is by no means a universal service; and cell/mobile phone signals can be limited by geography and terrain. As well as technical obstacles, cost can be a significant barrier in the acquisition of computers as well as of Internet services. The digital divide remains a real issue within societies and particularly internationally (see Gorard and Taylor, 2005; Haythornthwaite, this volume).

Modes of communication

Communication signals can carry sound, text, and images. These major forms of communication are often called, metaphorically, 'languages'. The aural and visual modes translate directly into sounds and moving and still images; the textual mode is, interestingly, based on an aural code (speech) but given visual form (text, letters). 'Text' is thus an abstracted, second-level symbolic system, a highly powerful medium or mode of communication that is itself hybrid. It can be conveyed visually and/or through sound and has, through history, manifested itself in various languages, each using different symbolic representation systems (e.g. Latin, Greek, Sumerian, Mandarin). The term 'text' can also be used to refer to multimodal texts as well as to linguistic texts.

Text is of particular importance for e-learning because not only is education heavily weighted toward the use and production of texts, but e-learning increases the textual load with conversations and interactions occurring largely through the texts of chat rooms, blogs, e-mail, bulletin boards, etc. Notions of Asynchronous Learning Networks (ALN), prevalent since the mid-1990s, stress near-exclusive use of text-based postings. It is only recently that proponents of ALN have begun to see this as a supplement or extender to face-to-face interaction, in ideas of *blended learning* (see below). This despite the fact that

programmes which have long been including synchronous and oral/aural components have found the interactivity and ability to hear others as the main attractions of real-time meetings on e-learning (e.g. Haythornthwaite and Kazmer, 2004). In e-learning in general, text has led the way, partly for technical considerations (e.g. slow Internet connections lead to video and even audio delays that make real-time interaction unworkable) and partly because the educational emphasis on text tends to place audio and video modalities second in importance and relevance.

As Stuckey and Barab suggest in this volume, to move away from single, text-mode communication for e-learning requires both social and technical planning. Multimodality occurs naturally in face-to-face settings, transparently combining visual, oral, aural and other physical cues with immediacy of communication.[1] Not so online. E-multimodality or multimedia must be planned, making choices between presentation via text, audio and/or video connection, as well as working out the social logistics of synchronicity, turn taking, and cross-modal interaction (e.g. live audio with text chat for questions, recorded video with audio questions and asynchronous text response). However, as multimedia options expand online, e-learning can move away from the notion that to learn something must be to abstract it, classify it, and simplify it. Instead, learning could be conceived as a framed activity, that entails bringing to the frame an open mind, willingness to learn, and a degree of concentration necessary to learn. In addition, learning would be expressible or (more likely) recastable in a different medium or media; and thus assessable, if necessary. Whole experiences may be captured and disseminated in multimodal formats, including moving image, sound, and text. However, the ability to include everything, from everywhere leads quickly to information overload. Like the writer Borges's mnemonist, we would need whole days to evaluate others' experiences of whole days. Thus, issues of selectivity come more to the fore, particularly in choosing what real-time capture to spend time viewing.

Information and communication technologies

In considering the 'e' side of e-learning, we need to address the products that have been made to store, access, and use information and which support the information and communication activities of e-learning. Computer use in e-learning is, at the most immediate level, experienced via software. Computers run on operating systems, like Windows, Linux or MacOS which provide the basic architecture. Specific software packages for particular purposes, like word processing, games, and spreadsheets created by commercial enterprises or collaborative efforts in open source computing, run on the foundation provided by the operating system. Collections of applications are then brought together into single environments – virtual learning environments, Collaborative Virtual Environments (CVEs), course management systems – with a common look and feel that signifies entry into a particular set of norms, practices and participants.

Computer interfaces provide the *entré* into online environments. At their best for information access they are easy to use, follow known conventions, are consistent, and support both the novice and advanced user; at their best, for communication, they allow seamless interaction with others through computers rather than with the computer. This is not the place to recapitulate the extensive work in human computer interaction (HCI; see, for example, Nielsen, 1994; Carroll, 2002), but it is the place to point out the importance of the interface in the user's experience of the e-learning environment. Upcoming research issues include not just what the best computer interface is for particular learning environments, but also how these will scale to handheld devices, provide interoperability between devices, and convergence of technologies on single devices (e.g. laptops, palmtops and third-generation (3G) mobile phones).

Before computing, our electronic communication devices included the phone (dating from the 1870s), radio (1890s), and television (1920s). The advent of the computer (1940s) and its desktop (early 1980s), laptop (late 1980s), palmtop (1990s), and PDA/3G phone (2000s) versions have brought increased and extended mediated access to information as well as, more recently, convergence with communication devices. In particular, the palmtop computer (or PDA) and third-generation (3G) mobile phones are converging, not only using advanced digital technology to access and use all three modes of communication described earlier (text, sound, image), but also to function as radios and televisions. Of course, none of this mobility would be possible without the rise of network infrastructures, including phone networks, computer cable networks, and wireless networks, as well as the accepted standards for communicating along these networks and rendering data on devices. Again, the history is too vast to discuss here (for further reading, see, for example, Abbate, 1999).

These multimodal devices suggest the future for ICT and e-learning. However, at present, they are little used. When we refer to e-learning and ICT, it is still, at this early point of the twenty-first century, the (increasingly wireless) desktop or laptop computer that is central to our concerns. While the small display features of palmtops and mobile phones may not be the major platform for e-learners, their existence suggests trends in how, when, and where we access information and communicate with others. These general trends cannot help but affect the habits of e-learners and thus also of e-learning instructors and administrators. (For more on mobile learning, see Sharples, Taylor and Vavoula, this volume.)

As well as the technology advances noted above, ICT for e-learning also includes many new and emerging technologies specifically designed to support learning activities. These include in-class tools such as the electronic whiteboards noted above; large tablet displays that accept and project writing on top of pre-formatted data so notes can be added during presentations; and clickers used by students to vote for their answers to questions. Added to these are the new online games used as media for learning and communication (see McFarlane, this volume), immersive technologies for virtual world and whole-body interaction,

and blogs and wikis as media for class writing and collaborative writing. We note these few here to highlight the rapidly expanding technological base that is evolving in conjunction with learning both in and outside the traditional classroom.

Features and affordances

Technologies are useful to the extent that they allow users – instructors, students, administrators – to achieve their goals. Sometimes technology facilitates application in education, sometimes it inhibits it. In discussing the use of technology, many analysts turn to Gaver's (1996) use of the term *affordances* (following Gibson, 1979; see also Norman, 1988) to make the distinction between the explicit features of technology and what these allow or facilitate for users. Explicit features of ICTs include such things as whether multiple modes are supported; whether design is for single or group use; whether interaction is effected through the keyboard, mouse, joystick or glove; whether data storage and retrieval occur to and from the Internet or on the local desktop. What a technology affords are ways of communicating and connecting with others, being visible in the online context, viewing and using data and information, creating and displaying content, and linking with others and with resources.

Affordances signify the possibilities for users, but, for these to become reality, systems must actually be used. Yet, in keeping with much that has been written about the adoption of technologies (Rogers, 1995), users may resist new uses, may not know how to use new features, or may avoid them as too complicated or incompatible with previous practice. Some of the affordances listed above are *social affordances* that provide possibilities for awareness and coordinated action with others (Bradner *et al*., 1999). These affordances may be particularly difficult to enact because users need to work together to create collective uses that are of benefit to the group as a whole. In these cases, some users may need to lead use by seeding a shared database, starting discussion and activity on a listserv, or modelling communication behaviours until a critical mass of users and behaviours is established (Connolly and Thorn, 1990; Haythornthwaite, 2002a, b, 2005; Markus, 1990). Social affordances are of particular relevance for e-learning since instructors strive to be aware of students and their contributions, and collaborative learning advocates promote the advantages of peer-to-peer awareness, exchange, and engagement (e.g. Bruffee, 1993; Koschmann, 1996; Koschmann *et al*., 2002; Miyake, this volume). Thus, rather than looking only at the features of a medium, it is important to examine what these features mean for users of the environment.

As an example of this issue, we take the key feature of asynchronicity and see what this affords for communication and e-learning.

Asynchronous technology and its affordances for e-learning

Perhaps one of the most talked about characteristics of computer-mediated communication and, one might argue, the most transformative is the ability to carry on conversations asynchronously. To be completely correct, asynchronous communication is in fact an affordance based on systems designed to store and retrieve messages. Computer technologies such as e-mail, listservs, bulletin boards, blogs, and wikis store messages for retrieval, review and response at times of the user's making. For the user, these each afford anytime communication. Depending on the availability of computing and networks, they can also afford anywhere communication. The applications differ in their affordances for routing messages specifically to others. For e-mail, unique identifiers for senders and receivers route messages to just the specified audience. In listservs and bulletin boards, posters are identified, but receivers may gain access more generally by entering passwords to view all posted information. The same is true of postings on blogs and wikis, although their use is more prevalent without password protection and thus anyone with computer and Web access can view the posted information in the same way as other kinds of Web pages.

These differences across these media may appear subtle, but each system affords different visibilities of messages, senders, and audience, which in turn afford different kinds of uses. E-mail affords privacy and control of readership (notwithstanding legal precedence for access to e-mail archives), which in turn may encourage discussion of more sensitive, personal information. Bulletin boards provide threading, grouping topics as they are discussed, affording easier review of message history. Blogs afford easy posting to the Web and a stage on which to perform for a broad, unspecified audience. Identifiers for senders and receivers may range from a set of anonymous-looking numbers to user-selected 'handles' that afford self-expression about identity or character. They may be easily traceable to the actual individual or provide protection from actual identification. Individuals may use one or many identifiers to present themselves to others, deliberately or by accumulation maintaining multiple identities within one type of medium (e.g. as we keep multiple e-mail addresses on various e-mail servers). Groups of receivers may be indicated by single names, e.g. when sending to a listserv address, obscuring whether the message is being sent to a few or many others. Thus identifiers can afford anonymity, role playing, and disguise, and can equally afford open identification.

Contemporary computing has made it possible to use many kinds of devices to interact with servers where messages are stored. This affords *mobility*. A poster no longer needs to be hardwired from their desktop to the institution's servers, but instead can access systems on and via the Web, through wireless communication initiated on their laptop, palmtop, or mobile phone. Mobility of individuals also means *distribution* of participants. Online engagement of this kind does not specify how many learners can be in the engagement at any one time, nor where they are embedded at the time they are members of the learning

community. They could be accessing the engagement for different periods of time each, from different machines (desktop, laptop, palmtop, phone), in different situations (café, home, hilltop, bus, etc.) and in different locations around the world. This affords the opportunity to bring in experiences from these different locations and suggests the ability to apprentice locally at the same time as obtaining education remotely. Thus the notion of 'situated learning' (Lave and Wenger, 1991) is not abandoned, but instead is given new identity through e-learning. It now operates at two levels: the local embedding, potentially leveraging an apprenticeship (see Kazmer, this volume) and the online embedding, creating an apprenticeship in the ways and means of online interaction and in the online practices of a future professional or interest-based community. Thus the 'situation' provides a dual education – in the subject and the online environment (Haythornthwaite *et al*., 2000) – and the potential for a dual apprenticeship in the local and online communities. Such contextualizing will come into play again later in this chapter, when we address theoretical issues.

ICTs also afford a new rhythm of interaction, one that differs from face-to-face and classroom dynamics. Many find the new rhythm liberating, but others decry the loss of immediacy. What underpins much of the discussion of the pros and cons of asynchronous, distributed education is the degree of *interactivity* provided by these various modes and means of communication. Interactivity can best be characterized by depicting a spectrum of degrees relating to both what the technology affords for the granularity of interactivity and interactivity among participants in online communities.

Interactivity with ICT devices ranges from low-degree – as occurs in interactive television or touch-screen panels, where operations are limited to a few functional buttons – to a high degree of interactivity, as might be found for situations in which virtual reality headsets and hand controls provide fine-grained manipulations. Typical practice in the use of a computer interface would be somewhere between these two extremes, but such interaction is often taken for granted. It is usually mediated via a conventional typewriter-derived keyboard (though there are other kinds, like concept keyboards). The user's input, whether via a keyboard or via a point-and-click mouse, is a significant limitation on the degree of interactivity possible. A mouse, for example, can point only to operations that have already been programmed into the computer; whereas a keyboard allows the textual possibilities of language to be exploited. However, a keyboard can be a barrier to communication for those who find its operation cumbersome (e.g. those with physical disabilities). In such cases, speech recognition technologies might yet prove to play a major part in interactivity. However, although available for some time, such technologies have yet to attain a sufficient degree of sensitivity to the varieties of the voice to become easy-to-use and reliable interface devices, and they have not yet become standard with a computer purchase.

This approach to interactivity describes the affordances of the technology, but interactivity also has a social, communicative dimension, one that may or may

not be achieved in practice. Interactivity can depend on the immediacy of question and response. This is inherently delayed in asynchronous settings compared to synchronous settings. Yet social norms about response times and social practices to respond in a timely manner go a long way to increasing the perceived interactivity of online communication. Rafaeli and Sudweeks (1997) use the term 'interactivity' to address responsive behaviour in communication, viewing this as a likely process that explains cohesion in online groups. As they state,

> Interactivity is not a characteristic of the medium. It is a process-related construct about communication. It is the extent to which messages in a sequence relate to each other, and especially the extent to which later messages recount the relatedness of earlier messages … Interactivity describes and prescribes the manner in which conversational interaction as an iterative process leads to jointly produced meaning. Interactivity merges speaking with listening.
>
> (online, n.p.)

Thus key issues to bear in mind regarding interactivity are not only what the technology affords for iterative and respondent processes but also the extent to which responsiveness is actually achieved using the medium.

Overall, posting messages for storage through contemporary networked computing affords the presentation of self online, sometimes anonymously and always pseudonymously (at least to the extent an e-mail address is a pseudonym), usually abiding by group communication conventions, and originating from any computer device, located anywhere with Internet access, at any time of the day or night. These are the essential elements bound up in the terms 'asynchronous communication' and 'asynchronous learning'; it is the reason the area is called *asynchronous learning networks*, signifying the computer network, but perhaps more importantly the social network that sustains learning efforts (Harasim *et al*., 1995; Hiltz, Turoff and Harasim, this volume). Thus, more than anytime, anywhere input, it is anytime, anywhere access to a community where conventions and common interests reside and where individuals pull together to define the way their community will work. We will return to the notion of the community of enquiry below, when we consider the 'learning' side of the e-learning equation, and when discussing theoretical models.

Beyond asynchronous

Text-based asynchronous communication is not the only option for e-learning. As outlined above many new technologies make it possible to include audio, still and moving images into e-learning offerings, both from the instructor side, with formally produced audio or video, and from the student side, with informally produced pictures, audio, and video. Also as noted, including multimodal communication in e-learning requires planning. It also requires an understanding of the affordances that make such planning worthwhile. This is an area of research that deserves more attention from a learning perspective and that can inform the introduction of new media into e-learning offerings.

Synchronous communication is found in many e-learning environments, including text, audio and video transmissions. Audio-conferencing has been with us for a while; new meeting software systems and better networking infrastructures now make video-conferencing a reality for multiple participants at multiple sites (e.g. Internet2 in the US, http://www.internet2.edu/). Synchronous text-based interaction is most prevalent and most available at present. Internet chat, instant messaging and more recently the short message text (SMS) available on mobile phones are examples. Text chat is used in e-learning for live class sessions that permit all participants to type and enter comments simultaneously. This kind of interaction underpins popular multi-player games (Multi-User Dungeons or Dimension, MUDs) and is increasingly used for online conferences. Extensions add graphical interfaces to create virtual worlds for gaming (Massively Multiplayer Online Roleplaying Games, MMORPG; and Virtual Reality, VR), which are also being adopted and adapted for education.

Not only new technologies, but also new venues are opening up for e-learning. Where e-learning inherits from distance learning (see Thompson, this volume) it is taken to be synonymous with online interaction only, happening away from educational settings such as classrooms. However, the continued penetration of Internet use into everyday life, combined in some instances with increased familiarity with online education, has led to a reverse trend of incorporating online features into on-campus classrooms. This trend in *blended learning* is developing strongly as students entering higher education are increasingly computer-savvy and highly conversant with online communication.

What is emerging is a *spectrum of different combinations of e-learning with conventional learning*. The term 'blended learning' has appeared to indicate practices that sit in the middle of the spectrum between online, distributed approaches at one end and traditional, face-to-face teaching at the other. At the distributed end, a course or programme can be entirely delivered and engaged with electronically. Every stage of the process of learning, from enquiry about the course to registration, from access to the materials to their use, from the submission of assignments to their marking, and so on to the final award of the degree or other qualification, could be handled electronically, via a computer interface. Such engagement could include synchronous communication or it could be handled without any synchronicity. In theory, as well as in practice, a course or programme could replicate the notion of the correspondence course in which the learner acted individually and had very little contact with teachers, lecturers or fellow students.

Moving along the spectrum, many online programmes build some face-to-face interaction (i.e., including physical proximity as well as synchronous engagement) into their schedule of largely electronic contact. For example, a programme might begin with a short residential course in which the learning community (lecturers, students, administrators) get to know each other, engage in joint learning and set up contacts and allegiances which they will develop electronically while taking the degree. They might meet again for a week after

one year and again for a week towards the end of the programme. Such a pattern is a type of blended learning. However, nothing is actually blended in such a model. Rather, there is a combination of types of learning situations.

A mid-point on the spectrum would be a course or programme that was divided fifty–fifty between e-learning and conventional learning, in whatever forms those types of learning took.

Towards the other end of the spectrum, e-learning can be used as a support for more conventional types of learning. An example would be a conventional undergraduate programme that provided reading material, a chat room, feedback facilities and e-mail contact with the lecturer or tutor in support of the programme. The Internet is there as a resource for electronic searching; some programmes provide guides or portals to enable students to access relevant databases, Web sites and other resources.

Finally, at the far end of the spectrum is conventional learning, by which we mean non-electronically mediated learning, fully offline, requiring no Internet access, online communication or online resource delivery. Even as we write we cannot imagine such a situation for higher education. Only retreats beyond the reach of Internet access and without the power to recharge portable devices could now fit this bill. As for fully online learning, we imagine the benefits of including use of ICTs in learning will be best achieved when attention is paid to the affordances of the technologies. Again, there is much research yet to be done on looking at these affordances for learning.

We end this section on e-learning by emphasizing again the need to consider the way technologies have modified – for better or for worse – the way information is recorded, stored, disseminated, and reviewed. E-learning as a whole is no more or less of a transformation than the one that takes place when knowledge is packaged for conventional learning and disseminated in a physical classroom; it is, however, a different transformation, and that is what we are all in the throes of living through and researching.

We turn now to address the 'learning' side of the e-learning enterprise.

THE 'LEARNING' IN E-LEARNING

The second element in the 'e-learning' equation is *learning* itself. While this is not the place for a consideration of the various theories of learning *per se*, it is necessary to say briefly what we mean by learning. We recognize that there is already much material on learning theory relevant to e-learning (e.g. work on collaborative learning, Bruffee, 1993, and computer-supported collaborative learning, Koschmann, 1996), and discussion of this and the nature of (e)learning will take place in the chapters of the *Handbook*, particularly those on modes and models of learning, and communities of learning. Here we highlight four general aspects of learning.

First, learning is a personal and social/political *transformative* act in which new knowledge is gained by the learner. The degree of transformation is critical to the kinds of learning that will take place. For example, the learning of a new fact by rote may in itself constitute a fairly minor transformative function, and thus be seen as learning to a small degree (accretive, gradual, a step forward). However, at some point such a small step might afford a more extensive vista. The analogy is the poet Alexander Pope's: that learning is like climbing a mountain, often in the mist. Steps are small, uphill, and hard work; but every now and again larger vistas open up, each one more extensive than the last. When such an expansive vista opens to the learner, the transformation can be said to be greater. The nature of the transformation can be purely intellectual, and/or it can be (a combination of) emotional, spiritual, physical.

Second, although learning is experienced by the individual, it is essentially an *effect of community*: not only is knowledge generated and preserved by a community throughout history, it is also learnt as an effect of being part of a community (Bourdieu, 1986; Crook, 2002; Haythornthwaite, 2006 Rogoff, 1990; Vygotsky, 1986). Some of the knowledge will be tacit, some will be explicit. The kinds of communities in which knowledge is made and transferred are varied: some are relatively informal, like families and peer groups; others are institutionalized and formal like schools or universities. Knowledge is packaged differently in these different communities, and also gained and tested differently. It is one of the main preoccupations of the present *Handbook* to define and explore the electronic communities in which e-learning takes place, considering them in relation to non-electronically mediated communities but also moving beyond a polarized distinction between online and offline communities to chart the new territory of e-learning. Indeed, this latter topic is a major area for research in e-learning, both theoretically and empirically.

Third, in order to distinguish it from experience, the transformative aspect of learning takes place in relation to *bodies of knowledge*. This does not mean to say that all knowledge is outside the learner because learning may take the form of enhanced self-knowledge; but it does mean that the learning is given definition by the way it transforms the learner in relation to knowledge of some kind. Hence learning and knowledge are inextricably related. To be able to say 'I now know that …' is to acknowledge that learning stands in relation to what was known before by the individual learner and also in relation to what is known and recognized as knowledge by a wider community.

Fourth, in keeping with the transformative and community aspects of learning, we add that knowledge is not simply delivered to a learner. The transformative act creates *new knowledge* that is the product of a learner's (or learners') research and exploration in territory previously unrecognized or uncharted. But this journey is not taken alone. New knowledge is tested against the world – the physical world, the social world, or the mental world of others' ideas – and so modified through practice, discussion, use, and interaction (Cook and Brown, 1999; Engeström,

1999a, b). In this interaction we find the community action on learning as a whole and knowledge development for all members of the community.

Of the four aspects of learning, it is probably the second – the nature and effect of the community of learners – that is the most distinctive in an e-learning environment. It is here that notions of distance learning come to the fore (as they had already in extension classes in the late nineteenth century; and via correspondence courses, for example those of the UK's Open University from the 1970s). E-learning allows the learners that make up a community to be far-flung in terms of physical distance, but also, as discussed earlier in this introduction, to operate asynchronously as well as synchronously. The fact of physical distance between learners and a lecturer/teacher, mediated by chat rooms, Web logs, e-mail, and other forms of group communication, means that: interaction can be recorded for future reference; learners operate largely from their computers or mobile devices; that physicality is largely absent; text, image, and sound provide the major modes through which communication happens; co-learners in the community may never meet face-to-face; the learning experienced is not situated in the physical, contextual ways we have come to expect; and contexts outside the classroom probably play a larger part in the learning experience than might be the case in a traditional programme or course conducted on the premise of regular, co-located, face-to-face meetings.

FROM 'E' + 'LEARNING' TO E-LEARNING

We have discussed the 'e' and 'learning' in e-learning, but this separation to discuss the technical, computer-based means of delivery and social perspectives on learning must now be recombined to consider the social and technological construct that is e-learning.

E-learning

E-learning is not a computer system. You cannot buy it off the shelf and plug it in. You cannot hand it to network administrators and be done with the job. To have an e-learning system means having *people* talking, writing, teaching, and learning with each other online, via computer-based systems. While e-learning is usually found implemented via a suite of software tools, such implementation is only the surface of the e-learning environment. E-learning encompasses any and all means of communication available to participants, from dedicated course management systems to late-night phone calls and e-mail in the early hours of the morning, from instructor-prepared lectures to collaborative products generated through discussion boards, blogs and wikis. E-learning is a leaky system; it spreads to take advantage of any and all opportunities for communicating, learning, and seeking resources, and, like an invasive species, turns up in many places not traditionally associated

with formal instruction – the kitchen table, coffee shop, workplace, hotel room on corner of the bedroom. Through instructor and student push-and-pull, e-learning colonizes new technologies and new spaces, with each new generation of technologies providing, but also creating demand for, new kinds of delivery (e.g. gaming environments, podcasting based on MP3 players, video streaming and mobility inherent in cell and mobile phones, PDAs, and laptops).

The question then remains – what does define and distinguish e-learning? The HEFCE definition cited at the start of this chapter is a good starting place, but some modification is needed. E-learning *needs to be more than* the 'use of technologies' and it *is more than a* 'communications and delivery tool … to support students and improve the management of learning'. At its best, e-learning is a reconceptualization of learning that makes use of not only instructor-led pedagogy but all the flexibility that asynchronous, multi-party contribution can bring. At its worst, e-learning is a substitution of one delivery mechanism for another; but even such implementations will be overwhelmed by the demands and expectations of users (both instructors and learners) and will change through social contracts, disuse, and idiosyncratic use. E-learning is *continuously emergent*, emanating from the possibilities of ICT in the hands of administrators, instructors, and learners, and created and recreated by use.[2] The forms and shapes of technology, learning, and technology-in-use for learning co-evolve, one pushing, pulling, and modifying the other.

This co-evolutionary view emphasizes the social and emergent nature of e-learning, i.e., the way people, operating with and through ICT, in communication and interaction with others, form what e-learning means. This is the core of our definition of e-learning. As such, it puts stand-alone learning programmes at the periphery; although successful learning can result from computer-based learning systems, such as self-paced tutorials, these are not centrally what e-learning is about. Similarly, use of ICT for resource delivery is not e-learning even though it is part of the e-learning phenomenon, just as delivery of books is not teaching although library collections are part of the learning activity. Teaching and teaching presence are essential parts of e-learning (Garrison and Anderson, 2003) and thus e-learning is more than delivery alone. Finally, e-learning is not (just) computer-mediated communication, in the same way that learning is not (just) conversation, although both are important in e-learning as a whole. The directed, purposeful pursuit of understanding, with resultant changes in knowledge, skill and/or practice, are inherent in learning and thus also in e-learning.

E–learning is a complex, multi-faceted phenomenon. Its scope includes the entirety of the social and technical system, from administrative decisions to systems developers, curriculum designers, and learners at the kitchen table. A range of educational systems and practices falls within e-learning. Children and adolescents are addressed in K-12/pre-school to senior high school/sixth-form online teaching and learning, as in virtual high schools (e.g. Zucker *et al*., 2003); young and not-so-young adults are addressed through full- and part-time education in community

colleges, training colleges, post-secondary undergraduate and graduate programmes. E-learning includes formally structured, degree-based programmes, as well as non-degree, continuing education programmes in museums, art galleries and other locations; and in proprietary in-house corporate training systems.

E-learning may be implemented to take advantage of as many technologies as possible, or only a few. Thus we include in e-learning single application additions to traditional teaching, such as electronic voting systems that add interactivity to large face-to-face lectures, online discussion added to on-campus courses, and myriad other blended learning configurations. E-learning may involve students and faculty geographically located on or off-campus, at a distance from each other and campus, or distributed with no corresponding physical campus. Distance may be as close as the local dormitory room, or as remote as thousands of miles away, from sites accessing the latest in Internet connectivity to those with less than perfect networking capabilities. Indeed, defining the campus may be a challenge, not only for locating the physical home of an online university, but also where rapidly emerging, multi-institutional programmes include students enrolled from many different campuses.

Social processes and technology

Researchers have been examining the interplay of social processes and ICTs for many years, building on a foundation of study of social processes and workplace interventions that include the 'time and motion' studies by Taylor (1911), the wiring room group behaviour studies by Roethlisberger and Dickson (1939) and the longwall miners studies by Trist and Bamford (1951) and the Tavistock group. These studies laid a foundation for identifying the importance of context in the presentation of technology in use and the recognition that similar technologies will take dissimilar forms depending on the social, political, and institutional contexts in which they are implemented. This has become known as a 'socio-technical systems' approach. It is popular in management for jointly optimizing the social and technical systems in the workplace.

With the advent of computing, the socio-technical perspective became an important approach for understanding changes in work practices brought about by the implementation of computer systems (see Whitworth's chapter in this volume). As researchers looked at early computing systems they noted a number of issues that still factor into contemporary uses and presentations of ICT. These are reviewed briefly here because the history of the progression of computer systems provides background to the kinds of processes seen in current systems and helps tease out where effects of ICT on learning may be found.

Early computing systems were designed with the primary purpose of automating office processes, reproducing paper-based systems for the maintenance of records and automating the production of statistical reports. Terms like

'electronic data processing' captured the essence of these computing applications. However, as Zuboff (1988) observed, these systems began to *informate* as they automated. With the rise of computing also came a rise in the observability of processes; and then of systems to process these observations, including statistical analyses and benchmarking of human performance. Zuboff eloquently demonstrated the impact of this computerization on individuals at work. Clerical workers who had worked in social groups now found themselves isolated at computer terminals, entering data on their own. Their productivity could now be assessed in terms of keystrokes. The *social impact* of this instance of computerization was both the isolation of data entry personnel and increased monitoring of the minutiae of performance.

Technological determinists see such changes as the inevitable outcome of technology, with human activity shaped by the technologies that are imposed on them. Others see technology use as more malleable and affected by strategies of individual or joint human action: strategies such as non-use, or more complicated appropriations of the technology to local contexts (Danziger *et al*., 1982; Rice and Rogers, 1980; Rogers, 1995; Rogers *et al*., 1977). These two sides are often portrayed against each other – technology determining social behaviour, or social behaviour determining technology – with neither technology nor social behaviour changing. This approach to computing followed earlier work in management trying to find the best *task–technology fit*, where the technology was the kind of organizational structure and process most appropriate for the manufacturing task at hand (e.g. Thompson, 1967), taking into consideration the nature of the incoming raw materials and the needed transformation process to create outputs (Perrow, 1970) and the context in which the work took place (e.g. contingency theory, Lawrence and Lorsch, 1967).

This idea of looking for fit was transferred directly to examination of computing implementations because the data management capabilities of information technologies (IT) reconfigured organizational structures and processes. For a while there was an effort to explore computer system–organization fit, including communication–technology fit (Daft and Lengel, 1986; Trevino *et al*., 1990). Studies of fit in the computing arena are best summed up in notions of *organizational validity* and *invalidity*, used to refer to how well the computing system corresponded to existing organizational structures and what could or should be done about it (Markus and Robey, 1983; Noble and Newman, 1993). Noble and Newman (1993) in particular noted that where fit was not made, the system could change, the people could change, or both could change. The socio-technical systems approach to computing emerges from this kind of observation: aligning social practices and technological support in the service of work outcomes is the essence of socio-technical systems evaluation, an approach that begins to make headway in thinking about systems design and implementation.

But, it is not enough to view the problem as one of accommodation, of making technology 'fit' the social or vice versa, or even of simultaneous adjustment, in part because this assumes a knowing observer, and relatively stable and

identifiable social/technical conditions. However, the rapid development of computing technology, at first the personal computer revolution and now the mobile technology revolution, have pushed change ahead of planned fit, making developers out of users. Grass-roots movements such as Usenet, the Web and open-source software show that systems and use have a general, societal-level implementation that is under the control of no one organization or entity. New practices are emerging at a societal level that influence what can be done, and what is expected, within any organization or institution.

A number of systems design approaches emerged during the 1980s and early 1990s that have strongly influenced approaches to computerization. These include workplace studies that articulate everyday workplace processes, using this as input to systems design that better reflects actual practice (e.g. Luff *et al*., 2000; Suchman, 1987), participatory design that brings the user into the design process rather than leaving the process to systems specialists alone (also known as user-centred design, e.g. see the work by Pelle Ehn, Morton Kyng) and shared cognition, with its emphasis on joint processes of learning and collaboration (e.g. Engeström and Middleton, 1996; Resnick *et al*., 1991 and Whitworth in this volume, who suggests that the social shaping of technology can be a contested process). Systems development has changed from *a priori* definition of all operations in a sequence of systems analysis, design and implementation to more responsive and flexible design techniques such as rapid prototyping and scenario-based design. Whole sectors of computer science have emerged to engage with human–computer issues, such as Human–Computer Interaction (HCI, or CHI) which centres on interface design (e.g. Nielsen, 1994; Carroll, 2002), and Computer Supported Co operative Work (CSCW) with its attention to systems for working jointly with others in and through online applications (e.g. Baecker, 1993; Bannon and Schmidt, 1991; Crabtree *et al*., 2005; Schmidt and Bannon, 1992; see also the proceedings of the CSCW and ECSCW (European) conferences). Research in Computer-Mediated Communication (CMC), which examines behaviour in and through computer media (for a review, see Herring, 2002), owes much of its heritage to the initiators of the CSCW field with their focus on understanding social processes and collaborative work on the way to designing support systems.

Examination of computing systems has also inherited from historical and sociological studies of technology, particularly in areas known as Social Studies of Technology (SST), Social Studies of Science (SSS) and Social Construction of Technology (SCOT). Work in this area is not limited to computers; some classic work has looked at how the particular design of bicycles we know today came about (Bijker, 1995). These areas look more broadly at how science and technology are constructed in society, and how this works with, and affects, society. Reviewing this area is beyond the scope of this chapter, but the attention these researchers give to the shaping of technology is an important construct for considering the place and presentation of e-learning technologies, and should

prove a useful resource for researchers interested in this perspective. (For further reading, see, for example, Bijker *et al*., 1987; MacKenzie and Wajcman, 1985; Pinch and Bijker, 1984; Williams and Edge, 1996).

Collectively, these approaches have provided a more holistic view of systems development: one that sees the social and technical sides of computerization not as two immutables in tension, but as two forces each shaping the other. As a whole, these new approaches to development and analysis of the unfolding of systems, plus the co-evolution of social and technical practices, are being gathered under the name *social informatics*.

Social informatics is one of two theoretical perspectives we find particularly relevant for e-learning. The other is rhetorical theory, which focuses on the relation between speaker, audience, and subject matter. Both of these are discussed at length in the next section as we turn now to look at theories that inform an e-learning research agenda.

THEORETICAL BACKGROUND

As noted at the outset of this introduction, our aim here and in the following chapters is to address the transformative effects of e-learning with a focus on research problems and challenges. In defining and building a research agenda for e-learning, it is necessary to find the theoretical base that informs evolving processes in a rapidly advancing technological environment, yet also addresses the kind of transformative activity that is entailed in e-learning and e-learning communities. Some key questions can be asked. What theories are useful for examining and understanding e-learning? Where does e-learning research fit in terms of theory? What are the parameters of the field? What are or will be our theories of e-learning? Is research conducted *about* the technology or *via* the technology – or both? These questions are essential for the conduct of research programmes, whether at masters and doctoral level or in terms of larger-scale joint research projects.

We make a start here on describing theoretical frameworks for e-learning. We do not attempt in this *Handbook* a 'grand theory' of e-learning, as we feel that the field is not in a sufficiently mature state for such theorizing; however, at the end of the section we present a number of questions that will help research move toward an overarching theory (or theories) in the field. Other chapters in the *Handbook* continue this theoretical framing. There are yet more theories that may prove useful for understanding the e-learning phenomenon coming from the fields and sub-fields of education, information science, communication, computer science, management, psychology, and sociology, to name a few. While we begin the process here, we expect more and new theories to be brought to bear on e-learning in the future.

As far as the electronic dimension of the field goes, communications theory and social informatics provide important perspectives. Communications theory is not a coherent field with a competing and/or convergent set of theories underpinning it. Rather, it draws on contemporary rhetorical theory and other sources to map out the nature and functions of the communicative acts that take place. Thus we begin with outlining the basics of rhetorical theory.

Rhetorical theory

Late twentieth-century thinking in the field of rhetoric sees it as an overarching theory that has a long tradition (Corbett, 1965), is grounded in historical and political change (Eagleton, 1983), has a pragmatic, Aristotelian pedigree rather than an idealist, Platonic one (Vickers, 1988), is centrally concerned with the arts of discourse (Andrews, 1992) and, through ICT, is intimately connected with democracy (Lanham, 1992) and argumentation. Contemporary rhetoric is concerned with the relationship among three key elements: the speaker/writer, the audience, and the subject matter. This communicative triangle (Kinneavy, 1971) enables exploration and definition of the purpose of the communicative act, as well as the possibility of investigation of the means by which the communication takes place. A key term in contemporary rhetoric is *dialogue*, deriving from the Greek for *through speech/logic* rather than from any notion of two people speaking.

Rhetoric can be used to analyse communication once it has taken place and also to predict (in ancient and medieval times, to *prescribe*) the patterns and means of communication that might be necessary in a particular situation. Behind such an understanding of the nature and purposes of communication is the philosophy of Habermas (1984), with his theory of communicative action and the function of argumentation (a subsection of rhetoric) in a society to bring about consensus before action.

Why is rhetoric a useful foundation for considering what happens in e-learning? All e-learning is contextualized, as suggested earlier in this introduction with reference to the work of Lave and Wenger (1991). It takes place in particular situations. Describing the contingencies and particularities of those situations is important because not all e-learning *acts* are the same. E-learning varies the relationship among the elements of speaker/writer, audience, and the 'thing to be communicated'. For example, a single teacher, lecturer, or course e-tutor may at one time address a whole class of e-learners; at other times, the communication may be one-to-one; and at yet other times, a single e-learner may send a message to the class as a whole on a bulletin board or as part of an ongoing dialogue. While these patterns of communication are no different in some respects from their face-to-face versions, the asynchrony available to e-learners potentially makes for a more reflective dynamic. Critically, from the audience's point of view in rhetorical theory, the reader/student/e-learner is more in control of the rhetorical process. Readers can choose when and whether they will respond to others or to the communication.

Rhetorical theory has already been used as a platform for understanding online communication. Studies have applied rhetorical concepts such as genres and discourse communities (Bakhtin, [1953] 1986; Frye, [1957] 1969; Miller, 1984, 1994; Swales, 1990) to online communication (Bregman and Haythornthwaite, 2003; Cherny, 1999; Orlikowski and Yates, 1994; Yates and Orlikowski, 1992). Concepts such as speech–act theory (Austin, 1962; Searle 1969) have been applied to the formalization of communicative action and design of communication systems (Flores *et al*., 1988; Malone *et al*., 1989; Winograd and Flores, 1986). However, this application has not been without controversy because of its overdetermination of actions (see Suchman, 1994; Winograd, 1994). Genre, rhetorical, and linguistic approaches also underpin the new rhetoric of *persistent conversation* (Erickson, 1999), which situates online communication somewhere between speech and writing.

Thus, rhetorical theory, with its basis in purposive communication and its recent application to communication via ICTs, is an important starting point for applying theory to e-learning. In what follows, we draw on Kinneavy's communication triangle as a basis for exploring e-learning. The discussion shows how the simple triangle of interaction between speaker, audience, and communication, when considered in relation to evolutionary processes of language, technology and purpose, shows a dynamic system, modified and modifiable by communicators' actions. The ideas echo those of others who point to the emergent nature of communication and technology use in group settings (e.g. Poole and DeSanctis's (1990) ideas of adaptive structuration which builds on Giddens's (1984) structuration theory; see also Monge and Contractor, 1997; Orlikowski, 1992).

To explore the emergent nature of communication in e-learning, we start with Kinneavy's (1971) basic notion of the communicative triangle, which is depicted in Figure 1.1: An adaptation of Kinneavy's model for e-learning (Figure 1.2) adds elements associating the writer/speaker with the teacher, the audience with the learners, and the body of knowledge with the 'substance of communication' or the 'thing to be communicated'.

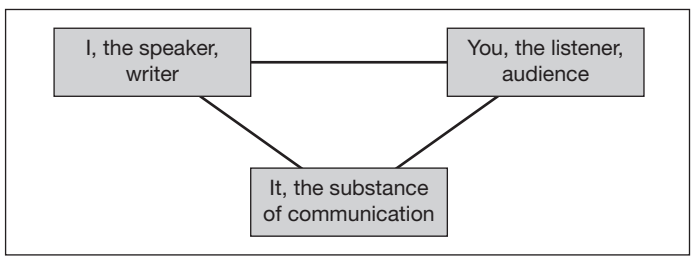

Figure 1.1 Kinneavy's (1971) model of communication

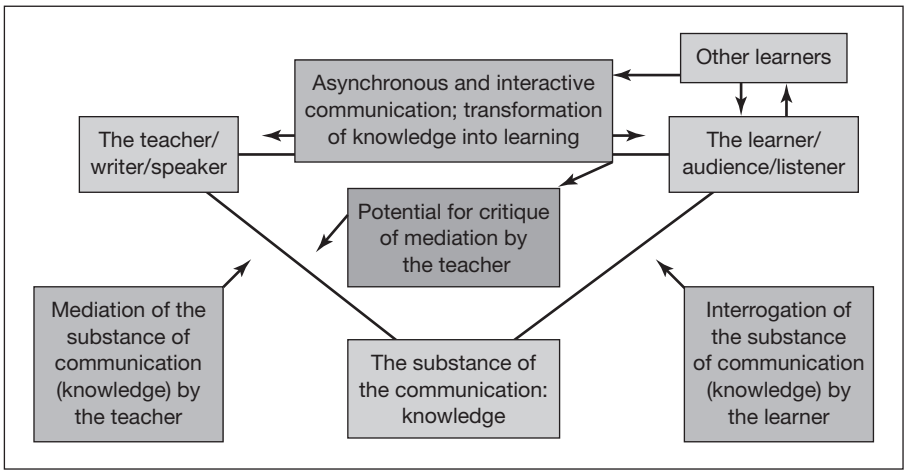

Figure 1.2 Adaptation of Kinneavy's (1971) model

In this adapted model, learning is conceived as a dialogic and dialectical exchange, not only between the learner and the teacher, but also between the learner and the body of knowledge that is being explored. Whereas, in Kinneavy's original model, the 'audience' was relatively passive; in this model the learner as audience is in a more powerful, active position in relation to the social dynamics of learning. He/she can even critique the teacher's mediation of existing knowledge, as indicated by the box in the middle of the communicative triangle. Furthermore, he/she is part of a community of enquiry with other learners.

This model not only retains the communicative element in e-learning, but provides a way of understanding how the individual learner positions him/herself in relation to a community of learners, a teacher/lecturer, and a body of knowledge. The *communicative* dimension of e-learning is an essential foundation to studies in the field. Moreover, although the model might just as well apply to learning, the asynchronous possibilities of exchange between learner and teacher, and between learner and co-learners, enables reflection to become an integrated part of the actual dialogic interaction between the participants *while in the process of learning*. Such reflection is possible in a conventional, face-to-face classroom, but the immediacy of the classroom environment and its many contextual cues – lecturer at the head of the class, students in desks, black/whiteboards and projectors, the presence of other students – and our natural reluctance to tolerate silence in face-to-face settings weigh against reflection during class sessions. But asynchronous communication as well as synchronous computer-mediated communication provides and tolerates a much longer lag between question and response, an expectation of silence, and a lack of visual scrutiny while thinking, all of which affords reflection in the learning process.

Another aspect of communication theory that might be helpful in understanding the use of language in e-learning is that made by Austin (1962) in *How to*

Do Things with Words, where he makes the distinction between locutionary speech acts – 'sayings' – and illocutionary acts (and their perlocutionary effects) in which language performs an 'action' or 'does something'. Although the distinction itself was critiqued by Searle (1969), it remains a potentially useful one in that it enables distinctions to be drawn between different types of language use in e-learning. For example, there is a distinct difference between online synchronous 'chat' on the one hand, which has a social as well as communicative function, and asynchronous dialogic exchange on the other, where there is less emphasis on the social and there may be less attention on the building of a co-constructed understanding of a particular phenomenon. There is considerable potential for studies in speech-act theory and e-learning in that the 'map' of communication exchanges in e-learning is yet to be fully charted.

Furthermore, Kinneavy's adapted model or other theoretical attempts to chart communication in relation to e-learning can be further adapted in order to better describe, explain, and analyse the rhetorical dimensions of e-learning. There are many research projects to be undertaken here and there is much exciting work to be done.

Social informatics

> *Social informatics refers to the interdisciplinary study of the design, uses, and consequences of ICTs that takes into account their interaction with institutional and cultural contexts.*
>
> (Kling *et al*., 2005: 6)

Social informatics provides another theoretical foundation for addressing e-learning, deriving not so much from rhetoric and communication theory as from the sociology of contemporary culture, particularly where it intersects with computing use by groups, organizations, communities, and societies. A few studies of e-learning using this perspective are just beginning to appear (e.g. Dutton *et al*., 2004; see also Haythornthwaite and Kazmer, 2004).

Many fields contribute to the social informatics perspective. Sociology has provided background pertinent to the study of information systems and e-learning in studies and theories about diffusion and adoption of innovations (Rogers, 1995), social construction and social shaping of technology (e.g. MacKenzie and Wajcman, 1985; Williams and Edge, 1996), activity theory (Engeström and Middleton, 1996), social networks (Wellman and Berkowitz, 1997) and actor networks (Latour, 1987). Perhaps not as well integrated into social informatics, but of particular importance to e-learning is work on literacy, particularly online literacy (Andrews, 2004; Hawisher and Selfe, 1999), language (Clark, 1996; Crystal, 2001), linguistics (e.g. Cherny, 1999; Herring, 2002) and genre (Bregman and Haythornthwaite, 2003; Orlikowski and Yates, 1994). Also important are many different approaches to community from social network definitions (Wellman, 1979,

1999) to discourse communities (Miller, 1994; Warschauer, 2000), knowledge communities (e.g. Collins, 1998; Knorr-Cetina, 1999) and communities of practice (Wenger, 1998). Studies in sociology, linguistics and communication have contributed to our understandings of community and its manifestation online (Baym, 2000; Cherny, 1999; Haythornthwaite *et al*., 2000; Kendall, 2002; Warschauer, 2003; Wellman, 1997; Wellman *et al*, 1996), as well as how offline communities are affected by online interaction (in studies of community networking initiatives and an area of research now often referred to as *community informatics*, e.g. Bishop, 2000; Cohill and Kavanaugh, 2000; Keeble and Loader, 2001 see also the studies in Wellman and Haythornthwaite, 2002).

New systems of social relationships

These many studies and theories share a common focus on the way new technologies change social interaction: with new language, meeting places, means of meeting, and meaning of associations. Castells (2001), for example, argues that 'a new system of social relationships centred on the individual' (p. 128) is emerging, in which the individual creates his or her own individualized communities in a society which creates emphasis on the individual through the relationship between capital and labour, between workers and the work process, and 'the crisis of patriarchism, and the subsequent disintegration of the nuclear family' (p. 129). Although individual networks have existed for a long time, supported through letters, travel by car and plane, and the telephone (Wellman, 1979, 1999), the Internet in particular has been cited as supporting (and creating) such individualized sociability (Wellman, 2002; Wellman *et al*., 1996; Wellman *et al*., 2003), with consequent positive or negative effects (e.g. Kraut, *et al*., 1998; Kraut, Kiesler *et al*., 2002; for a review, see Haythornthwaite and Wellman, 2002). The Internet is effective in maintaining weak ties and perhaps also instrumental in creating the space or the opportunities in which strong ties can be made stronger (Haythornthwaite, 2005). Online communities, suggests Castells (2001), 'are better understood as networks of sociability, with variable geometry and changing composition, according to the evolving interests of social actors and to the shape of the network itself' (p. 130). (For a review of social networks and online community, see Haythornthwaite, forthcoming-b.)

Although Castells (2001) does not address issues of e-learning *per se* in his book, the implications for networked communities of learners are clear: e-learning communities are social communities of a different kind from conventional learning communities, which may allow the individual to assert him- or herself more at the centre of a range of networks. Although the individual and his or her learning are defined by those networks, it is also the case that he or she defines the networks. A number of e-learning researchers have begun to examine networked aspects of ties built in association with e-learning (e.g. Aviv *et al*., 2003; Cho *et al*., 2002; Haythornthwaite, 2002a, b; Hrastinski, 2006; Saltz *et al*., 2004). These studies hold promise as a theoretical platform on which to build e-learning research.

Exploring the nature of e-learning communities, Haythornthwaite and Kazmer (2002), in presenting findings about on- and offline relations for e-learning, discuss the claims and counter-claims that the Internet both 'reduces involvement with those whom we share strong, local, interpersonal ties, taking us away from face-to-face involvement and potentially decreasing our well-being' and also 'is seen as providing the means for increased contact with others' (p. 434), for example with those with whom we share an interest, such as co-learners in a distance learning programme. They argue that often each side of the argument has been simplified, the truth of the matter being in elaborately textured networks of strong and weak ties that change in time (weak ones faster than strong ones). The Internet is seen, not so much as a social world, 'but as a medium through which we have the opportunity to maintain our multiple social worlds' (p. 442).

Scott and Page (2001) see learning communities as 'social spaces, physical and/or virtual, within which users are invited or enabled to engage in a shared learning process, while respecting the diversity of their knowledge base' (2001: 152). If, as Scott and Page suggest, learners in such an environment 'are encouraged to set their own learning goals' (2001: 152) and if such networks encourage and support individualism, then there are interesting questions to be asked about the nature of the common experience of e-learners: in particular, can it be said that an e-learning programme can set such goals itself, or should it err on the side of the individuals setting their own goals? As ever, some kind of balance has to be struck; it may be important to determine exactly what the possibilities of balance are in any e-learning context. Loader (1997) provides further discussion of the governance of cyberspace. One of the many interesting aspects of that discussion pertains to notions of information polity or informationality, with clear connections to the nature and accessibility of knowledge, its location (on- or offline) and its use. Mere accessing of information may not, in itself, be akin to learning; some transformation of the material into new knowledge for the individual must, we think, take place if such activities are to be called 'e-learning'. Thus the term 'e-learning' becomes something greater than the sum of its parts, inviting research and examination in terms of an independent phenomenon rather than a re-purposed version of offline learning.

From social informatics to educational informatics

Extending the principles of social informatics into the learning sphere leads logically to the adoption of the term *educational informatics*, as Levy *et al.* (2003) have done. They define the domain of educational informatics as: 'the study of the application of digital technologies and techniques to the use and communication of information in learning and education' (p. 299) and the main concerns as twofold:

> First, research in educational informatics seeks to understand the effects on people of using digital information (re)sources, services, systems, environments and communications media for learning and education. It examines the issues and problems that arise from their

> practice and how these relate to factors such as educational and professional context, communication and information practices, psychological and cognitive variables, and ICT design and use. Second, it seeks to contribute to the development of practical knowledge that is relevant to diverse forms of ICT-supported learning.
>
> (Levy *et al.*, 2003: 299)

In reviewing how computer systems have been received, there are many parallels in the receipt of learning technologies. For instance, unquestioned technological or social deterministic views hold back an effective transformation to e-learning. Teachers may avoid online teaching because they feel constrained by the technology (a technological determinist view, resisted through non-use), or they may come online expecting to transfer existing teaching practices wholesale to the online enterprise (a social determinist view, expecting no change in their pedagogy). But neither approach serves the long-term interests of educators and neither approach can be maintained for long. In the former case, student use and demand for technology plus campus initiatives to 'keep up' with the technology use of other campuses will remove the option of non-use for teachers; and in the latter case, as has been shown from many studies, simple transfer from offline to online does not make good pedagogy – teachers interested in good pedagogy learn to modify their practices in accordance with the online environment.

There are parallels in the way computerization automates and informates e-learning in the same way it has done for other operations. Formerly transient and ephemeral processes are now routinely recorded as part of the delivery process. Conversations, discussions and lectures that remain in digital records facilitate asynchronous participation, but their persistence also allows interrogation and review. They create a source of information about the course progress and conduct. As Berge (1997: 15) notes, an 'interesting line of research involves the fact that computer conferencing programs can produce complete transcripts of all interactions they have mediated. These transcripts are a rich data source.' Beyond research, however, they are also an interesting source of data for monitoring, accountability and benchmarking.

Paralleling the concerns described by Zuboff of workers cut off from human contact (see also Kraut *et al.*, 1998, for similar concerns about Internet use), many conceive of e-learning as an individual working alone at their computer. What is different now is that the isolated student is just as likely to be carrying on conversations with many others via class discussion boards, e-mail and whispering, moulding and forming the communication dialogue they prefer. Invisible to the outside observer is the communication that goes on between students, and between students and instructors, as the student sits 'alone' at their terminal, as well as the actions they take to initiate and sustain that interaction. Perhaps now we should say that computers automate, informate, and 'communicate' (in the sense that computers facilitate communication). The turn from HCI to CSCW marks a turn from humans interacting with computers to interacting with others

through computers, an observation made early in relation to education in a collection of papers concerned with computer-supported collaborative learning (CSCL; O'Malley, 1989). In that volume, Bannon connects ideas from CSCW with CSCL, describing the computer's role 'as a medium through which individuals and groups can collaborate with others' (Bannon, 1989: 271; see also Crook, 1989; Kaye, 1991, 1995). These interests in collaboration have led to the development of more all-embracing systems developments for supporting knowledge work, such as collaboratories (also known as collaborative virtual environments, Finholt, 2002) which lead naturally to the idea of collaborative learning and collaborative learning environments (Lunsford and Bruce, 2001).

Bringing together rhetorical and social/educational informatics perspectives

If rhetorical theory and social/educational informatics provide some theoretical basis to the field, what are the field's parameters? How do we know what is included and what is excluded from research in e-learning? Our answer comes from one aspect of discourse theory that itself derives from sociological theory: the notion of framing. Put simply, any research study needs to be framed in some way: it needs to define its boundaries, state what area it intends to cover and provide a 'map' (literature review) of the field.

Tannen (1993), in *Framing in Discourse*, traces the concept of framing back to Bateson's 'A theory of play and fantasy' ([1954] 1972). Bateson, she suggests, 'demonstrated that no communicative move, verbal or nonverbal, could be understood without reference to a metacommunicative message, or metamessage, about what is going on – that is, what frame of interpretation applies to the move' (p. 3). The notion of framing – itself deriving metaphorically from the framing of paintings in the visual arts or other forms of art, like theatre and its framed spaces – has been taken up by researchers in communication and psychology, anthropology, and most notably in sociology in Goffman's *Frame Analysis* (1974). As far as rhetoric and the arts of discourse go, it is a central organizing principle of communication. (See also Engeström and Middleton, 1996, on activity theory and complex systems theory.) Frames are systemic (political assumptions, ideologies, historical tendencies), concrete (a school, other institutions), genre-based (socially habitual forms of communication, like debates, conversations) as well as 'inside the head' – a kind of cultural programming. Frames can be transgressed as well as observed. They can also be imposed by others. Such imposition can be made directly or through technologies and/or organizational structures which make it literally impossible to do things in certain ways.

In terms of the field of e-learning research, what frames are brought to bear in its interpretation? We could posit these as technical, sociological and pedagogical. *Technically*, there now appears to be no limit to what is possible in terms of connectivity. Wireless connection, access grid technology, and broadband Internet

connection allow multimodal communication between two or more people. There is the possibility of synchronous and asynchronous communication, albeit without physicality and with the constraints of access to equipment, networks and the technical skill required to make such connection reliably. *Sociologically*, the dispersed, sometimes international nature of communities of enquiry makes for distributed learning, often more informally than has been the case in the past. *Pedagogically*, the teacher comes and goes in the class – a presence which co-ordinates, directs, supports, and challenges the learners. It could be said that the relation between teacher and learner has the potential to be equalized in e-learning, with authoritative, canonical positions adopted by teachers less likely to be accepted by learners; on the other hand, anecdotal evidence suggests that a teacherly presence and/or leadership is important for sustaining the group. Whatever the precise and specific dynamic of an e-learning community, the nature and power (and extent) of networks becomes more telling and more influential in the nature of the actual learning that takes place. Rogoff (1990) has suggested that 'learning is an effect of community'; that is, what we learn is a read-off or affordance of being part of a community, whether that community is a school, family, street corner, club, society or looser group of friends. Essentially, without a community of some sort, the learning that arises from involvement in it cannot take hold. Community, therefore, is a *sine qua non* of learning. To adapt Rogoff's (1990) phrase for the twenty-first century and in particular for e-learning, learning becomes an effect of computer *networked communities* rather than an effect of local, geographical community.

It is exactly at the point where questions are asked about networked communities of practice that current theory in e-learning begins to break down. Questions that suggest themselves for future work include: What do we mean by a community of enquiry? How do e-communities relate to situated, real-world communities? (see Kazmer, this volume) What kinds of community experience are best suited to high-quality learning? Where and what are the boundaries between being, and acting in the world, and learning? What could an ecology of learning mean, and, once defined, how would e-learning fit into it?

A central theme emerging from such questions is the relationship between the social control of learning and individual agency in learning. From the identification of such a theme – one that is not confined to e-learning, but which applies to learning more generally – further questions arise. When engaged in e-learning, what are you learning? Whose model of learning and whose selection of knowledge are you adopting? What are the unexpected consequences of the drive for e-learning initiatives, such as the continued exclusion of non-ICT users? What is the digital divide (see Haythornthwaite, this volume) in terms of access to and use of ICT in learning?

This is a short list of questions, and there is much scope for examination. As said above, this is an exciting time to be exploring this phenomenon. To help in that exploration, we turn now from theoretical considerations to issues of methodology and method.

METHODOLOGICAL CHALLENGES FOR E-LEARNING RESEARCH

Methodologically, e-learning research requires inventive approaches. The complexity of e-learning situations cannot always be easily described, let alone investigated and analysed. In this section, we explore some of the difficulties of finding the right methodology (overall approach) and methods (techniques) for researching e-learning; we also propose some possible solutions. In particular, we are concerned to point out that conventional approaches to research in education may not be adequate to the task in hand; and that finding appropriate methodologies may be more important than discovering new methods. More specifically, we think that one-way models of research (the simple causal model in which an intervention has an effect on an existing state of affairs) and two-way models ('there is a symbiotic relationship between technologies and learning') need to give way to reciprocal co-evolutionary models of the relationship between the 'e-' and 'learning' in e-learning research. In order to demonstrate an emerging model, we will use the specific case of research into the relationship between ICT and literacy education, scaling up the model to apply to research into e-learning.

One of the problems with research in education – and it no doubt applies to other fields of enquiry too, and to research in particular disciplines – is that the object of research is often framed too simply. To put it more precisely, the object of research is conceived of as a single entity that is affected or influenced by one or more factors or variables. Such a single entity is often the focus of whatever method or methods is/are used to understand it and to shed light on it.

Whichever approach we take, the problem of a single entity on which we are focusing remains. It is, perhaps, a vestige of what is assumed to be a 'scientific' approach to the investigation of a single entity – something we try to isolate, by controlling variables, in order to understand it. However, conceiving of e-learning situations in terms of their singularity will not help us progress far in research terms, because the very nature of e-learning is enmeshed within social and informational contexts of the kind we have described in the theoretical section of this introduction.

To explain our emerging sense of what is needed in e-learning research, we start with the example of studies of the relationship between ICTs and literacy development. We suggest that the lessons learnt from trying to interrogate this relationship at the level of literacy development can be scaled up to apply to learning in general and thus provide a more powerful methodological model for the future of e-learning research.

The remainder of the introduction articulates a model for examining e-learning that incorporates elements of rhetorical, communication, and social informatics theories. This model has been developed by Andrews, and was first presented at conferences in 2005 (Andrews, 2005a, b).

Modelling e-learning processes

If we are interested in the effectiveness of a particular intervention – say the computer interface – on some educational outcome – say learning development for 5–16 year olds, or for undergraduate students – we could set up a controlled experiment in which we try to isolate and measure the impact of the intervention from effects from all other variables. Or we could study the case of a single pupil, or a group of pupils, or the equivalent at undergraduate level and undertake a holistic study in which we embraced all the variables or factors that were at play in order to get a better understanding of what was going on with our particular case. In the former approach, the methodology is exclusive; in the latter, it is inclusive.

What most researchers and reviewers of research have been asking to date in the field of ICT and literacy education in schools is 'What is the *impact* of ICT on literacy development?' When it has been hard to pin down exactly what is meant by 'impact', researchers have narrowed the aperture to ask a more precise question: 'What is the *effect* (or effectiveness) of ICT on literacy development?' and thus narrowed the attention to controlled trials, and randomized controlled trials where they can be found (see Andrews, 2004; Andrews *et al.*, 2002; Andrews *et al.*, 2005; Burn and Leach, 2004; Locke and Andrews, 2004; Low and Beverton, 2004: Torgerson and Zhu, 2003). Rather than discuss this and other research, we will depict the progress from the one-way model of research methodology – which we now find too limited for our purposes – to a dialectic and longitudinal model that is appropriate for the study of e-learning in higher education and other contexts. The progress from conventional approaches to cause–effect study through to a new model is depicted through stages.

In the stage depicted in Figure 1.3 the relationship between an intervention (x) and the phenomenon which it affects or has impact on (y) is basically causal; x is assumed to be unchanging, but its arrival on the scene, its presence, its actions make a difference to y. Most studies in the field of ICT and literacy education have used this model in the 1980s and 1990s and indeed into the first part of the twenty-first century. In fact, most short-term evaluations are of this nature (of which there have been many in the field of ICT's impact on literacy and other aspects of education since 1980 or so; see Tweddle, 1997). The most reliable and highly controlled experiments of this kind are randomized controlled trials, which, by controlling for wayward variables and randomizing participants to experimen-

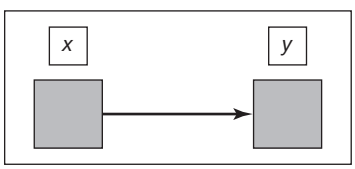

Figure 1.3 One-way model of causality. This model assumes the impact or effect on *x* and *y*. It assumes that, although *y* is affected by *x*, *x* remains unchanged

tal and control groups, can claim to say something about the causal relationship between *x* and *y*. Discussions of the nature and complexity of causality are often put aside in such research projects, as they would interfere with what looks like a relatively simple model. We all know this model: it is one of a number of default models in educational research, often removing considerations of context from a study in order to identify an internal and single causal relationship.

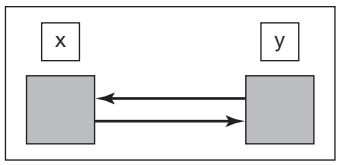

Figure 1.4 Two-way model. This model assumes there is some kind of *dialogic* relationship between *x* and *y*. In other words, although *x* may affect *y*, it may also be the case that *y* affects *x* – perhaps to the same degree, or perhaps to a lesser extent (or even, possibly, to a greater extent). In studies in literacy development the relationship has been described as 'symbiotic' by Haas (1996)

While the one-way model provides a starting point, neither life nor learning stops after one interaction. Thus, we build on to the one-way model a reaction or simultaneous action of *y* on *x*. Figure 1.4 shows that the relationship between *x* and *y* is complicated by the fact that the reaction of *y* may have a bearing upon *x*. This relationship can be described as symbiotic, in that the two parties or entities affect each other, with each adapting to the other's characteristics. It is a two-way process; indeed, each party comes to depend on the other. For example, the advent of word-processing software may have affected writing practices, but writing practices in turn have affected word-processing programmes. Word-processing software has evolved from its earlier simplicity to include features permitting tracking changes, adding editorial comments, and reformatting documents. But such features do not entirely arise from the technology; they were practised by scribes in the medieval period and are part of writing process practice that re-emerged in the work of Graves (1983) and others (e.g. Andrews and Noble 1982) in the early 1980s. In this case, writing practices have had a backwash or informing effect on software design, thus enabling the inclusion of tracking and other editorial devices in the word-processing packages.

Co-evolutionary model

The model depicted in Figure 1.4 is closest to what Haas (1996) calls the *symbiotic* relationship between ICT and development. This acceptance of a two-way process in the interaction between ICT and learning, in our model, can be scaled up to a two-way process in understanding the relationship between any two phenomena, as long as there is some degree of mutability in both phenomena.

However, symbiosis is not the appropriate term to characterize the relationship between ICT and learning development, nor any scaled-up dialectical relationship between mutable phenomena. The problem is that *symbiosis* is essentially conservative, i.e., a symbiotic relationship is one where the two parties try to preserve and conserve the equilibrium that they have reached. Such conservatism clearly isn't the case with the relationship between ICT and learning, nor in most dialectical, developmental situations. So, in order to reflect more accurately what goes on between the two phenomena, it is necessary to move towards a model that biologists call 'reciprocal co-evolution'.

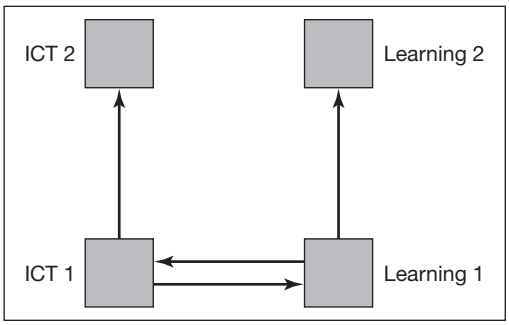

Figure 1.5 Co-evolutionary model, stage 1. Both ICT and learning change in time. What counts for ICT in 1990 is different by the year 2000, and again different in 2010. Similarly, what counts as being a learner also changes.

For the moment, let us concentrate on the internal dynamics of the relationship, though it is obvious that there are external factors at play in bringing about change in ICT and in learning. Figure 1.5 introduces a temporal dimension into the relationship. In research terms, it would be characterized as longitudinal. In the fast-changing world of information and communication technology, what counts as standard one year is not the same as what is standard a year or two later. If we compared 1980 with 1990, and then with 2000 and 2010, for example, we would register considerable change in the ICT field, not only in terms of what is available, but also in the degree of accessibility to that technology. Similarly, what counts as learning also changes (though more slowly) and educational changes – in curricula, classroom design, social practices within schooling, etc. – tend to follow even more slowly. Rather than complicate the model at this point, the educational contexts and the individual growth of the learner are left out, though they clearly have a bearing on the learning that takes place and they also change over time.

Thus, methodologically, any study of the relationship between ICT and learning needs a dialectical as well as a temporal dimension if it is to give a full account of the relationship. Figure 1.6 depicts the fact that a new state of affairs has come about – which we have called ICT 2 and Learning 2. There is not only a new 'two-way' or quasi-symbiotic relationship between the two phenomena, but there are also

backwash or delayed influences, indicated by the diagonal arrows. For example, the use of Microsoft's PowerPoint as a presentational tool was extensive in the first part of the first decade of the twenty-first century, even though other presentation software or approaches were available (e.g. through the creation of a Web site with hot spots to reveal information, using hypertextual principles). As individuals 'discovered' PowerPoint and added it to their repertoire they operated at different levels: plain slide presentations using given templates; the creation of individual and/or corporate templates; the introduction of images; the introduction of moving images and/or sound; the creation of hot spots to automate links to Web sites. Presenters often back up their electronic presentations with acetate slides for an overhead projector. 'New' technologies and practices, like presentation through a Web site or PowerPoint, thus backwash on to older technologies and practices.

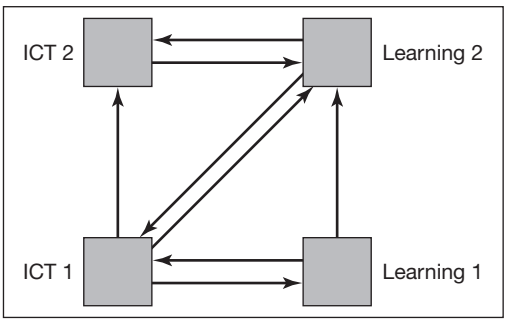

Figure 1.6 Co-evolutionary model, stage 2. Both ICT and learning change in time, but so do the learners as they grow up and develop. A new 'symbiosis' is established at ICT 2 and Learning 2; but there are also residual influences

Such residuality, backwash, and consolidation are important both for ICT development and for learning development. As suggested earlier in this introduction, residual technologies take their place in relation to new forms of learning rather than being replaced by them, creating a new economy in communicative and educational practices. To put it another way: old technologies and practices don't necessarily disappear as new technologies come along. They are absorbed, added to, or find their place, rather than being replaced. Their place is determined by the economies of use: the key rhetorical principle of what is or are the best medium/media of communication in any particular situation and set of circumstances. So, as indicated in Figure 1.6, ICT 1 may have effects and impacts on Learning 2 and (perhaps to a lesser extent) vice versa. The emergent complexity of the model is shown in Figure 1.7.

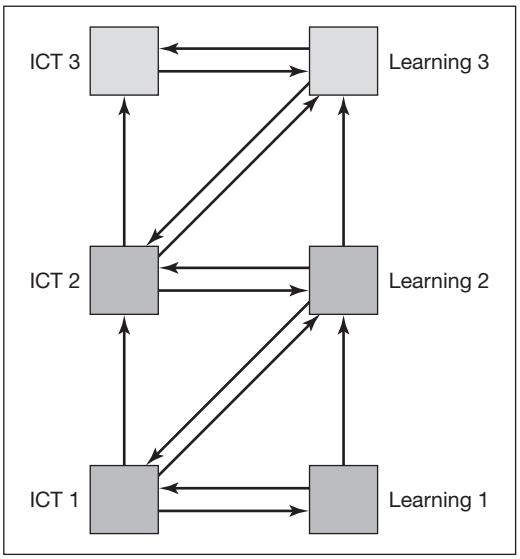

Figure 1.7 Co-evolutionary model, stage 3

The diagonal effects can also be from an advanced state of ICT development in relation to less advanced states of learning development, as shown in Figure 1.8. Here we have the almost fully-fledged model describing the complex of relationships between two entities that are both developing in time. The figure also

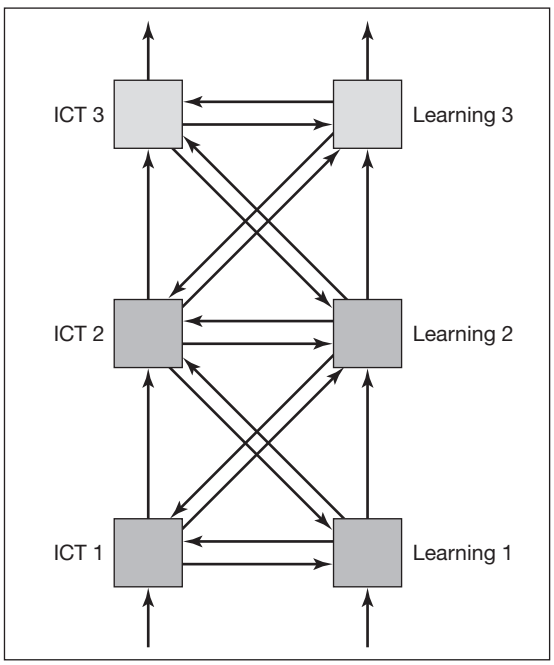

Figure 1.8 Co-evolutionary model, stage 4

suggests that each of the entities brings a history with it and that both are likely to continue changing into the future. To put it another way: every new form of ICT runs through old ways of use until new forms – many of them hybrid – are found.

The value of the co-evolutionary model is that it can provide a framework for studies in ICT and development of learning practices. While research studies may concentrate on only one aspect of the model – for example, the effect of ICT 1 on Learning 1 – such limited study needs to be placed within a bigger picture, without making claims that would apply to the whole of the relationship between the two entities.

In broad methodological terms, the co-evolutionary model posited here goes beyond simplistic notions of causality and introduces a temporal dimension. In research methods terms, the model suggests the need for an approach that is more able to describe and analyse such a dialectical relationship. Although it is not possible to explore all possibilities in detail in this introduction, one approach that looks useful is cross-lagged panel analysis (or cross-lagged panel design; Oud, 2002). This approach was first mooted by Lazarsfeld (Lazarsfeld, 1940; Lazarsfeld and Fiske, 1938). It has been used more recently to study the reciprocal relationship between parenting and adolescent problem-solving behaviour (Rueter and Conger, 1998). There is room for further exploration of the applicability and worth of cross-lagged panel designs in educational research, in particular in paying attention to the problem of how continuous (and sometimes erratic) development can be adequately mapped in staged analyses of reciprocity. This standard approach to dynamic phenomena in natural science could be used to explore the relationship between ICT and learning with the use of qualitative as well as quantitative data.

Before we leave this model, however, there is one further consideration to take into account: that these phenomena – ICT development and use – do not take place in a vacuum and are in themselves phenomena affected by and affecting context.

Adding societal context

To complete the model, we need to take into account something that has arisen already in systematic reviews of the relationship between ICT and literacy/learning development, i.e. neither ICT nor literacy/learning is a simple entity in itself (see, for example, Cope and Kalantzis, 2000, on multiliteracies). Similarly, learning is not a self-contained entity, but instead is heavily influenced by local, regional, national, and international contexts. To take ICT: the term itself covers a multitude of different technologies and modes of communication. When researchers take ‘ICT’ as one of their points of reference, they take much for granted. Are they talking about desktop computer interfaces and their use, or are they talking about the same software interfaces being used on a laptop, palmtop or via mobile phone? Are moving images, as experienced in the cinema, at home, or in the classroom, included or excluded from the definition of ICT?

Such considerations suggest the need for another dimension of classification – what biologists refer to as a *phylogeny* of the field. A phylogeny of e-learning would track the historical/longitudinal and taxonomic progress of ICT and learning (separately) and then show at what points they converge. The nearest analogy outside Biology is probably the 'family tree' model. We have not space in this introduction to create such a phylogeny, but invite future researchers to do so. Such a phylogeny would have the advantage of defining exactly the social and political provenance of a particular aspect of e-learning, distinguishing it from other related activities that might otherwise be confused with it.

Similarly, contexts of family, educational and social policy, economic funding and international competition affect the learning context; and technology advances, networking infrastructures and ICT developments constitute and affect the e-learning context. In the light of these considerations, the co-evolutionary model depicted above needs to be extended to accommodate wider contexts. Figure 1.9 presents a version of a co-evolutionary contextual model that can act as a starting point for theoretical models of research in e-learning in general. The new model shows how factors external to the internal dynamics of the model need to be taken into account when investigating phenomena like ICT and learning. These include factors that determine the changing nature of ICT, like economic, design and scientific factors; the changing nature of electronic communities; and the determinants of longitudinal growth.

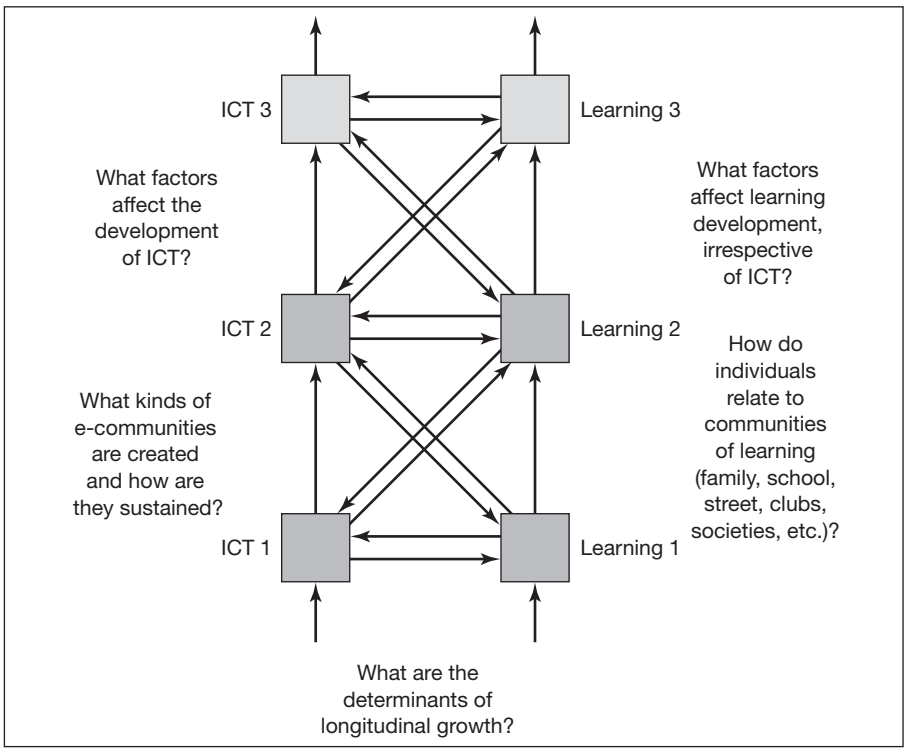

Figure 1.9 Co-evolutionary contextual model

Clearly a conclusion at this point in time would be inappropriate for a developing, exploratory model. Better approaches for the time being are: to critique the proposed model itself; to look for ways of testing the efficacy of the model's power to explain; and to ask questions of its scalability.

In the sense that the model itself is predicated on a dialectical principle, there is probably scope for its use. Not only horizontal and diagonal effects are equally or unevenly reciprocated, but vertical ones might also exist which describe the advances made from one state to another for a particular phenomenon. These vestigial or residual elements might be investigated in themselves. They are developmental and diachronic, as opposed to synchronic. The opportunity for dialectical interaction between states/snapshots of development is full of potential.

To sum up: the vertical axes represent change in time. We can research these by identifying points in time at which measures will be taken of the state of technological development or the state of learning (whether the latter is a particular age group growing over a number of years, or a cohort changing over a short period of time) and by modelling the changes alongside each other. The horizontal axes represent the causal and symbiotic relationships between the two entities. The diagonal axes represent residual and predicted changes as a result of interaction between the two entities.

Research studies in the field of e-learning may not explore every axis, nor each particular link in the structure, but by referring to a larger picture of reciprocal co-evolution between ICT and learning, may be able to position themselves more clearly and accurately in a complex and intra-related field of enquiry.

A FRAMEWORK FOR EXAMINING EMERGENT PROCESSES IN E-LEARNING

The model of emergent processes described above, and the social informatics research perspective, both draw our attention to the way e-learning is itself an emergent process. While some view it as a new delivery mechanism for education, and others view it as a new pedagogical challenge, what that delivery looks like and what frames the pedagogical challenge emerges from the interplay between new educational strategies, new teaching approaches, new technologies, and new participants in this endeavour. A key need for e-learning research is, then, to consider how this phenomenon unfolds in educational settings. Emergent, socio-technical change is not random. Knowing what is likely to influence the changing face of e-learning lets us predict, and, indeed, shape its future form – though these forms are going to be adapted on the 'shop floor' and in individual contexts. As a final presentation in this introduction, the following framework and its examples are offered as a beginning to exploration of the co-evolutionary developments in e-learning.

In grappling with the complexity of the area, four primary areas of action stand out for examining change processes in e-learning. These are actions taken by or emanating from *administration, pedagogy, technology*, and *community*.

Change in any of these areas not only drives further change within the area itself, but also drives and is driven by change in each other area. *Administration* encompasses the decisions made about e-learning initiatives in education, and the decision makers who direct this agenda. *Pedagogy* entails the knowledge accumulated about teaching and learning, as well as the teachers and instructors who build and deliver courses. *Technology* in this instance is narrowly defined as the delivery mechanisms for e-learning, i.e., primarily computer-based technology, including course management systems, e-mail, the Internet, and newly emergent information and communication technologies. *Community* refers here to potential and actual elearners and the communities they live in, both physical and virtual, on-campus and off.

As decisions and implementations are made in each area, they have direct and indirect effects on other areas. Table 1.1 presents a first run at sorting out and describing the complex interactions of the four prime areas. It is offered as a beginning of such explanation. Future research will be able to refine and verify impacts, as well as considering other areas and streams of influence (e.g. economic factors). In Table 1.1, the direct and indirect effects are classified as *driver, passenger, emergent* and *second-order effects. Driver effects* are evident when an action stemming from one of the four identified areas has an impact on other aspects of e-learning, e.g. when administrative decisions about technology drive what options are available for giving online classes and for maintaining an online community. *Passenger effects* are evident in the way practices are transformed by the driving forces, e.g. in the way pedagogy can or must now proceed because of an administrative choice about technology. All driver effects have an impact on a passenger, but to save redundancy the passenger side impact is not given in the table. Instead, identification of a passenger effect is limited to instances where the effect is less immediately expected. Readers may, however, prefer to see them all as driver effects, since even the unexpected passenger effect then becomes a driver for further change.

Outcomes that arise from action within the same area are identified as *emergent effects*; these appear primarily along the diagonal in Table 1.1. Such influences may come from action within the local institution or programme, but also from outside, e.g. as institutions look to and emulate peers, as colleagues share pedagogical techniques at conferences, and as new technologies appear. (See Scott, 1992, for more on the many kinds of ways organizations pay attention to their environments, for example, following the actions of peer institutions, regional competitors, etc.).

Finally, outcomes that emerge because of new practices are indicated in the table as *second-order effects*. These do not arise immediately but emerge later in time as a set of less expected outcomes; sometimes these become further driver, passenger, or emergent effects.

The effects described in Table 1.1 begin the work of identifying the major push-and-pull between developments in each of these areas. The ideas presented in the table are not intended to be exhaustive, but instead illustrative of the kind of iterative action and reaction that is of importance to e-learning. It is hoped that it will be taken up, expanded and tested by future e-learning research.

Table 1.1: E-learning driver, passenger, emergent, and second-order effects

	Administration drives …	*Pedagogy drives …*	*Technology drives …*	*Community drives …*
Administration	External A drives A: decisions about the adoption of new practices that are made at peer institutions drive decisions and practices made for the local institution	P drives A: early adopters of technology experiment with new technologies in their classes, driving class transformation, outreach programmes and distributed learning, even before wider administration choices are made New P drives A: the need to meet new technology-based pedagogy drives administration to implement support mechanisms for non-early adopters to learn to teach online	T drives A: availability of learning technology systems determines development versus off-the-shelf purchase options for administrative choices T drives A: local adoption of technologies increases need for hardware and software purchase, management and training and system upgrading	C drives A: community use of technology drives administrative response to keep up with incoming student expectations and employers' expectations about training
Pedagogy	A drives P: administrative decisions and directives drive how education will be delivered and thus the priorities for pedagogy	External P drives P: changes in pedagogical practice are discovered and exchanged through professional organizations, research and publication affecting local practice New P drives P: norms of use are built, creating a comparison set for e-learning practices as well as a set to learn from and copy	T drives P: technology choices drive how teaching can be delivered and who can receive it P and T co-evolve: limitations of technology drive changes in pedagogy, but pedagogical requirements drive technology design and improvement	C drives P: changing community work and knowledge needs drive need for lifelong learning, distributed and mobile learning
Technology	A drives T: administration makes decisions about institution-wide technology adoption and support A drives T: administrative decisions push use of technology and can limit choice of technology (e.g. campus-wide selection of a learning platform limits instructor options to use different systems and approaches)	P drives T: teachers adopt and then experiment with technology in their classes, determining their technology preferences, and sit on working committees determining technology adoptions New P drives A and T: e-learning solutions are adopted and implemented in response to opportunities for outreach, new pedagogy, etc.	External T drives T: technology trends are matched in e-learning, e.g. enterprise-wide systems with course management systems; computer-mediated communication with e-mail accounts and support for students; Internet with online course reserves, electronic publication licences; distributed computing with distributed learning; mobile computing with mobile learning New T drives T: e-learning systems offer a standard range of options, driving conformity but also narrowing e-learning options	C drives T: community expectations about what technology makes an institution and its programme progressive drive attention to technology within the institution

Table 1.1: ***continued***

	Administration drives …	*Pedagogy drives …*	*Technology drives …*	*Community drives …*
Community	A drives C: expectations of technology use in classes in higher education drive the need for the community to prepare students appropriately	P drives C: pedagogical requirements for use of online resources have the unexpected consequence of distributing responsibility to public access points, e.g. public and university libraries at locations local to the students; such institutions then act as nests for the distributed learning 'cuckoos' (Searing, personal communication)* P drives External A: use of local university libraries by non-enrolled students leads to new inter-organizational administrative practices	T drives C: technology presence drives community efforts to promote information and computer literacy, thus affecting how well students are able to take advantage of technologies and e-learning T drives C: distribution possible because of technology now places teachers and learners in the community, at work, at home while at school	C drives C: community technology use, and support for use, bootstraps community readiness to use technology and to take part in e-learning C drives C: embedded learners enact new relationships with embedding context C drives C: increased use of online interactions for education drives norms for how to communicate and do work, changing the skill set available to employers

A administration, C community, P pedagogy, T technology
Driver effects Passenger effects Emergent effects Second-order effects
*Personal communication, Sue Searing, Library and Information Science Librarian, University of Illinois at Urbana-Champaign

STRUCTURE AND LIMITATIONS OF THE *HANDBOOK*

We have taken the opportunity in this introduction to begin work on building a framework for e-learning research, emphasizing the key elements involved in the e-learning enterprise – learners, teachers, information and communication technology, local and societal level knowledge, and embedding contexts – leading to a focus on two theoretical perspectives – rhetorical theory and social informatics – and an emergent, co-evolutionary process of development. Ours is just a beginning, and invites testing and debate. It is now time to turn to the work of others in this *Handbook* who can illuminate other areas of research and exploration for e-learning.

The *Handbook* is organized in five parts. The first chapters set the *context for research in e-learning*, providing histories of important predecessors to e-learning, including reviews of the now long-standing fields of asynchronous learning networks (Hiltz, Turoff and Harasim) and computers and writing (Hawisher and Selfe); the state of the digital divide (Haythornthwaite); the online experience of gamers (McFarlane); and of the learning sciences that design and study learning environments (Hoadley). The chapters in Part II address *theory*, including a plea to maintain the understanding of 'distance' in our new e-learning contexts (Thompson), explorations of the rhetoric of new spaces and cultures of e-learning (Locke), the ways in which e-learning research, development and implementation can be (and actually are) organized (Whitworth), a theoretical approach to learning in a mobile age (Sharples, Taylor and Vavoula) and computer-supported collaborative learning (Miyake). From there, in Part III, we turn to *policy*, including issues of copyright and ownership in relation to e-learning intellectual property (Varvel, Montague and Estabrook), an examination of international policy (Conole), e-learning in the community (Kazmer), and what we know about individual differences and the effectiveness of digital learning systems (Morgan and Morgan). In Part IV issues of *language and literacy* are addressed, beginning with two chapters addressing multilingual issues: one on bilingualism (Brutt-Griffler), and one reviewing second language learning online (Chapelle); and one applying literacy, learning and technology research to e-learning (Snyder). A further chapter examines the practicalities of researching e-learning (Zhao). Part V examines *design issues*, starting with how to design technically and socially for community (Stuckey and Barab), and continuing with chapters on programme design for professional development (Harlen and Doubler) and graduate education (Roberts and Rostron); and a final chapter looking at current and future possibilities in digital video production and literacy in schools (Burn).

Inevitably, in such a large and expanding field of enquiry, there are limitations to the *Handbook*. While we have concentrated on the social dimensions of e-learning, the nature of e-learning itself, communities of e-learning, theoretical and methodological issues, and modelling e-learning processes, we acknowledge that we have hardly touched on technical or technological issues, pedagogical issues, the visual dimension of e-learning, forms of argumentation within e-learning, e-learning in the global south (see Leach *et al.,* 2005), or

computer modelling of learning. These are all important and fascinating subfields, worthy of handbooks to themselves. Nevertheless, we hope to have provided at least an initial map for further research in the field.

NOTES

1 For more on modalities, see Halliday (1985) for detailed discussion of the distinctions between field, tenor and mode in systematic functional linguistics, and Kress (2001, 2003, 2005) for a development of the Hallidayan model into the semiotics and multimodalities of communication in education.

2 The continuously emergent nature of social interaction is inherent in Giddens' (1984) structuration theory. This has been taken up in relation to ICT use by Poole and DeSanctis (1990), Orlikowski (1992) and Galegher and Kraut (1990). For more on emergent communication processes see Monge and Contractor (1997, 2003).

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