

Networks and learning: communities, practices and the metaphor of networks.

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This paper examines the metaphor of networks and the ways in which it might be useful in understanding advanced learning technologies when they are applied to education and training. The idea of networked learning has become commonplace as an alternative to e-Learning that stresses the interaction of learners and educationalists through networks. The arguments put in this article are firstly that learning technology needs to take account of the wider debate about networks and secondly that research in this field needs to address the theoretical and practical issues raised by advances in the field of networks. A third point is that the idea of the network acts as a powerful metaphor even if we are able to discount any particular theory generated in its support. The network metaphor can act as a unifying concept allowing us to bring together apparently disparate elements of the field. Networks are an important issue in the study of learning using advanced technologies and they speak to one of the central issues in learning theory, the idea of virtual communities and in particular the idea of communities of practice.

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Introduction

Though use of computers has grown exponentially in the past 25 years it is worth noting that the "Network Nation" as envisaged by Hiltz and Turoff in the late 1970s has often developed more slowly than its advocates anticipated. The authors of this key text noted just prior to the widespread adoption of the Web that:

The first edition had one major mistake: over-optimism about the speed at which computer-mediated communication would be adopted around the world, to create a 'network nation'. (Hiltz and Turoff 1993)

Networking of personal computers has since that time experienced a surge of growth and generated the reality of social forms based on distributed systems that allow communication between large numbers of people. The merging of information and computing technologies in the Web has pushed the possibilities of computer networks to global dimensions. However the theoretical approaches to computer networks have hardly kept pace with the spectacular adoption of networks in fields such as education and learning.

The growth of the Internet and specifically the Web has opened up an apparently limitless field for communication and the searching out of resources. Yet at the same time we are increasingly aware of the 'small world phenomenon', those strange connections that seem to emerge and make this vast expanse feel much closer and more limited (Watts and Strogatz 1998). Castells has recently written about the way in which the possibilities and limits of the Internet play out in relation to community (Castells 2001). He claims that the Internet is especially effective at maintaining weak ties (p129) as well as strong ties at a distance. In education the focus has often been on the latter with an interest in community and communities of practice being strongly related to the introduction of networked technologies. Castells suggests that the pattern of the Internet is one of 'networked individualism' in which on-line communities may emerge but which relies on networks built out of an interaction between off-line and on-line sociability. This stress on the interconnection between

off-line and on-line elements is a corrective to the often overhyped claims for Virtual Universities and the notion that online worlds are somehow sequestered from real life concerns and processes.

Networks

Networks are providing an interdisciplinary framework for understanding a wide range of phenomena. The use of the term is not neutral and John Law has noted that the ubiquitous nature of the metaphor may be due to more than the emergence of new social forms. Indeed it is possible:

that we are in the process of *uncritically reproducing some kind of dominant ideology*. We are reproducing the ways in which the current orderings of the world like to represent themselves. (Law draft para No 1)

As such networked learning is part of a hegemonic discourse not simply in educational terms but as part of wider debates concerning the nature of social processes, power and culture. John Law notes that when we analyse in terms of networks, we also help to perform networks into being. The danger he identifies is that when we write as network analysts we may be buying into and adding strength to a managerialist agenda. I don't wish to minimise this point and I give it prominence here as a corrective to any suggestion that might arise in what follows that networks can be adopted uncritically as a technical term solving a number of practical problems. Networks have within them a latent politics that must be considered in our work.

At a simple level mathematical modelling of networks concerns itself with the description of phenomena in terms of nodes and the links between them. Basic techniques focus on the ways in which transfers can take place across a network, for example whether the network is traversable or not. The importance of this field of study is that it holds out the prospect of developing mathematical laws of networks that may prove to be robust in describing a broad range of phenomena. In recent years a number of texts aimed at lay readers, originating in mathematical and physical science traditions, have begun to examine phenomena from a wide range of areas, including social and biological domains (Barabasi 2002, Buchanan 2002). Network analysis examines systems through the links between nodes in a web like structure. The nodes can be Web documents, individuals, groups, publications or language. Within this paper I make no proper assessment of these broad claims, rather my intention is to draw attention to the literature, its relevance to the field of networked learning and a number of conceptualisations that arise from this work.

Work reported by Barabasi has argued that advances in the characterisation of complex networks that focuses on scale-free and hierarchical architectures demonstrate that a wide range of complex networks including the Web and Internet share these properties (2002). Without attempting to develop the maths involved in a proper description of scale-free networks it is important to state that these networks differ from random networks in which nodes are connected without any organising principle. Scale-free networks show a degree of organisation, in particular they display a power-law distribution. Those nodes with only a few links are numerous, but a few nodes have a very large number of links. The power law distribution is radically different from the familiar bell curve distribution with the distribution tapering off

towards both margins. The rationale behind this kind of distribution rests on some simple propositions. Firstly networks grow through the addition of new nodes and these new nodes link to pre-existing nodes. Secondly there are preferential attachments within the network such that the probability of linking to a pre-existing node is higher if it already has a large number of attachments.

As well as being scale-free most networks also display a high degree of clustering. This clustering is consistent with the predictions of the scale-free description of networks with a power law distribution if a hierarchical organisation is introduced into the network model. The presence of the hierarchical structure helps to re-interpret the role of hubs in complex networks. The theory predicts a modular topology with self-nesting groups of nodes in clusters with dense interconnections. The overall suggestion is that networks are:

far from random, but they evolve following robust self-organising principles and evolutionary laws that cross discipline boundaries (Barabasi et al 2002).

The interesting nature of these networks retains some of the advantages of random networks, few steps between any two nodes, with the features of organisation.

Mark Buchanan in his recent book *Nexus* (2002) concentrates on recent developments in a well known set of mathematical problems known as small world phenomena. The most popularised form of this problem is in the idea of six-degrees of separation that any one person is likely to be connected to any other through only six degrees of separation. This idea gains strength from our own anecdotal experience of small worlds, meeting someone unexpectedly who has connections with either you yourself or someone close to you. One of the key elements in the description of the networking structures and patterns that lie behind small-world phenomena is the idea of the strength of weak ties. Strong links, for example between close family members do not reach out very far. It is often the weaker links that can bridge between quite different clusters in networked worlds. Buchanan reports a light-hearted challenge in a German newspaper to connect a Turkish kebab-shop owner in Frankfurt with his favourite actor, Marlon Brando. This was done using no more than six links of personal acquaintance using a bridging weak link, a friend of the kebab-shop owner living in California. The small world phenomena draw attention to the need for weak links and bridging contacts to the organisation of networks. These links are central to the dissemination and propagation of ideas and are of particular interest in education. Together the idea of networks as having a self-nested topology and the idea of small worlds begins to map networks as self-organising structures that lie somewhere between order and chaos

Network Society

Networks of computers date back to ARPANET and pre-date the emergence of the personal computer but it was the convergence of the two in the development of the Internet that profoundly affected our views of how computers impacted on social life and educational and learning activity.¹

The social theories that postulated a new form of society in which industry and factory production were replaced by service industry pre-date the development of

¹ A brief history of the Internet can be found in Castells (2001)

networks by some years. This point is worth noting as theories of the 'information' society, developed well before networked computing, are often presented as outcomes of the application of computer technology. Daniel Bell's idea that just as industrial society had replaced agrarian society so a new post-industrial society based on services would replace industrial society was later popularised in Alvin Toffler's writings as *The Third Wave* (1980). Steve Wosniak, one of the originators of the personal computer at Apple has been quoted as saying that the inventors of the PC were self-consciously exploring the idea of a technological revolution reshaping society². Whilst the PC was an invention tangential to the development of networks, this comment implies a much more sophisticated relationship between technology and society than that suggested by a simple technological determinism, one in which the design of technical artefacts was informed by the very debates that claim the technology their source.

The information society debate still has many echoes that directly affect discussion of how networks affect education and society. Policy within the UK and many other countries is based upon the idea of computer networks being the prime lever for social change. As an example I include the remarks of two recent Ministers of Education in the UK.

In sum, higher education in this century will need to look very different to the system which evolved in the second half of the twentieth. It will typically be mixed mode - delivering through ICT and other learning at a distance, as well as face to face. (paragraph 78 Blunkett 2000)

When you look back at the development of our schools it has been very strangely evolutionary. One of the reasons for that is there has not been a development, there has not been an invention which has brought about a transformation which has signalled the revolution and if you look at health it was maybe antibiotics or it was maybe the discovery of DNA. If you look at transport it was maybe the internal combustion engine and once those discoveries were made, once those changes happened nothing was ever the same again. I think ICT is our DNA, it's our internal combustion engine it is the trigger that can introduce a revolution in how we teach and in how we learn (Morris 2002)

Christine Steeples and I have discussed the persistence of the technological determinist approach in networked learning and its effect on policy elsewhere (Jones and Steeples 2002). At this point I simply want to stress the idea that the debates about the information society and more recently networked society inform the policy makers who in turn set the parameters for work in the field of networked learning. Advanced learning technology is introduced in relation to policy frameworks and funding decisions closely associated with an understanding of society that claims it is fundamentally transformed by the use of computer networks. Recently Alison Wolf (2002) has provided an illustration of how the view of a changing workforce, central

² Steve Wosniak was quoted as saying "People started getting together and exploring the idea that there was going to be a revolution in technology which was going to change society so drastically" Equinox Channel 4 TV 1986 quoted in Lyon, D. The roots of the information society idea. In Heap, N., Thomas, R., Einon, G., Mason, R., and Mackay, H. *Information Technology and Society: A Reader* (1995) London: Sage. This short chapter provides a good short introduction to the information society debate.

to the idea of an information society, misinforms a major plank of government policy. The economic case for widening participation and the massification of higher education is closely related to the idea that services are replacing industries and that knowledge workers are replacing unskilled and manual work. In her conclusion Alison Wolf comments that:

for the last quarter-century education policy has been driven consistently by preoccupation with growth and with workplace skills The results have been frequently disastrous. (Wolf 2002 p244).

It is not necessary to agree with Wolf's anti-government agenda to agree with this observation, one that links failing government policies with a particular view of the needs of an information society.

A second connection with the wider debate about network society is through the idea of virtual community. Howard Rheingold's highly influential book *The Virtual Community* (1993) generalised out from the WELL, a virtual community based in the San Francisco Bay area in the mid-1980s. This book argued that the Internet opened up the possibility of a new form of community based on-line and formed around shared values and interests. This claim about a technological basis for a new sociability formed a natural alliance with educational theories that placed an emphasis on communities of practice. Accounts of situated learning, for example by Lave and Wenger (Lave and Wenger 1991, Wenger 1998) and Brown, Collins and Duguid (1989), have had a particular importance for computer supported learning. The accounts of community facilitated by computer networks, provided by Rheingold, aligned with social and situated views of learning and the idea of communities of practice in Computer Supported Collaborative (or Cooperative) Learning (CSCL).

This set of ideas has recently come under critical review (Fox 2002, Hodgson and Reynolds 2002). Fox articulates a view of communities of practice as sub-units within wider actor-networks that include both animate and inanimate elements described as actants. He argues that the communities of practice idea relies on a certain romanticism deriving as it often does from anthropological studies set outside of modern societies. He goes on to suggest that its application within modern bureaucratised organisations focuses on sub-cultures, non-canonical groups in the interstices of organisations. In summarising learning as peripheral participation in such communities of practice Fox comments:

It is a community which is specialised around some specific practice or other, a single task, occupation, interest or profession. It may rely on a certain amount of formal education as a pre-requisite for joining (e.g. the US naval quartermasters often had to attend training school), but the real learning comes from the triadic communal relations between old-timers, young journey-men and/or women and newcomers, i.e. real learning comes from the social relations between people with more knowledge and skill interacting with people with less knowledge and skill in the pursuit of a common practice. (Fox 2002 p 111)

As an alternative to communities of practice Fox suggests actor-network theory (2002, 2002a). In his view communities of practice may be seen as a special case in terms of actor networks as they have specific practices within them such as mimicry, demonstrating and working together. Beyond a certain scale Fox argues that a

community of practice becomes an imagined community in which the actor-networks link and connect multiple communities of practice. The view Fox outlines is one that has a strong resonance with the observations by Castells in relation to networked individualism and community in networked society. Together they imply that communities and communities of practice are not the necessary or inevitable outcomes of networked society or networked technology, rather they are special cases of a more general network phenomena that relies on a particular form of individualisation.

Hodgson and Reynolds' critique of community focuses on power and democracy. They argue that networked learning offers a promising medium for supporting participative approaches to learning and that participative and democratic values are facilitated because it allows for the emergence of 'splinter' groups based on differences or differences of interests. They claim that traditional approaches tend to reflect notions of collaboration that discourage recognition of differences and that practices in networked learning still conform to that approach. In practical terms Trehan and Reynolds (2002) have noted that within peer assessed groups aspects of power relations, associated with wider social networks in education, impinge on the practices of a learning community intended to foster a cooperative and collaborative style of working. The comments of Hodgson, Reynolds and Trehan touch on some central questions in relation to networks and communities when they are applied to educational settings. Network metaphors can be used in such a way that power relations become diminished or invisible. The different access to resources held by different actors in the network can be ignored by a focus on connections between nodes rather than on which nodes act as attractors in the flows across the network. In education the gloss of the 'guide on the side' has often ignored the power of the tutor in setting assessment tasks and in grading those assessments (Jones 2000). As Trehan and Reynolds make clear these power relationships are also evident in the interactions of collaborative and peer assessment.

Networked Learning in the Network Society

The claim of this paper is that the use of the network metaphor can link the different aspects of research into the use of advanced learning technologies based on computer networks. In this section I want to draw attention to the connections at various levels and how the network metaphor might be applied. The aspects I will cover are not exhaustive but I hope that they may give a flavour of the range of issues that this metaphor can be applied to.

1. Policy and politics

Higher education is currently suffering something of a policy overload in the UK. The government White Paper issued in the spring of 2003 may well be on its way to implementation or dead in the water by the time this article appears in print. The entire process of consultation and negotiation of this policy will illustrate a powerful application of network theory in terms of government and governance. The idea of policy networks has developed in relation to a broad change in the relationship of government to society. The notion of governance has been used to separate out government action and actions that may include government and its agencies but which incorporate a network of bodies, some within and some outwith the boundaries

of government itself. Governance in this sense refers to the management of “self-organising, interorganisational networks with the following characteristics.”

1. Interdependence between organisations
 2. Continuing interaction between network members
 3. Game-like interactions, rooted in trust and regulated by rules
 4. No sovereign authority, self-organising, with a limited state steer.
- (abridged from Rhodes 1997)

This structure based on networks can be contrasted with both hierarchies and the market. Politically it is an organisational Third Way, standing between the hierarchy associated with the bureaucratic active state and the anarchy of the market (Rhodes 1997).

There are potential concerns that this form of governance is not as loose as it might appear at first glance. In managerial terms the autonomy of teams, brought together either for specific projects or as self-managing units, is circumscribed. An early commentator on new public sector management described such arrangements as “freedom within boundaries” (Hoggart 1991). In other words networks can concentrate as well as disperse power. Power can be exercised in the setting of the limits within which component parts can operate. At another level governance can concentrate its efforts on performance, on products not process. Traditional management might be concerned with the way that work was conducted, with process issues. Networked forms of governance shift concerns to outputs and performance, to what is done not how it was achieved. The education system has been at the sharp end of reforms based on this model.

The network metaphor can also help us to evaluate novel policy initiatives that are emerging. The evaluation of the Learning and Teaching Support Network pointed to the network nature of the organisation and how this structure had a particular effect on how policy flowed through it and its influence on policy formation. The Subject Centres had a high degree of autonomy in their dealings with subject communities and this had a strong influence on how they developed. The overall structure of the LTSN was of a managed network and policy was introduced into this system through the Executive who had a close eye on government policy and the funding councils. The flow of policy initiatives was negotiated through this complex system in which there were power relations often expressed through financial constraints. The LTSN provided an interesting example of how networks can provide a unique responsiveness to diverse interests and retain at the same time retain a degree of structure and control that makes them of interest to policy makers.

The LTSN is a policy initiative that relies upon remaining close to its constituency. To be effective that strand of the initiative is critical. Yet that requirement sets up a tension with the natural desire of the funding bodies and beyond them the government, to make such initiatives responsible for carrying through major items on the policy agenda (Jones 2002).

Network metaphors are useful in relation to policy and definite policy initiatives such as the LTSN but they are also useful in relation to new and developing forms of management. A Dutch school of political studies has moved from using network

analysis to describe government to setting out some basic guidance on how networks can be managed (Kickert et al 1997). This type of analysis may be especially appropriate in higher education as there are multiple centres of power and influence in the sector. Kickert et al comment that:

Management in networks is about creating strategic consensus for joint action within a given setting (1997 p 167)

Finding a common purpose for higher education is one of the great challenges in the midst of current social and technological changes, and for this an analysis of how managed networks operate is invaluable.

2. Networked learning

A first wave of writing about the use of computer networks in education took place in the late 1980s and early 1990s with the emergence of such canonical texts as *Mindweave*, *The "virtual classroom"* and *Online Education* (Mason & Kaye 1989, Hiltz 1994, Harasim 1990). The focus of these approaches was largely textual, emphasising the interactive nature of the technology and exploring how these could be used for distance education in particular. Robin Mason (1994) commented that:

No concept so characterises educational thinking in the 1990s as does interactivity..... So embedded in the spirit of the age is it that there is relatively little questioning of its value, much less evaluation of its effects. (p 25)

Interactivity altered its focus during this period from interacting with computers to interacting through computers (Crook 1994). In 1996 Tim Koschmann tried to periodise the developments in the context of research programmes (Koschmann 1996). Koschmann identified what was then an 'emerging paradigm', which he called CSCL. This emerging set of research questions was contrasted with previous outlooks, CAI (Computer Assisted Instruction), ITS (Intelligent Tutoring Systems) and the 'Logo-as-Latin' paradigm associated with Papert's seminal text 'Mindstorms'. The research conducted in the CSCL paradigm was related by Koschmann to socially oriented constructivist viewpoints such as the Soviet sociocultural theories and theories of situated cognition. Likening the paradigm shifts he identified to a gestalt change in view, he claimed that the new paradigm drew attention to the social and cultural context of education as the object for research. In interviews with UK academics using networked learning, the paradigm identified by Koschmann has been found to provide a high level philosophy informing the thinking of practitioners in UK higher education (Jones *et al* 2000, Jones and Asensio 2002).

In 2001 Koschmann returned to this theme and examined the emergent paradigm of CSCL in more detail.

CSCL research has the advantage of studying learning in settings in which learning is observably and accountably embedded in collaborative activity. Our concern, therefore, is with the unfolding process of meaning-making within these settings, not so-called "learning outcomes". It is in this way that CSCL research represents a distinctive paradigm within IT. By this standard, a

study that attempted to explicate how learners jointly accomplished some form of new learning would be a case of CSCL research, even if they were working in a setting that did not involve technological augmentation. On the other hand, a study that measured the effects of introducing some sort of CSCL application on learning (defined in traditional ways) would not.

I find this definition of the field somewhat unsatisfactory precisely because it fails to relate the research area to the particular features or affordances of the technology. I would suggest that the technological change surrounding the Web, only in its infancy in 1996, has been the spur to generating another set of research questions, in an area that I would describe as networked learning.

The Centre for Studies of Advanced Learning Technology (CSALT) group at Lancaster University and I have been associated with the following definition of networked learning.

Networked learning is learning in which information and communication technology (C&IT) is used to promote connections: between one learner and other learners, between learners and tutors; between a learning community and its learning resources.

This definition of networked learning is, like CSCL, related to social theories of learning. It develops beyond CSCL in moving away from defining the new paradigm simply in terms of the local processes of social learning. Networked learning remains concerned with social process but it sets itself the task of understanding the links between different nodes, the learners, the tutors and the resources that make up a networked learning setting. The growth of the Web and the drive to digitise and make accessible a range of reifications related to education in 'learning objects' and digital resources has made the focus on social process understood as group collaboration too narrow as a research framework. It is important now to understand the relationship of individuals and groups to artefacts as a sense making activity. The move from interaction with computers to interaction through computers has now moved on to interaction in relation to computer *networks*. The computer itself is no longer the centre of research attention, rather it is the network and network resources made available through the computer. Indeed if mobile and ubiquitous computing develop strongly the device through which the network is available may well cease to be recognisable as a computer. Networked learning can take account of policy, organisational and whole institution issues that arise with the embedding of the new network technologies. Networked learning is still concerned with meaning making and the social process of learning but it is also concerned with the social and organisational dynamics within which those processes take place.

3. Research into networked learning

As networked learning develops it will be increasingly important to develop an understanding of how traditional research approaches might transfer to networked environments. In my own field of interests there has been a growing interest in 'virtual' or 'on-line' ethnography. In her book *Virtual Ethnography* Hine (2000) comments on some of the ways that the virtual is distinct from face to face settings. In particular she notes that networked technologies show 'a high degree of interpretive

flexibility' (p64). She argues that this flexibility derives from the way the technology is dependent upon different contexts and the way that the technology has to be 'acquired, learnt, interpreted and incorporated into context' (p64). Hine's conclusion is that:

Virtual ethnography is adequate for the practical purpose of exploring the relations of mediated interaction, even if not quite the real thing in methodologically purist terms. (p65)

Andreas Wittel has also explored the move 'From Field to Net to Internet' and has suggested a move to an ethnography of networks (2000).

Networks are still strongly related to geographical space - like field. Unlike field, a network is an open structure, able to expand almost without limits and highly dynamic. And even more important: A network does not merely consist of a set of nodes but also a set of connections between nodes. As such, networks contain as much movement and flow as they contain residence and localities. An ethnography of networks would contain the examination of nodes of a net and the examination of the connections and flows (money, objects, people, ideas etc) between these nodes. (Wittel 2000 paragraph [5])

His conclusion is similar to Hine's in recommending a reshaping of the concept of field site to one focused on flow and connectivity. By continuing to place an emphasis on the node within a network Wittel's formulation has the benefit of retaining some aspects of the idea of location within the expansion of the concept to cover flow and connectivity.

Conclusions

I have argued that using the metaphor of networks can assist us to theorise the broad context in which learning and education take place in a society reliant on computer networks. I have not outlined a research programme associated with this view but there are within this article strong hints that such a research programme could and possibly should be elaborated. Networks are providing a useful focus for analysing the patterns of growth and interaction in a wide range of fields. The use of the network metaphor in learning technology helps us to connect ourselves to that wider debate and theorising about the fundamental nature of the network and the patterns of activity associated with it. The use of the network metaphor also links our work in learning technology with the work being conducted in terms of the network society. This work has some direct connections to learning technology because it informs debates in higher education and training in terms of the type of workforce that awaits our current students and the type of skills they are likely to need.

The networked society debate directly relates to the idea of virtual communities and the idea of communities of practice. Network theory would suggest that the strong notions of community contained in these theoretical approaches might ignore the importance of the 'strength of weak links'. Networks can be structured in ways that combines both the benefits of random and organised patterns. The educational focus on strong links and community may have made less visible those necessary but weak

connections that make the network idea so powerful. The idea of online communities also tends to separate out and privilege the virtual as against the real. The ideas of online and offline communities need to merge in the activity of real people who are both simultaneously on and offline when they are engaged with computer networks.

In relating networked learning to the networked society this paper has identified three areas that may be open to investigation using network analysis. Policy, politics and management is one area in which network analysis is already well developed in ways that may be of direct use for researchers in learning technology. This is also an area in which the idea of networks can help social practice theories of social and situated learning connect themselves to the policy debate. The idea of clusters and hubs in hierarchical networks may allow us to develop a rich picture of just how it is that communities of practice relate to the wider policy networks in education. In terms of the current dominant paradigms influencing learning technologists the network metaphor assists in shifting the emphasis towards the reifications deployed in networks alongside a focus on meaning-making. Finally the paper raises the question of the research methods that may be appropriate for research both of networks and making use of networks. It raises the possibility that researchers may need to adjust and amplify their methods to take advantage of new possibilities and to translate classic research methods into the network setting.

References

Barabasi, A-L. (2002) *Linked: The New Science of Networks*. Cambridge, MA: Perseus Publishing.

Barabasi, A-L., Dezso, Z., Ravasz, E, Yook, S-H., Oltvai, Z. (2002) Scale-free and hierarchical structures in complex networks.

Available online at:

<http://www.nd.edu/~networks/PDF/Proceeding%20Sitges2004.pdf>

Bates, A.W. (1999). *Managing Technological Change: Strategies for Colleges and University Leaders*. San Fransisco: Jossey-Bass Publishers.

Bell, D. (1974) *The coming of post-industrial society: a venture in social forecasting*. Hamondsworth: Penguin.

Brown, J. S., Collins, A., and Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher*, 18(1), 32 -42.

Buchanan, M. (2002) *Nexus: Small Worlds and the Groundbreaking Science of Networks*. New York & London : W.W. Norton & Co

Castells, M. (1996). *The Information Age: Economy, Society and Culture Volume 1. The Rise of the Network Society*. Oxford: Blackwell.

Castells, M. (2001) *The Internet Galaxy: Reflections on the Internet, business, and Society*. Oxford: Oxford University Press.

Crook, C. (1994). *Computers and the Collaborative Experience of Learning*. London: Routledge.

Fox, S (2002) Networks and Communities: An Actor-Network Critique of ideas on Community and Implications for Networked Learning. In Banks, S, Goodyear, P, Hodgson, V and McConnell, D. *Networked Learning 2002: A research based conference on e-learning in Higher Education and Lifelong Learning*. Sheffield. University of Sheffield pp 110 - 118

Fox, S. (2002 a) ' *Studying Networked Learning: Some Implications from Socially Situated Learning Theory and Actor-Network Theory*' In Steeples, C. and Jones, C. (eds.) *Networked learning; Issues and Perspectives*. London: Springer.

Harasim, L. (Ed.). (1990). *Online Education; Perspectives on a New Environment*. New York: Praeger.

Hiltz, S. R. (1994). *The Virtual Classroom: Learning Without Limits via Computer Networks*. Norwood, N.J.: Ablex Publishing Corporation.

Hiltz, S. R., and Turoff, M. (1993). *The Network Nation - Revised Edition*. Cambridge, Massachusetts: MIT Press.

Hodgson, V., and Reynolds, M. (2002) Networked Learning and Ideas of Community. In Banks, S, Goodyear, P, Hodgson, V and McConnell, D. *Networked Learning 2002: A research based conference on e-learning in Higher Education and Lifelong Learning*. Sheffield. University of Sheffield pp 119 - 127

Hoggart, P. (1991) A New Management in the Public Sector? *Policy and politics* 19 (4) pp 243 - 256.

Jones, C. (2002) "Is there a policy for networked learning?" In Banks, S, Goodyear, P, Hodgson, V and McConnell, D. *Networked Learning 2002: A research based conference on e-learning in Higher Education and Lifelong Learning*. Sheffield. University of Sheffield pp 175 -182

Jones, C. (2000) "From the sage on the stage to what exactly? Description and the place of the moderator in cooperative and collaborative learning." In David Squires, Gabriel Jacobs and Grainne Conole. *The Changing Face of Learning Technology - Selected Papers from ALT-J*. University of Wales Press, Cardiff. 2000

Jones, C., and Asensio, M. (2002) "Designs for Networked Learning in Higher Education: A Phenomenographic Investigation of Practitioners' Accounts of Design." In C. Steeples and C. Jones. *Networked Learning: Perspectives and Issues*. London: Springer

Jones, C., Asensio, M., and Goodyear, P. (2000) "Networked learning in higher education: practitioners' perspectives" *ALT-J, The Association for Learning Technology Journal*. Vol 8 No 2 pp 18 -28.

Jones, C and Steeples, C. (2002) "Perspectives and Issues in Networked Learning" In C. Steeples and C. Jones. *Networked Learning: Perspectives and Issues*. Springer: London.

Kickert, W, J, M., Klijn, E-H., and Koppenjan, J, F, M. (1997) *Managing Complex Networks*. London: Sage.

Koschmann, T. (Ed.). (1996). *CSCL: Theory and Practice of an Emerging Paradigm*. Mahwah, NJ.: Lawrence Erlbaum Associates.

Koschmann, T. (2001). Revisiting the paradigms of instructional technology. In G. Kennedy, M. Keppell, C. McNaught & T. Petrovic (Eds.), *Meeting at the Crossroads*. Proceedings of the 18th Annual Conference of the Australian Society for Computers in Learning in Tertiary Education. (pp. 15 - 22). Melbourne: Biomedical Multimedia Unit, The University of Melbourne. Available online at: <http://www.medfac.unimelb.edu.au/ascilite2001/pdf/papers/koschmann.pdf> [Accessed 28th February 2003]

Lave, J., and Wenger, E. (1991). *Situated Learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Law, J. (Draft) 'Networks, Relations, Cyborgs: on the Social Study of Technology', published by the Centre for Science Studies and the Department of Sociology, Lancaster University. Available online at: <http://www.comp.lancs.ac.uk/sociology/soc042jl.html> [accessed 24th February 2003]

Mason, R. (1994). *Using Communications media in Open and Flexible Learning*. London: Kogan Page.

Mason, R., and Kaye, A. (Ed.). (1989). *Mindweave: Communication, Computers and Distance Education*. Oxford: Pergamon.

Rheingold, H. (1993) *The Virtual Community: Homesteading on the Electronic Frontier*. Reading, MA: Addison-Wesley.

Rhodes, R.A.W. (1997) *Understanding Governance: Policy Networks, Governance, Reflexivity and Accountability*. Buckingham: Open University Press.

Toffler, A. (1980) *The Third Wave*. London: Pan

Trehan, K., and Reynolds, M. (2002) Online Collaborative Assessment: Power Relations and 'Critical Learning'. In C. Steeples and C. Jones. *Networked Learning: Perspectives and Issues*. Springer: London.

Watts, D.J., and Strogatz, S.H. (1998) Collective Dynamics of 'Small World' Networks. *Nature* 393 pp 440-442

Wenger, E. (1998). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press.

Wittel, A. (2000). Ethnography on the move: From field to net to Internet [23 paragraphs]. *Forum Qualitative Sozialforschung/Forum: Qualitative Research* [Online Journal], 1 (1). Available at: <http://qualitative-research.net/fqs> [accessed 24th January 2004]

Wolf, A. (2002) *Does education Matter? Myths about education and economic growth*. London: Penguin Books.