

# ***Towards an ontology of networked learning***

*Steve Walker*

*Dept. of Communication & Systems, The Open University, s.walker@open.ac.uk*

*Linda Creanor*

*Learning Enhancement and Academic Development (GCU LEAD), Glasgow Caledonian University, l.creanor@gcu.ac.uk*

## **Abstract**

Networked learning, conceived of as networks of people, informational resources and technologies, constitutes what has been termed a 'highly intertwined' technology. In this paper we develop our earlier argument that sociotechnical networks can form the basis for a non-determinist theory of learning technology.

Firstly, we argue that Kling et al's sociotechnical interaction network (STIN) is compatible with a realist ontology, drawing on Fleetwood's 'ontology of the real' and Lawson's proposition of the social nature of the artefact in networks of 'positioned practices'. This, we suggest, gives a more secure basis for the STIN concept, and provides a clear alternative to actor network theory (ANT)-based views of sociotechnical networks which do not distinguish between the influence of human and material agents. This also, we argue, provides an alternative way of anchoring concepts from the social informatics literature, often influenced by Giddens' structuration theory, in ways that can help networked learning research.

Secondly, we explore some potential implications of such an approach for theories of networked learning and learning more widely. In particular, we suggest a possible ontology of elements of learning technology. The use of the word 'learning' here is somewhat problematic, as it is routinely used rather loosely to describe changes at multiple levels but which are likely to have rather different underlying mechanisms. A more thorough ontology of learning technology would allow us to distinguish between these uses and identify potentially distinct mechanisms at play in different forms and levels of learning.

Thirdly, we use this approach to explore how viewing learning technologies as sociotechnical networks helps to clarify our thinking about identities in social networking for personal, learning and professional purposes.

## **Keywords**

Sociotechnical systems, actor network theory, ontology, realism, networked learning.

## **Introduction**

Networked learning uses technology to promote connections for the purposes of learning (Jones & Steeples, 2002). Technology links the realms of the material world and the social world. Sociotechnical approaches to the study of technology emphasise the interaction of the social and material in the design and use of technology, generating a range of concepts and theories through which we can understand aspects of technology and their interaction with people. Understanding technology and its role in networked learning thus requires a theory or theories of both the material and social worlds and the interactions between them.

One way of linking these two realms has been to think of technologies in terms of networks of human and non-human/artefactual nodes, most notably through actor network theory (ANT). ANT has been critiqued for its ontological flatness and its insistence on a strong symmetry in human-artefact relations (e.g. Mutch, 2002). The beginnings of a less exigent network theory of technology can be seen in the concept of the sociotechnical interaction network (STIN) (Kling et al, 2003) which we have used in earlier accounts of learning technology in transnational trade union education (Walker & Creanor, 2009).

However, the STIN concept is rather under-developed. Most notably it is not explicitly linked to any wider theory of how society works. Here we attempt to use concepts from critical realist accounts of information systems and technology to extend a view of sociotechnical networks, and use this to explore some implications for the theory and praxis of networked learning, and in particular the emergence of professional identity as a pertinent issue.

## **A networked view of technology**

Views of technology, and digital technologies in particular, as sociotechnical networks (e.g. Kling et al, 2003; Lawson, 2008; Walsham, 1997) share a concern to include both the social and the material. These approaches mitigate the risks of falling into technological determinisms in which accounts of technology and change are reduced solely to accounts of the properties of artefacts. Actor network theory does this by denying any difference between human and artefactual agency in accounts of technical change and by reducing social phenomena to network effects operating at a single 'flat' level of analysis of interactions between human and non-human actants (Latour, 2005). Neither Lawson (2008) nor Kling et al (2003) place such stringent constraints on the roles of the nodes of their networks or the relationships between them.

Lawson's approach takes as a starting point Bhaskar's 'transformational model of social activity' (TMSA) (Bhaskar, 1998) which takes a relational view of social structure as networks of 'positioned practices', broadly similar to roles, that we assume in various aspects of our lives. These positioned practices and their relationships generally predate their occupation by a particular person (for example, the positioned practice of chairing a conference pre-exists its occupation by a particular individual, and will in all likelihood persist after that individual has left it). As we fulfil these roles we have the capacity either to reproduce them or to transform them more or less radically, depending, inter alia, on the interactions with other, neighbouring positioned practices. They do not, though, exist independently of the social practices which constitute them. Lawson distinguishes between the TMSA, with its focus on social activity, and what he terms a parallel 'transformational model of technical activity' or TMTA constituted by 'technical objects, which serve as the condition and consequence of technical activity, and technical subjects, those human agents involved in technical activity' (Lawson, 2008:5). In effect, technical objects are like social structures in that they both enable and constrain human activity.

For Lawson, technical objects are irreducibly social in two ways. Firstly they are the outcome of the social process of design. They carry in them the intentions and values of those individual, corporate and other actors involved in the design process. Secondly, they are social in the sense that they 'slot into' relationships among positioned practices; networked learning technologies are, in Kling et al's terms 'highly intertwined', and the slotting of technologies in to relations between, for example, tutors and learners seems fairly evident (Walker & Creanor, 2009), although Lawson argues that this view of 'slotting in' applies to all technical artefacts. As they become a part of mediating relations between positioned practices, they may or may not be enrolled in processes of social transformation (that is an empirical question) but the consequences of their introduction are enabled and constrained both by pre-existing social relations (as in the TMSA) and by their existence as technical objects (as in the TMTA).

Unlike ANT, using TMSA and TMTA as the basis for thinking about the relationships between technology and society allows us to consider multiple levels of social action through critical realism's commitment to emergence. We have already seen that networks of positioned practices differ from social networks in that they exist prior to, and after, their occupation by a particular individual. Particular sociotechnical arrangements might also exhibit properties that are dependent on the positioned practices that they encompass, but are irreducible to them. For example, a university consists of a range of positioned practices, including for example, cleaners, lecturers, researchers, heads of department, lab technicians, accountants and so on. However, the properties of a university as an institution are not reducible solely to the properties of individual practices; we can't explain the behaviour of a university solely by explaining the practice of even its most distinctive practices, like teaching or research. Similarly, most lecturers and researchers would not be able to function as such outside the relationships that constitute the university.

Fleetwood's (2005) 'ontology of the real', originally developed in the context of organisational studies, can help to clarify some of the elements of the relationships between technical object and the human in these (sociotechnical) networks. For a critical realist, something is real if it has an effect in the world. However, they

may be real in different ways. Lawson illustrates different modes of reality through the example of explaining why it is that a car stops at the traffic lights; an explanation would include both a description of gravity (albeit mediated by our theories and conceptions of it - in this case Newtonian physics would be adequate) and of the highway code. The former is real by virtue of its existence in the material world; the latter, by norms, conventions and social regulation mechanisms of which the Highway Code (in the UK) is a part. Fleetwood identifies four modes of reality in relation to organisational studies, derived from his ontology of the real from three 'ontological commitments' of critical realism: that entities (including the material world) exist independently of our knowledge of them; that our knowledge of these entities is, however, indirect and always mediated by our conceptions of them (and hence open to refutation); and that these entities exhibit different 'modes of reality'.

Fleetwood identifies material, ideal, social and artefactual modes of reality. Material reality refers to things, like the moon or the sea, that exist independently of what a person or community might 'say, do or think'. The dark side of the moon existed before any human knew what was or wasn't there; we didn't bring it into being by photographing it. The moon caused tides before humans understood that it did. Secondly, the 'ideally real' refers to discursive entities such as language, beliefs, theories and so on. These are real in the sense that they influence human behaviour and have causal effects in the world; people behave as they do because of the ways they understand the world. They may or may not have referents, and these referents may be other ideal entities, such as knowledge (of particular significance in education) or non-ideal entities. Importantly, our knowledge of material reality is always mediated by our theories and understandings of it. Thirdly, the socially real refers to practices or 'states of affairs', like childcare, teaching or other social structures (including organisations). They are social in that they depend on human activity, though importantly they may exist independently of our identification of them; for example, patriarchy and social class exist independently of whether or not they are or were recognised as such in a particular society. Again, though, our knowledge of these social realities is mediated by our theories and so on, and so have an ideal reality through which we recognise them. Fourthly, and of central significance here, is Fleetwood's 'artefactually' real as seen in tools such as computers. They are, he argues a synthesis of the material, ideal, and (along the lines discussed above) socially real.

We probably need to add a fifth mode of reality, and which is also an aspect of digital reality, the 'computationally real' by which we mean those aspects of a digital object which are real independently of any physical instantiation, and which have causal effects in the world. These might include for example cryptography (important elements of which are understood through mathematical reasoning) or an artefactual (in that it is designed and built) data structure. A digital artefact, such as a computer forum may have a material mode of reality (it is always viewed as part of a machine) but has a computational reality, such as its data structure, which is abstract but can cause a particular course of action to be easier or harder. We can infer that this is distinct from the material reality because the mechanisms we use for understanding computation are derived from mathematical reasoning rather than from scientific experiment.

While these modes of reality may be present in any networked learning artefacts, their relative significance and salience will be an empirical question, depending inter alia on the kind of research question we are asking.

## **Some implications for networked learning technology**

So, the artefactual is comprised of ideally, socially and materially (and in the case of digital technologies, computationally) real dimensions which identify the ways in which a technology is real through its consequences in the world. Drawing on Lawson (2008) and Kling (2000) in particular, we have elaborated two senses in which the artefactual is socially real. We have noted the ideally and materially real dimensions of an artefact, and suggested a further, computational, mode of reality of digital artefacts. However, our discussion this far has been entirely in the abstract. In Kling's (2000) terminology, networked learning technologies are examples of exactly the kind of "highly entwined" technologies for which his sociotechnical interaction network was intended<sup>1</sup>, so we might reasonably expect these ideas to have significance for networked learning.

---

<sup>1</sup> Kling et al (2003) do not claim their 'sociotechnical interaction network' as way of thinking about all technologies, but make the more modest claim that it provides a valuable heuristic in the case of 'highly entwined' digital technologies. Lawson (2008) does not place such a constraint on his sociotechnical network perspective, only that it applies to all 'technical' objects (as distinct, for example, from food or art).

The concepts of sociotechnical network and multiple modes of reality both encourage us to think more broadly about networked learning technologies. We suggest that considering a technical object's modes of reality inevitably steers us away from a simple determinism based on the inherent properties of a particular technology and towards a richer understanding of the multiple causal effects at play. Below, we illustrate this through sketching examples of contemporary issues in networked learning to highlight how the different modes of reality might be involved in understanding the sociotechnical networks involved.

#### *Social reality*

As noted above, we can distinguish two ways in which technical objects are irreducibly social; their location in sociotechnical networks, as nodes or in 'slots' among positioned practices, and the way in which their particular instantiation reflects the social practices, values, theories, and so on held by participants in the design process.

#### *Artefacts and positioned practices*

We would like to consider some of the implications of this approach for the study of networked learning technology. We suggest that viewing networked learning as heterogeneous networks of positioned practices and technical artefacts has at least two significant sets of implications.

Firstly, with any highly intertwined technologies, and not solely learning technologies, we can examine the way pre-existing sociotechnical networks can both condition and be changed by the development of particular technical artefacts. That is, a technical object and its consequences cannot be considered independently of the sociotechnical networks which design, build and use it. Kling (2000) argues that his sociotechnical network approach implies an 'ecological' view of technologies in which technical objects exist in networks whose components are also members of other sociotechnical networks as well as any particular sociotechnical network that we might be studying. This is reflected in the concept of 'learning ecologies' which have emerged from research into the role of web 2.0 and social networking on learning and the learner experience (Creanor & Trinder, 2010). Viewing these ecologies allows us readily to analyse the relationships between positioned practices and technologies in the institutionalisation of learning technologies.

The familiar tutor-student, expert-novice relationships which have evolved over an extended period of time, and which have influenced communication, interaction and power relations between tutor and learner, are now being revisited (Anderson, 2003; Selwyn, 2010). Long established pedagogies are being reviewed, with innovative theoretical concepts and frameworks emerging in direct response to new possibilities presented by increasingly intertwined and connected technologies (e.g. Siemens, 2004; Ravenscroft, 2009). The boundaries of networked learning have become much less contained and constrained than before, with Web 2.0 and social networking applications undermining tutor control over the learning environment and leading to the emergence of an 'underworld' of communication amongst learners (Creanor et al, 2006).

In some cases the adoption of networked learning technologies has been accompanied by the conscious design of new roles. Creanor & Walker (2005) refer to 'network animateurs' & 'barefoot pedagogues' in transnational and national trade union education contexts respectively (TUC report, 2005). Network animateurs were nominated by trade union organisations to lead and manage distributed online networks of European trade unionists. Walker (2004) identifies seven 'aspects' of animation from a transnational European project: ambassador (primarily a 'backstage' function resolving issues between the online network and other organisational structures, for example around legitimacy); archivist (implementing policies for dealing with content 'past its sell-by date'); chair (leading/facilitating discussions on specific topics and managing the network agenda); host (maintaining a socially supportive environment); librarian (managing online information within the online structures set up for the network); support (first-line/expert user-level technical support and management of communications with specialist support functions) and weaver (concerned with pulling together substantive threads of discussion and synthesising contributions distinguished from task-oriented chairing). Few are likely to be able to fulfil all of these roles simultaneously suggesting animation as a team or distributed activity. The 'barefoot pedagogue' refers to planned developments in the Swedish trade union movement to train trade union officers in elements both of educational (pedagogic) practice and technology, particularly in relation to needs assessment in both areas, such that they can diagnose opportunities for learning and technology interventions in both areas as part of their ongoing trade union officer responsibilities. To date there is little empirical evidence of the experience of this initiative. The 'barefoot pedagogue' concept is similar to the 'Occasional Facilitators' trained in popular education methods by the Canadian Union of Public Employees

during the 1990s, and members of the Public Service Alliance of Canada's Alliance Facilitators' Network, who were trained to identify learning needs and develop appropriate modules (Taylor, 2002).

In more formal educational settings, in the UK at least, we have seen attempts to identify and to some extent institutionalise roles associated with learning technologies (Conole et al, 2007), for example through the Association For Learning Technology's (ALT) Certified Membership scheme (CMALT). The scheme aims to certify as 'learning technologists' people who "are actively involved in managing, researching, supporting or enabling learning with the use of learning technology". This is clearly a wide range of activities which are themselves being absorbed into and changing traditional 'positioned practices' in education, such as those of academics and various types of support staff. The scheme includes a range of specialist options such as evaluation, interface design and VLE administration each of which relates to some aspect of an effective networked learning infrastructure. It is evident therefore, that the pedagogical and technological design of networked learning will have implications for these positioned practices, not all of which are predictable or entirely manageable. These are likely to include uncertainties over the role of tutors and their professional identities as both subject and pedagogical experts, and that of learners as they adjust their expectations of consuming knowledge to that of investigating, sharing and creating knowledge as autonomous learners (De Laat et al, 2007; Goodyear et al, 2005).

The preceding discussion of how positioned practices in education might be evolving in relation to changing technological artefacts could in principle apply to use of networked technologies in any context, not just educational. It may be, though, that one of the distinguishing features of sociotechnical networks in education is that they are established precisely to change some aspect of the knowledge, skills or behaviour of the occupants of at least one positioned practice, the learner. While we are not in a position to explore this in more detail at the moment, we suggest that a critical realist view of emergence might be of real value in helping us to disentangle quite what we mean by learning and the underlying mechanisms involved. We suspect, for example, that much of the current debate around the significance or otherwise of connectivism which argues that 'knowledge is in the connections: learning is the forming of connections' (Siemens, 2004), is hampered by a lack of a clear ontology which would help to clarify the nature of learning through the technology-supported 'connection forming' process. Some types of learning may well be analysable in terms of the reorganisation of a learner's links both to other people and to new resources. We would expect to see such changes reflected in the reorganisation of a learner's personal sociotechnical network ('ego-sociotechnical network', as we have referred to this elsewhere). However, it does not follow that this is a new learning paradigm or some such. It does not negate other forms of learning (for example the drill-and-practice learning which remains necessary in the study of subjects such as music or sport).

### *Inscribing the social*

The second sense in which technical artefacts are irreducibly social is that they carry in them the values and theories of their designers. For example, one difference between many social media and those designed specifically for use in education is the way in which different roles are inscribed into the technology. Audiographic software like Elluminate for example, is designed to support real time online audio (and, where network quality allows, video) interactions modelled on the traditional tutorial (Kear et al, 2012). Typically a tutor will have 'moderator' privileges which allow them to structure and control the flow of communication, for example by determining when others may speak, controlling access to a whiteboard or screensharing facilities, or by allocating 'students' to small groups. Arguably for very good reason, the software design carries in it an echo of the social arrangements of the traditional classroom. That it could be otherwise, though, is clear from a quick look at other widely used internet-based video/audio tools such as Skype or more recently chatroulette.com or Google hangouts, which do not have these relationships inscribed in them. We might expect to see (for better or for worse) rather different patterns of behaviour emerge in these instances.

### *Ideal reality*

Fleetwood's identification of the 'ideally real' is critical in differentiating his approach from a simple empiricism. While the social and material modes of reality may exist independently of our knowledge of them, our knowledge is always mediated by our theories, concepts and so on. In thinking about technologies, this is essentially equivalent to Orlikowski & Gash's (1994) 'technological frames'; the differing understandings and concepts that relevant social groups (to borrow a term from the social construction of technology literature) have has significant implications for how networked learning is designed and appropriate sociotechnical connections created or enabled. Orlikowski and Gash demonstrate the significance of differing technological frames in influencing subsequent technology use between different groups in a large consultancy firm. Where different

groups' frames are incongruent we might expect greater difficulty and conflict in building or reconfiguring a sociotechnical network.

While we are not able here to explore in detail technological frames associated with particular technologies, some general perspectives seem prevalent among learning technologists. One of these, for example, is a widespread view that we need to stay abreast of rapidly changing technologies, displaying 'a commitment to keep up to date with new technologies (ALT, n.d.). Many educators appropriate technologies developed for other, often business related, purposes, resulting in the need for constant horizon scanning and continuing research into their potential for learning (Johnson et al, 2011; Conole, Galley and Culver, 2011). In so doing, we run up against the different, and varied, frames of other groups, most notably of learners. While some educators have shown a commitment to the use of social networking sites, such as Facebook.com, to communicate with students, as a way of 'taking the learning to where the student is', it is clear that not all students see Facebook as a learning technology and reject it as an educational tool. Its effectiveness as a networked learning tool depends inter alia on a congruence of the technological frames of educators and (potential) learners. These frames are themselves social and political constructions) which may be changed and managed over time (Lin & Silva, 2005) , or congeal and prove remarkably resilient. In either case they are significant in the behaviour of the overall sociotechnical network.

### *Material reality*

There is a great deal of contemporary interest in 'mobile' learning, an emerging sub-discipline with its own journals and conferences. There are extensive definitional debates about what precisely constitutes 'mobile learning' (e.g. Traxler, 2009) but despite the efforts to broaden the definition away from the digital mobile device, to include definitions such as 'anytime, anyplace' learning or 'taking learning to individuals, communities and countries that were previously too remote' (Traxler 2009:3), it is hard to avoid the conclusion that were there no mobile phones or portable computing devices, we would not be discussing mobile learning in these terms<sup>2</sup>. However, we would argue that the distinctive materiality of small digital devices does have consequences in the world. They are small, lightweight, have communication capacity and (often overlooked, see Bissell, 2011) contain the results of remarkable developments in battery technology. These material attributes of the technology are real and have consequences; until portable networked devices became commonplace, a whole raft of practices would not have been feasible.

Importantly, though, this is not to argue that these material features determine any particular approach to learning (or, indeed, any other realm of life). The actual devices have been created through deeply social processes which have resulted in the inscription into the way they work of particular sets of values. Most obviously, some devices are strongly linked into aggressively monopolistic business practices for network connections and the distribution of data. In this case, it is easy to see how mobile devices could have been different; instead we appear to have a decreasingly diverse mobile infrastructure. As noted above, educators' technological frames often include horizon scanning for new developments that may usefully be recontextualised into learning. Again, this is a deeply social process which, in the case of mobile technologies has led educators and researchers to create the social institutions of journals, books and conferences specifically on the subject legitimating mobile technologies as an area of study. Learners too have their own agency in the understanding and use of these technologies. South African students' understanding of the role and significance of mobile technologies, and their practices in using them are markedly different from those in, say, the UK (Czerniewicz et al, 2009).

The central lesson here, we suggest, is that in recognising that the material and computational realities of particular artefacts, we need not immediately lapse into technological determinism. The technologies remain 'irreducibly social', but the artefacts may still place constraints on our interpretive flexibility.

## **Discussion and conclusions**

This paper has focussed on ways of conceptualising the relationships between the social and the technical in networked learning as sociotechnical networks. We have borrowed from Fleetwood's 'ontology of the real' to examine the different ways in which the social and the technical may interact. We have linked this ontology of the real to networked views of technology in general, and networked learning in particular. We have attempted

---

<sup>2</sup> It is not uncommon for OU academics to comment on the frequency with which they see students with traditional OU textbooks working on trains in debates about the cost/value of printed learning resources, but this form of mobility is rarely discussed in the mobile learning literature.

to illustrate the potential significance of such an approach with examples from the networked learning literature in which the differing modes of reality are significant. This should not be taken to imply that certain cases display particular modes of reality, or that they are all present in all cases, but that the relative significance varies and is to be determined empirically.

This approach offers a way of thinking about technology which locates artefacts in networks of social relations and conceptions of technology, avoiding reductive technological determinism. It does, though, allow us to consider enablements and constraints that particular artefacts are likely to place on our action. Importantly, it allows us to avoid recourse (as in actor network theory) to treating artefacts and humans as essentially equivalent.

There is one final, important point to be made. In our focus on conceptualising technology within sociotechnical networks, we have not attempted to consider all of the forces at play in shaping the development of these networks. It is clearly the case that our approach to networked learning technologies will be greatly influenced by widespread, and drastic, reduction in public spending on education in general, and higher education in particular. It will be tempting for policy makers to use the rhetoric of technology to argue that we can 'do more with less'. It is likely that some technological evangelists will respond to this with, to coin a phrase 'yes we can!'. In understanding the likely future evolution of networked learning technologies, we suggest we need to retain a critical, even sceptical, edge to our considerations of what technology can deliver. To use the terminology of our paper, studying the the perspectives and technological frames of educators (and learners) will help us develop a deeper ontological understanding of networked learning, leading to more pedagogically effective design and use.

## References

- ALT (n.d.) CMALT Prospectus, <http://www.alt.ac.uk/get-involved/certified-membership/cmalt-support>
- Anderson, T. (2003) Modes of Interaction in Distance Education: recent developments and research questions, in M.G. Moore & W.G. Anderson (Eds) Handbook of Distance Education, 129-144, New Jersey: Lawrence Erlbaum Associates
- Bhaskar, R. (1998) The Possibility of Naturalism: A Philosophical Critique of the Contemporary Human Sciences (3rd Ed.), London, Routledge
- Bissell, C. (2011) 'The information revolution': taking a long view in Ramage, M. & Chapman, D. (Eds.) Perspectives on Information. Abingdon, UK, Routledge.
- Conole, G., Galley, R., & Culver, J. (2011) Frameworks for Understanding the nature of Interactions, Networking and Community in a Social Networking Site for Academic Practice, International Review of Research in Open and Distance Learning, 12, 3, 119-138
- Conole, G., White, S. & Oliver, M. (2007), The impact of e-learning on organisational roles and structures, in G. Conole & M. Oliver (Eds) Contemporary perspectives in e-learning research: themes, methods and impact on practice, 69-81, Abingdon: Routledge
- Creanor, L. & Trinder, K. (2010) Managing Study and Life with Technology, in R. Sharpe, H. Beetham and S. de Freitas.(Eds), Rethinking Learning for a Digital Age: How Learners are Shaping their Own Experiences, Routledge
- Creanor, L., Trinder, K., Gowan, D., Howells, C. (2006) The Learner Experience of E-Learning Final Report, JISC, available online at [www.jisc.ac.uk/uploaded.../LEX%20Final%20Report\\_August06.pdf](http://www.jisc.ac.uk/uploaded.../LEX%20Final%20Report_August06.pdf)
- Czerniewicz, L., Williams, K. & Brown, C. (2009) Students make a plan: understanding student agency in constraining conditions. ALT-J, 17, 75-88.
- De Laat, M., Lally, V., Lipponen, L. & Simons, R.J. (2007) Online teaching in networked learning communities: A multi-method approach to studying the role of the teacher, *Instructional Science* 35, 3, 257-286
- Fleetwood, S. (2005) Ontology in Organization and Management Studies: A Critical Realist Perspective. Organization, 12, 197-222.
- Giddens, A. (1984), The Constitution of Society: Outline of the Theory of Structuration, Cambridge: Polity Press
- Goodyear, P., Jones, C., Asensio, M., Hodgson, V., & Steeples, C. (2005) Networked Learning in Higher Education: Students' Expectations and Experiences, Higher Education, 50, 3, 473-508,
- Johnson, L., Smith, R., Willis, H., Levine, A., and Haywood, K., (2011). The 2011 Horizon Report. Austin, Texas: The New Media Consortium.

- Jones, C. & Dirckinck-Holmfeld, L. (2009) Analysing Networked Learning Practices: An Introduction. In Dirckinck-Holmfeld, L., Jones, C. & Lindström, B. (Eds.) *Analysing Networked Learning Practices in Higher Education and Professional Development*. Rotterdam, Sense Publishing.
- Jones C. & Steeples C. (2002) Perspectives and Issues in Networked Learning, in Steeples, C. and Jones, C. (Eds.), *Networked Learning: Perspectives and Issues*, 1-12, London: Springer Verlag.
- Kear, K., Chetwynd, F., Williams, J. & Donelan, H. (2012) Web conferencing for synchronous online tutorials: perspectives of tutors using a new medium. *Computers & Education*, 58, 953-963.
- Kling, R. (2000) Learning About Information Technologies and Social Change: The Contribution of Social Informatics, *The Information Society*, 16 (3), 217-232
- Kling, R., Mckim, G. & King, A. (2003) A bit more to it: Scholarly communication forums as socio- technical interaction networks. *Journal of the American Society for Information Science and Technology*, 54, 47-67
- Latour, B. (2005) *Reassembling the social: An introduction to actor network theory*, Oxford University Press, Oxford
- Lawson, C. (2008) An Ontology of Technology: Artefacts, Relations and Functions, *Techné: Research in Philosophy and Technology*, Virginia Tech, 11 (1) <http://scholar.lib.vt.edu/ejournals/SPT/v12n1/lawson.html>
- Lin, A. & Silva, L. (2005) The social and political construction of technological frames. *European Journal of Information Systems*, 14, 49-59.
- Mutch, A. (2002) Actors and Networks or Agents and Structures: Towards a Realist View of Information Systems. *Organization*, 9, 477-496.
- Mutch, A. (2009) Technology, Organization, and Structure - A Morphogenetic Approach. *Organization Science*, published online before print July 28, 2009, DOI: 10.1287/orsc.1090.0441. , 1-14.
- Orlikowski, W. & Gash, D. (1994) Technological Frames: Making Sense of Information Technology in Organizations'. *ACM Transactions on Information Systems*, 12, 174-207.
- Ravenscroft, A. (2009), Social software, Web 2.0 and learning: status and implications of an evolving paradigm. *Journal of Computer Assisted Learning*, 25: 1-5.
- Siemens, G. (2004) Connectivism: a learning theory for the digital age, available online at E-Learn Space <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.87.3793&rep=rep1&type=pdf>
- Selwyn, N. (2010) Looking Beyond Learning: notes towards the critical study of learning technology, *Journal for Computer Assisted Learning*, 26, 1, 65-73
- Taylor, J. (2002) Union e-learning in Canada. IN SPENCER, B. (Ed.) *Unions and Learning in a Global Economy: International and Comparative Perspectives*. Toronto, Thompson Educational Publishing.
- Traxler, J. (2009) Learning in a Mobile Age, [International Journal of Mobile and Blended Learning](#), 1 (1), 1-12
- Walker, S. (2004) *Dialog On Project Evaluation Report*. European Trade Union College
- Walker, S. & Creanor, L. (2009) The STIN in the tale: a sociotechnical interaction perspective on networked learning. *Journal of Educational Technology and Society*, 12, 305-316.
- Walsham, G. (1997) Actor network theory and IS research: current status and future prospects in Lee, A. S., Liebenau, J. & Degross, J. (Eds.) *Information Systems and Qualitative Research*. London, Chapman Hall.
- Williams, R., Karousou, R. & Mackness, J. (2011) Emergent Learning and Learning Ecologies in Web 2.0, *International Review of Research in Open and Distance Learning*, 12, 3, 39-59