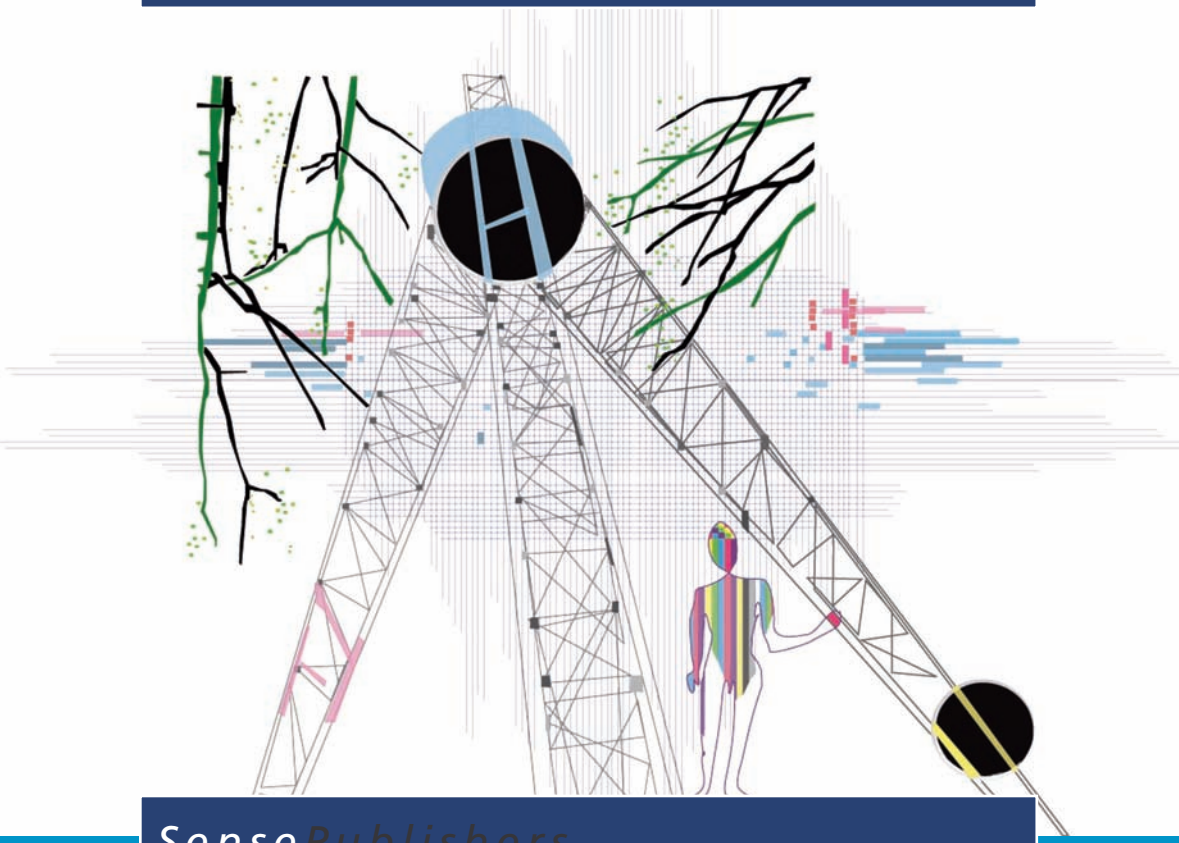
TECHNOLOGY ENHANCED LEARNING

Analysing Networked Learning Practices in Higher Education and Continuing Professional Development

Lone Dirckinck-Holmfeld, Chris Jones and Berner Lindström (Eds.)



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Analysing Networked Learning Practices in Higher Education and Continuing Professional Development

TECHNOLOGY ENHANCED LEARNING
Volume 4

Scope
The rapid co-evolution of technology and learning is offering new ways to represent knowledge, new educational practices, and new global communities of learners. Yet the contribution of these changes to formal education is largely unexplored, along with possibilities for deepening our understanding of what and how to learn. Similarly, the convergence of personal technologies offers new opportunities for informal, conversational and situated learning. But this is widening the gulf between everyday learning and formal education, which is struggling to adapt pedagogies and curricula that were established in a pre-digital age.

This series, *Technology Enhanced Learning*, will explore learning futures that incorporate digital technologies in innovative and transformative ways. It will elaborate issues including the design of learning experiences that connect formal and informal contexts; the evolution of learning and technology; new social and cultural contexts for learning with technology; novel questions of design, computational expression, collaboration and intelligence; social exclusion and inclusion in an age of personal and mobile technology; and attempts to broaden practical and theoretical perspectives on cognition, community and epistemology.

The series will be of interest to researchers and students in education and computing, to educational policy makers, and to the general public with an interest in the future of learning with technology.

Analysing Networked Learning Practices in Higher Education and Continuing Professional Development

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PETER GOODYEAR

FOREWORD

"…whereas for farmers and herdsman, the tool is an instrument of control, for hunters and gatherers it would better be regarded as an instrument of revelation."

Ingold, 1993, p. 441

"…you should not confuse the network that is drawn by the description and the network that is used to make the description."

Latour, 2005, p. 142

INTRODUCTION

First up, I want to try to describe how this book succeeds in avoiding three of the endemic failings of the educational technology literature. This will help position it in the intellectual landscape where technology and learning meet and, I hope, will help explain why it is worth reading.

The literature is suffused with material produced by innovative practitioners, whose enthusiasm is catching, but whose shareable insights are limited by the constraints of everyday language. Reflection without theory is trapped in the idea scape of folk psychology. Of course, there is also a small and impressive literature which is deeply coloured by theory – especially the theory of high modernity which can paint any practical activity into a corner. Foucault and co have been terrific at helping us see the invisible: the insidious intrusions of power, the power of language, the incoherent flux of the self. But critical theory can be seen as a luxury enjoyed by the intellectual aristocracy who live on the rents of cultural capital. It is not of obvious use to those who must work for a living. Then we have the books on self-improvement – the 'how to' manuals that explain the best way to catch the latest wave. These draw on theory, but so simplify the world that one wonders about their possible relations with action.

This book is rich in theory – it cuts below the surface and upsets everyday assumptions about people, tools and learning. It is by people who work for a living. For good and ill they are enmeshed in the imperatives of action. They teach and design and want to get better at doing what they do. Their action, experience, reflection, teaching, learning and writing are disciplined by a sense that what matters is not always obvious.

Secondly, I want to consider some key terms.

Networked learning is a diffuse idea. It's hard to believe that it would work analytically – that one would be able to distinguish between 'networked' and 'non-networked' learning situations, other than in trivial cases. In all of the studies presented in this book, everyone has access to the Internet and significant parts of what they do, and what they learn from their activity, involve connections that depend upon the net. Everything is networked learning. Perhaps it is better understood as an organisational fiction, of a pedagogical kind. People involved in networked learning agree to make sense of what they are doing by acknowledging the salience of technology-mediated connections. *Then* we can study what this *means* to them, and how it differs from other mutually defined pedagogical arrangements. Or perhaps what one needs to do, rather than patrol definitional boundaries, is look at characteristic practices. Some of these chapters do exactly that. For instance, engaging in online textual discourse, attenuated over time and space, or packed densely into a realtime chat, is a central practice of much networked learning and teaching. Richer conceptions of text and language; persistence and evanescence; genre, voice, writer, speaker, reader and listener, can help us all towards a better understanding of how to act in helpful and comprehensible ways.

Neither is *learning* straightforward, as an idea. It can be implicit or intentional. It can happen in formally arranged circumstances, but often doesn't. There's some fudging about whether it denotes a change in a person – in what they understand or what they can do – or a set of cultural practices. I'm probably odd in preferring the former, and wanting the freedom to be able to talk about what people think, believe and take with them as they move from place to place. Of course, what one thinks, and can do (and believing involves both) is bound up with place in subtle but powerful ways. These things are situated. But they *are*.

I think there is real merit in distinguishing between learning – seen as change in an individual's capabilities – and the complex mix of activities that are intended to provoke one's learning. Reading, writing, listening, explaining, searching, browsing, puzzling; flicking through notes, highlighting quotes, drafting, polishing; tidying one's books, sharpening pencils, finding peace and quiet…all these things are necessary, from time to time. All of them count, when we are thinking about how activity is structured and how technology and activity shape each other.

If nothing else, my writing about educational design has insisted upon the centrality of activity – what people do when they are trying to learn is what should matter to teachers and/as educational designers. Tasks, tools, resources, infrastructure succeed or fail in relation to such activity.

Understanding the character and limits of *design* is important in networked learning. I originally used analogies with ergonomics and especially with architecture to rethink educational design and I still find them useful sources of insight. Architecture involves the crafting of affordances, rather than deterministic logics of human control. Architecture has methods for managing complexity – not just complexities of construction but also complexities of representation and design. Architecture draws on multiple sources of knowledge and combines ways of knowing. It understands people from – at least – the perspectives of biology, psychology and culture.

It understands – at least – the physics, geometry, economics, aesthetics and history of buildings. Its practices are imbued with epistemic fluency, to a degree that makes many educationalists look, unexpectedly, like members of the Spanish Inquisition.

It is not much of a stretch to think architecturally about relations between activity and infrastructure (a strong sub-theme in this book). Educational design *has* to do this. In the case of networked learning, design attention has to be paid to the pros and cons at multiple choice points where tools and artefacts can be offered in material or digital form. The accelerating substitutability of material and digital versions of elements of infrastructure adds to the complexity of design. We no longer have a simple choice between local and distance learning, or between online and face-to-face courses. It becomes easier to construct a blend of many different components – but this *adds* complexity to *design*. So does the growing availability of tools and artefacts, and other elements of infrastructure, that combine material and digital components. These design considerations can be located on an axis linking space; place and activity (see Figure 2 in chapter 1, below). On this axis, teachers and other educational designers co-configure learnplaces with students. Moreover, this co-construction has both consciously planful and organically evolving moments. Vernacular design, like gardening and *bricolage*, is not easily separated from everyday action. Buildings, gardens and cities are shaped by repeated actions, as well as shaping those actions. They bear the traces, and in some ways *are* the traces, of repeated action. As Stewart Brand would put it, good buildings learn from their inhabitants. In the same way, the shifting mix of digital and material tools, artefacts, etc that come to constitute the infrastructures for networked learning are shaped and reshaped by their 'users'. Learnplaces are places that learn, as well as places for learning. Understanding the force of *indirection* in design requires at least this sense of the multiple agencies at work.

Moreover, the notions of indirection and architecture do not just apply to infrastructure. There are also architectures for the division of labour – for the multitude of ways that people, as students, might usefully be invited to work together and identify with one another. From dyads to global communities of inquiry, thinking about the design of architectures of collaboration invokes the axis I have (awkwardly) labelled 'organisational forms – community – activity'. To catch it simply, the place – space axis is concerned with the physically situated aspects of activity; the organisational forms – community axis is concerned with the socially situated aspects of activity. The first is about things; the second about people – how they work together, what they feel about each other, etc. This 'people' axis identifies an important design component. It says nothing about the value of one division of labour, or set of social arrangements, over another.

Looking beyond things and people, there are also architectures of outcomes, of tasks and activities, of cognition, beliefs, practices, etc. My point is not to use architecture as some way of smuggling back in some kind of structuralist supremacy. Rather, it is to help say that teachers can:

– work within the tight confines of classical instructional design, with its determinism and logics of control, or

– abandon all hope of taking useful action – leaving it to students to sort themselves out, or
– accept the challenge of discharging their professional responsibilities in a design environment which is complex and challenging, but not unlike the design environments in which other professionals (such as architects) have learned to survive, and sometimes succeed.

If this third way is accepted, and I see no other route forward for networked learning practitioners, then at least three significant implications follow. First comes an acceptance of the need for epistemic fluency: that no *one* way of knowing or source of knowledge is enough. We need psychology, anthropology, philosophy, ergonomics, computer science and more. We need to see how each of these can inform different kinds or levels of design decision. (For example, screen-based communication cannot ignore what we know from studies of perception in Human Computer Interaction. Reading this literature does not make us traitors to the cause of social practice theory.) Secondly, we need to be much more energetic and noisy in explaining to all those who shape curricula, learning infrastructures, educational quality assurance policies, etc, that macro and micro are not independent and both are important. Universities, in particular, are singularly inept at linking infrastructure planning and pedagogical planning, and at seeing how decisions at the macro level can thwart the best of intentions at the micro level. Several chapters in this book are particularly good at examining the meso level, which turns out to be key in understanding the interactions up and down the scale levels in educational organizations. Finally, we need to locate design in the context of self-organising systems. Networked learning systems – let's pretend they exist – evolve through the actions of teachers and students (and others, like IT developers). It's not clear that evolution as the consequence of a multitude of *independent* actions, rather than socially-organised actions, is necessarily the best way to advance. So part of the design challenge is to strengthen self-awareness. That is, a networked learning system might be seen as evolving most successfully when the people involved in it spend at least some of their time thinking and talking about, and acting on, the system level. In an important sense, *pace* Bruno, a healthy networked learning community needs tools to describe itself.

This is where the book in front of you plays an essential role. I cannot recommend a better toolkit for networked learning communities in search of self-understanding.

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ANALYSING NETWORKED LEARNING PRACTICES

An Introduction

O! this learning, what a thing it is.

William Shakespeare, The Taming of the Shrew

We live in an age of rapid technological and social change. Education is fundamentally implicated in these changes. It is affected by changes arising in other sectors of society, such as the growth in new networked digital technologies and the rapid integration of economies on a world scale. Conversely education and training are themselves motors of social change. Governments and large business organisations see themselves as operating in a climate of economic competition in which knowledge and knowledge workers are key resources enabling them to gain competitive advantage over others. As a consequence education and training are central to contemporary social and economic change and they are key sectors actively engaged in the conception of the future bringing about the new social forms emerging alongside digital and networked technologies.

For the education sector in general digital networks seem to offer novel ways to make learning universal, while also offering us the potential to share human knowledge in a manner that would previously have seemed utopian. When Ivan Illich wrote about de-schooling society, in the very early days of computing, he imagined being able to network expertise and interests in ways that then seemed technically difficult, using a mix of computer databases, mail and telephone (Illich, 1970). It is still shocking to read Illich writing using the terminology of learning webs, educational objects, skill exchanges and peer matching. These ideas still find their echoes amongst the most technologically forward looking research activities today. The technological elements of Illich's learning webs are now available on any networked computer, both commonplace and relatively simple to use, yet educational practice has remained, in some significant ways, largely unchanged. How is it that digital technologies can infuse social life so fully and seem to offer such radical and simple solutions to educational problems but regularly turn out to be difficult to embed in day-to-day educational practice (Cuban, 2001)? This book sets out to examine what we know about productive learning in networked environments and to draw out some conceptual developments that may help us to bridge the gap between the potential of digital networks and current educational practice.

L. Dirckinck-Holmfeld, C. Jones and B. Lindström (eds.), Analysing Networked Learning Practices in Higher Education and Continuing Professional Development, 1–27.

To give readers a flavour of the changes taking place and how they affect student experiences of higher education we begin with three brief vignettes of life as it is already being lived in tertiary education in a networked society.

VIGNETTE 1 – THE 'NET GENERATION' UNDERGRADUATE

Anna is an undergraduate student at a large urban university. She lives in student accommodation that has a broadband connection available in every room. She has her own basic laptop computer and a good mobile phone both of which she uses for social life and pleasure as well as work.

When Anna gets up in the morning one of the first things she does is to turn on her computer. As she makes a hot drink she logs on to the network and launches her preferred social networking site and an instant messaging (IM) service launches automatically in the background. As she eats a quick breakfast she reads messages posted to her Facebook 'wall'. She reads that Nina has had her mobile (cell) phone stolen while she was out last night and is asking everyone to send her their mobile numbers so she can reconstruct her address book. Her boyfriend Tom, who is at another university has left a short message in which he complains about being up late writing his dissertation, "Dissertations suck!" is his main comment. He has been joined on her wall by her cousin who is a post grad in another city, she agrees with him that "dissertations suck" and she goes on to complain about the quality of supervision on her masters course.

As she begins to wake up Anna checks her schedule and re-reads the briefing for her next assessment. She isn't clear what the question means and sends an IM to Vicki, another student on her course to ask what she thinks the question means. She then leaves the computer to take a shower and get herself ready for classes.

The classes Anna attends are lectures and seminars that entail small group activities. The university buildings she works in are spread over a large area of the town. All rooms in the university buildings are equipped with computers, fast Internet access and projection equipment. Some of her classes are in dedicated computer labs but increasingly the university is replacing older class rooms with new areas that have wireless networks and are intended to enable an integration of mobile devices with the physical environment. These areas are more flexible spaces and look nothing like the old classrooms. Some have glass walls and can be easily reconfigured. Corridors are wide and comfortable interspersed with lounge areas and workstations where individuals and groups can stand around and discuss their work. There is wireless access and there are power points everywhere in the new areas. Anna takes her laptop with her and always has here mobile phone switched on, though she has it on silent during classes.

During the day's work Anna moves between online and offline status depending on her location. In the afternoon she works in the library, which has good wireless access but restricts the way she can work face to face with others because most areas are intended for quiet personal use. She arranges to meet her group after the library in the coffee shop because they can talk more freely and the wireless connection is good. She is always in touch with others, contacting her local friends

and arranging meetings or discussing work. Often she is keeping up with her extended network of friends around the country and beyond.

In the evening she arranges to watch DVDs with some friends in one of their rooms. Before they meet she works online in her room, moving seamlessly between a number of applications on her computer, some involving work and others just for pleasure. She downloads music, sends email and has IM conversations and posts messages on social networking sites. She is rarely completely alone in the virtual world, even when she sits alone in her study bedroom. After watching DVDs for a few hours she returns to her room, checks her messages and puts the computer on standby. Sometimes when she cannot sleep she turns the computer back on and checks or sends messages. Her mobile phone is by the side of her bed, primarily as an alarm clock but it is also a source of further interruptions because messages come in even late into the night.

VIGNETTE 2 – THE DISTANCE STUDENT

Shah lives abroad and has recently signed on to a Distance University course because the university has a good international reputation and it is part of a national system that he thought would be well regarded by prospective employers. As an ex-patriot he could have signed up with a University back home but he thought this would work out better if he continued to work abroad or for other multinational companies – even if he eventually went back home. When he gets the chance he does some of his work in the office on the company Intranet, but this is not always reliable because of the local firewall, which blocks some content. It is easier for him than working from home because the place they rent is open plan and the kids are always playing when he wants to work. His computer is also the family computer and it is tucked away in a corner of the main room. His wife tries to distract the kids or take them out when he needs to work, but it isn't fair on her to do this all the time. The kids also want to use his computer, which is the best for games and the Internet. This means that he often works late into the night after they have all gone to bed, even though it makes him tired the next day.

Shah's job is very demanding and his studies have to fit in around his work schedule which isn't easy. For example, he had a piece of work due for completion this week but there was a project report for work due at the same time, so he found himself balancing two heavy demands on his time. Worse than that they were both tasks that needed 'thinking space' – it wasn't just the time he lacked – it was the physical and mental space needed to let his thinking develop and mature. He has begun to talk to some of the other students about this. As the course progresses he has found others on the course in a similar position to his own and one in particular in a similar job and time zone. They use IM to keep in touch day-to-day, but his other contacts with the course are less regular. His study is largely solitary and he works at times when most other students aren't online because of their different time zones and working patterns.

He has tried to use smart phone to read some documents but he finds it difficult to read anything very long on the small screen. He likes to listen to some things

that are podcast and he can listen to them whilst driving to work. Shah tries to imagine the other students. Some have their own blogs and they have personal spaces on some social networking sites that gave a little insight into their lives. He finds it important to look at photographs of the people he is working with, even though he gets some sense of the person from what they write. In fact he has been shocked on some occasions when he saw a photograph and the person was not at all how he had imagined them to be. Shah wonders if that is because he does not know the places they come from so he has filled out the details of what he doesn't know with images from work or the TV. Perhaps they do the same when thinking about him. That is the reason he has started his own blog 'Ex-pat Tales', which isn't for study but helps him work out his ideas and present himself as more than just a student.

VIGNETTE 3 – THE BUSY PROFESSIONAL POST-GRADUATE

Laura starts her work in the Virtual U, the online university system on Sunday at lunch time. At the moment she is part of a group with four other students, all male and all with different professional backgrounds. One is a university manager employed as a student counsellor; another is an educational designer in an international company, while the others are teachers in higher education. Yesterday Laura arrived back from a seminar at one of the participating universities where the group was formed. The seminar ran from Thursday to Saturday and they were together for two full days. There will be four seminars held during the year. All Laura's other study activities take place in the online environment. On the first evening of the seminar the course groups for the full semester had been established. Laura is part of a group that totals fifty students this year and they are split into ten sub-groups. Laura was pleased that the process went surprisingly smoothly. The tutors had used a special technique to help them form the sub-groups. Laura had an idea of who everyone was before she met them because they had already presented themselves online, providing an initial introduction to each other before the seminar.

Laura thought that the seminar program was very comprehensive with a lot of activities. At the seminar, there was a hands on demonstration and an introduction to the online system. Laura was happy that they had included a session on communication and collaboration in networked learning environments because this was a new way of working for her. This session was run by older more experienced students so that each course group met a group of older students. Laura had enjoyed meeting with the more experienced students and thought this was a very effective way of introducing her to this new way of working and to a problem based style of teaching. On the Friday evening at dinner, the coordinator gave a speech about the history of the programme. Laura had enjoyed the informal part, singing some funny songs about the program and poking fun at the outdated technology they were still using. It seemed that despite its weaknesses everybody starts to love the programme when they become familiar with it. For Laura the seminar had been important because it became much clearer how the five universities worked together. She thought this was fascinating, bringing things

together in a new way and providing insights into the different traditions at the participating universities.

Looking back at the experiences of the seminar Laura was a bit nervous that it would be difficult to build up an identity as a student at masters level. She wondered if she could set aside enough time for study because of her work. The strong feelings aroused by the seminar made her think that this masters programme had a very strong identity, and the problem based approach to group work would help. The approach would help her to work with problems from her own working life. Sometimes the theories seemed a little academic and out of touch, as if the authors have never been outside a university, but nevertheless Laura found the prospect of applying the theories very interesting and challenging. Her hope was that through the masters' network she might find new friends and colleagues with whom she could share experiences.

When she looked back to the start of the seminar she had been a bit nervous about the project and the group work. However it had been good fun and the technology seemed to work well. She hoped that the group would soon find a good way of communicating using the various tools in the online system. They were using a virtual learning environment, but Laura thought it felt like her old email system, although there were some synchronous tools as well. She wondered if the students would stay inside the system or if she could use something like Skype to talk to the other students via the Internet and her blog to keep a record of the course as it developed. Laura also wondered about the group work. She thought of herself as quite responsible in a group but some of the others seemed to work very quickly and to add comments all the time. Laura was concerned about whether she could keep up with them, especially if one of her children became ill.

NETWORKED LEARNING

The core subject for this book is the notion of networked learning. There are a variety of competing terms used to describe related approaches: e-learning, online learning, virtual learning, and web-based learning. We have chosen the term networked learning partly in order to link the processes of education and learning to more general societal changes. The idea of networked learning has developed some force especially within European research. It has been expressed in a number of publications and a series of international conferences. The definition of network learning arising out of this tradition is that networked learning is:

> learning in which information and communication technology … is used to promote connections: between one learner and other learners, between learners and tutors; between a learning community and its learning resources (Goodyear et al., 2004, p. 1).

The central term in this definition is *connections* and the interactions this points towards include human interactions with materials and resources, but interactions with materials alone are not sufficient and networked learning requires aspects of human-human interaction mediated through digital technologies. This definition

takes a relational stance in which learning takes place both in relation to others and in relation to learning resources.

Perhaps the most well known author to place networks at the centre of modern societies is Manuel Castells (1996, 2000, 2001). Castells has written about the architecture of relationships within and between networks, and the ways that they are enacted by information technologies, which configure the dominant processes and functions in our societies. Castells building on work by Barry Wellman (Wellman et al., 2003), has used the evocative term 'networked individualism' to describe the form of sociality in such societies (Castells, 2001, p. 129 ff). Networked individualism relates firstly to the way social relations are realised in interaction between on-line and off-line social networks (Castells, 2001, p. 126–127) and to a move from physical communities to personalised or privatised virtual networks. Secondly it is related to the way the new economy is socially organized around global networks of capital, management, and information, whose access to technological know-how is at the roots of productivity and competitiveness:

> Business firms and, increasingly, organizations and institutions are organized in networks of variable geometry whose intertwining supersedes the traditional distinction between corporations and small business, cutting across sectors, and spreading along different geographical clusters of economic units (Castells, 1996, 2000, p. 502).

On the other hand Castells claims that the work process itself is increasingly individualized:

> Labour is disaggregated in its performance, and reintegrated in its outcome through a multiplicity of interconnected tasks in different sites, ushering in a new division of labour based on the attributes/capacities of each worker rather than the organization of the task (ibid. 502).

The concept of networked individualism points to a contradictory process in which overall social organisation through networks is accompanied by a tendency towards individualisation.

This social trend raises fundamental questions about the relationships between the emerging networked society and the organization of learning environments in both formal education and training. Networked individualism might suggest that we need to take a more critical approach to the theories of education and learning that are based on community and collaboration. The term also suggests that we can do this without ruling out the central place of communication and dialogue in education and learning. Networked individualism suggests that community is re-configured within networks so that different aspects of community are supplemented whilst others are decreased. We argue that a key question for research is whether the Internet will help foster more densely knit communities or alternatively whether it will encourage more sparse, loose knit formations. Educational researchers may not see these as oppositions and may wish to design for both the individualising and communal aspects of such changes. Furthermore we argue that a significant question is whether designs for networked learning environments should reflect the

trend towards networked individualism or serve as a counter balance to this trend, offering opportunities for the development of collaborative dependencies.

CONCEPTUAL FRAMEWORK

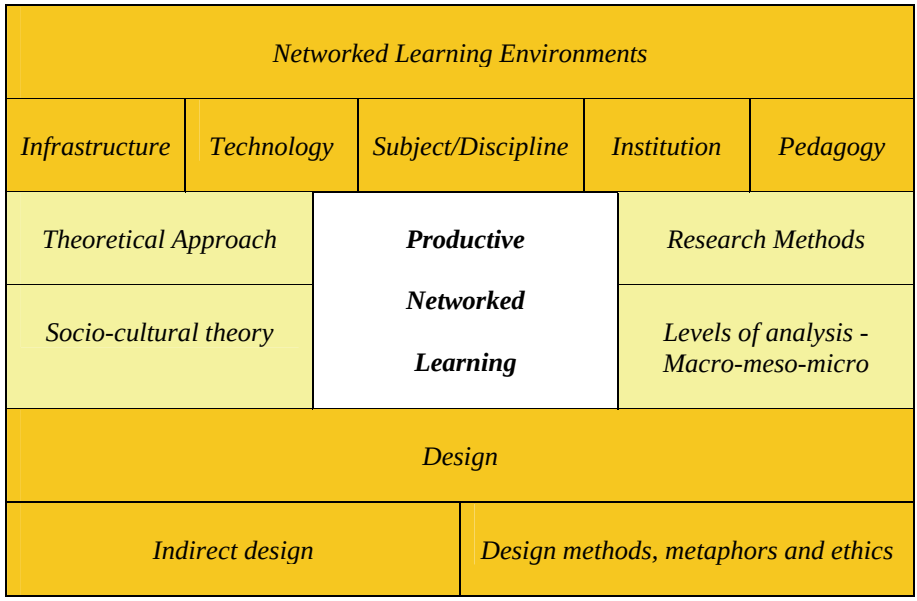

Figure 1. Conceptual framework

The focus of our work is summed up in the term *productive networked learning*. We identify two central layers of concern in the promotion of productive networked learning, *networked learning environments* and *design*. By networked learning environments we mean the sets of technological and organisational arrangements in which educators and students work and study which are often given and over which they often have limited control. By design we identify those aspects of a setting in which educators can organise for future activities and developments. Between these two core layers we identify linking elements in the form of *theoretical approaches* that educators and students apply and engage with and in the *research methods* used. The research methods are included because they influence the kinds of information and outlooks that educators have at their disposal to understand the complex interplay of issues that arise in networked learning.

The book presents a framework for understanding and designing networked learning building on a socio-cultural theoretical foundation. An essential part of this framework is the interrelated set of conceptual tools that help us rethink some of the basic issues and concerns in the domain of networked learning environments, starting with the very definition of networked learning. These conceptual tools, infrastructure, technology, subject/discipline institution, and pedagogy are interlocking

building blocks for the development of a theoretically sound and coherent understanding of networked learning environments. Some of the elements are dealt with more fully than others and our focus being more directly on technology, institution and infrastructure than it is on pedagogy or subject and discipline. The book is not simply pursuing an abstract understanding of networked learning; rather it is concerned with the practical engagement of educators and the encouragement of productive educational practices in networked learning environments. A key issue in this regard is the way in which designs for learning in networks must necessarily have an indirect character and an element of unpredictability to them. We combine this constraint with a consideration of those design methods, metaphors and ethical considerations that can be deployed to assist educators when planning networked learning activities.

The introductory section of the book elaborates the theoretical underpinnings of this framework, examining the issues that arise in relation to the theoretical underpinnings and in relation to research methods after which we go on to set out the two core areas of the framework, networked learning environments and design.

THEORETICAL APPROACH

The conceptual framework (see Figure 1) suggests two linking areas between networked learning environments and design. The first of these concerns the general theoretical approach to both the analysis and design of networked learning environments. The theoretical approach adopted in this book can be described as socio-cultural, and to be more specific we draw upon cultural-historical approaches to learning, for example Vygotsky (1978) and Engeström (1987, 1999, 2001). We also draw on other social theories of learning, for example Wenger (1998), Brown et al. (1989), Lave and Wenger (1991) and Bakhtin (1986). The key elements of socio-cultural theories in terms of pedagogy are that:

- Learning is mediated by tools, both symbolic tools such as language and physical artefacts
- Learning is social and language and artefacts are both cultural and social products rather than learning being the products of individual minds.
- Learning is historic because we ‘inherit’ cultural tools we need to understand the history of their development.

A socio-cultural approach stands in contrast to cognitive and psychological theories of learning that take the individual mind as their starting point. This difference in approach affects both the unit of analysis, which for socio-cultural theory is always a social/activity system, and the idea of learning itself. Learning in the socio-cultural tradition is achieved socially using mediating tools and artefacts to support the socially and physically embodied individual’s internalisation and co-construction of knowledge (Säljö, 1999).

In some part these discussions relate to the central focus on meaning making that several authors propose as fundamental to the field of Computer Supported Collaborative Learning (CSCL). Koschmann for example states that CSCL is a field of study centrally concerned with meaning and the practices of meaning

making in the context of joint activity, and the ways in which these practices are mediated through designed artefacts. (Koschmann, 2002, p. 20), and Stahl states that meaning making can be treated as an essentially social activity that is conducted collaboratively by a community, rather than by individuals who happen to be co-located (Stahl, 2003, p. 523). The strong case that Stahl makes is that meaning making takes place not just in the context of social practices and mediation through artefacts. However, meaning making is composed of those practices and mediations (see also Wenger, 1998).

RESEARCH METHODS

The second linking area identified by the framework concerns some of the methodological issues pertaining to the conditions for productive networked learning. We claim that studies within the humanities and the social sciences must take into account the *intentional* nature of human action and the centrality of the concept of 'meaning' to such intentional action. We contended that each situation is unique both because of the exceptional nature of the elements involved and because of the unique way they interrelate in any given case. This uniqueness does not preclude the possibility of situations, actions, and contexts being prototypical in respect of their overall pattern or gestalt. It does, however, preclude the possibility of a positivist approach to the replication of situations and of postulating law-like generalizations on the basis of the investigation of representative cases. As a consequence the explanations sought for within areas of human activity will be of a different nature than explanations in the natural sciences. Likewise, the form of generality pertaining to case studies will differ from natural laws, and the validity of the analyses will relate to the complex, interwoven meaningfulness of the phenomena that they put in view, not to their corroboration by impartial observation and experiment.

In this stance we follow Winch and others (*e.g.* Winch, 1990; Taylor, 1985; Flyvbjerg, 2001) by drawing a distinction between causal and interpretive explanations. In studies of human activity, the latter kind of explanations must be dominant, *i.e.* actions must be explained by the meaning they have in the situation – for the agents themselves, for others, and for the organisational setting of which the situation is a part. These explanations must relate to possible differences in meaning for such agents and settings and to the consequences such differences have for further actions. In this book this approach is related to our emphasis on case studies that are situated within particular settings as both a source and background to our more generalised statements. In contrast to the causal explanations of the natural sciences, the interpretive explanations point only backwards in time, seeking to understand *reasons* for actions and *relations* in terms of meaning between such actions. Winch makes the important point that although it is possible to understand after an action *why* it was undertaken, it is not possible to predict an action before it takes place. Denying this asymmetry is denying the uniqueness of meaning of each situation and action. Therefore, instead of complaining about the lack of predictive theory leading to cumulative research results one should start further back with basic investigations regarding the kind of rationality that is essential to the conduct of

research involving human learning activities in their contexts. Such an approach enables us to specify a more robust definition of validity that is suitable for applied science regarding context and learning.

This book in line with a broadly socio-cultural understanding of the social sciences does not seek a scientistic or positivist form of explanation. Rather we adopt what has been termed, following Aristotle, phronesis (Flyvbjerg, 2001). Phronesis concerns values and as such it relates closely to notions of practice and praxis. Phronesis steps beyond traditional analytic, scientific knowledge (episteme) and technical knowledge or know how (techne). Phronesis involves judgements and decisions made in the moment, on the fly, by what Flyvbjerg calls virtuoso social actors. Flyvbjerg summarises the point of departure for phronetic research in four questions:

– Where are we going?
– Is this development desirable?
– What, if anything, should we do about it?
– Who gains and who loses, and by which mechanisms of power? (Flyvbjerg, 2006, p. 374)

Flyvberg has written in defence of case study research and against what he calls five misunderstandings from the perspective of phronesis:

> By and large, the conventional wisdom is wrong or misleading… the case study is a necessary and sufficient method for certain important research tasks in the social sciences, and it is a method that holds up well when compared to other methods in the gamut of social science research methodology (Flyvbjerg, 2003, p. 432).

Flyvbjerg contends that phronetic research can yield pragmatic, context dependent and actionable knowledge based on experience and informed by value rationality. We wonder whether a phronetic research approach is a viable way of letting the holistic gestalt of the situation present itself and thereby showing generality through uniqueness. It is from this perspective that we both present our conceptual developments and our case study work in the separate sections of the book. Neither section could exist separately but the rich detail of each case is only able to be expressed in terms of the context dependant but necessary abstraction of the conceptual work.

LEVEL OF ANALYSIS – MACRO, MESO, MICRO

Often research in the CSCL tradition has naturally focused on the collaborative learning that takes place in single, small groups (Stahl, 2006). This is not a universal pattern and approaches to CSCL have also included attempts to link different level of analysis:

> The understanding of collaborative learning requires both a microanalysis of group interactions and a macro analysis with regard to the socio-cultural context in which learning occurs. (Dillenbourg in Strijbos et al., 2004, p. xvii)

The school of research derived from the early Soviet tradition of Vygotsky has retained an ability to deal with issues at different levels of granularity. In the hands of Engeström and others cultural historical activity theory is able to locate activity systems at various levels in any given social system, including whole institutions. Activity systems are not restricted to the level of single small groups and activity theory can be applied at various levels of analysis (Engeström, 1987, 1999, 2001). CSCL research while often confined to a micro level of analysis has clear connections to larger social networks and the macro level has been clearly acknowledged in work in this field.

We argue that it is necessary to supplement these approaches and to focus on what we have called the meso level of collaborative learning. Such an approach would focus on:

- How to design for collaborative learning at the institutional level, in organizations, university settings, and in networked learning environments
- Identifying the basic conditions that allow for collaborative learning in these settings
- Understanding how technologies and infrastructures afford and mediate the learning taking place

The meso level at its simplest can be thought of as the level of interaction that was intermediate between small scale, local interaction and large-scale policy and institutional processes. The idea of a tripartite division into macro, meso and micro levels is not new and has been developed most recently in the field of complex systems (Liljenström and Svedin, 2005). CSCL is in our opinion a classic example of a complex system with non-linear interrelationships between variables, including thresholds, lags and discontinuities. Most importantly CSCL systems include human agents and such systems are prone to both feedback and feed-forward loops and radical indeterminacy. The meso level can be characterised from this point of view as "the level in between the micro and the macro, as that is the domain where bottom-up meets top-down." (Liljenström and Svedin, 2005, p. 5). We would argue that differentiating between levels in this way can help us to identify the detail of what otherwise might appear as a simple or monolithic social system.

We would also suggest that it is possible to use levels and the distinctions between macro, meso and micro levels in a more analytic way. Used in this way the meso level points to the place of social practice as the locus in which broader social processes are located in small, local group activity (Schatzki, 1996; Schatzki, Knorr Cetina, and von Savigny, 2001). This suggested link with social practice also helps to connect the idea of a meso level of analysis with previous work in cognate research areas such as Computer Supported Cooperative Work (CSCW). In CSCW organizational concerns have been more generally addressed than in CSCL (e.g. Harper, Randall, and Rouncefield, 2000). The link to social practice also provides a bridge to broader concerns with organizations (e.g. Orlikowski, 2000, Wenger, McDermott, and Snyder, 2002). In this analytic form meso is an element of a *relational* perspective in which the levels are not abstract universal properties but descriptive of the relationships between separable elements of a social setting. In this view meso is not a characteristic that adheres to a particular set of arrangements

it arises in the processes of relating these arrangements upward towards macro processes and downward into micro processes.

These elements in the relationships can be separated over both space and time. The term micro then identifies small group interaction with a highly local (not necessarily spatially local) setting occurring over short time periods. Meso would identify interactions in and with the settings beyond the small group, but still with a local focus that was open to routine control and intervention over moderate time spans. Macro would identify the level of interaction beyond meso that was general in character (even if represented locally) and not open to routine control within moderate or short time spans, such that it could on many, if not most occasions, be treated as a given.

NETWORKED LEARNING ENVIRONMENTS

We argue that networked learning *environments* are critical for networked learning. The term learning environment points to the physical or virtual aspects of a setting and the characteristics or arrangements of elements of that setting within which learning can take place. Of course learning can take place anywhere and the idea of a learning environment implies that these settings are intentionally designed and arranged to allow learning to take place. The term learning environment has at least two recent usages within educational research literature. One recent use of the term in the context of the use of computers and computer programmes in education suggests something small scale and self-contained such as a simulation or micro-world. This sense of learning environment although it is closely connected with computers and computer programmes, could also be applied to resources that are not computer based but which offer the student a contained experience where they might learn through the exploration and manipulation of objects. Modern museum exhibits often have this general approach to the design of a learning experience. A second use of the term learning environment is more encompassing and would include the totality of resources on which the learner can draw. This view is found more widely in educational literature and is particularly strongly associated with the relational or phenomenographic approach to learning (see for example Laurillard, 2002). More recently the idea of a learning environment has been strongly identified with commercial products marketed as virtual and/or managed learning environments. These computer-based environments could be thought of as being at the meso level, neither small-scale self-contained environments, nor encompassing a totality of resources. It is this level of learning environment that most concerns the authors of this book, environments that involve wider social processes and that offer significant control to practitioners who wish to actively design course environments.

The concept of a learning environment points towards the physical environment alongside the social organisation of the setting and as a consequence the idea of a networked learning environment points towards the socially and physically networked nature of learning environments distributed over space and time. From this we argue that the relationship between the design of a technology and the use of that technology is a central concern for networked learning. In this we follow

Vygotsky's socio-cultural approach in suggesting that tools fundamentally mediate both higher mental functioning and human action. In education we argue in favour of a focus on how digital and networked technologies function in the appropriation and understanding of conceptual knowledge (Säljö, 1999). Tools and technologies have a clear material form and persist as material objects even when they are not incorporated into the flow of action (Wertsch, 1998). Both the material and symbolic properties of tools are seen as having important implications for understanding how internal processes come into existence and operate. The technology of computer networks has generated a number of debates around issues that may impact on a networked learning environment. These include:

- Time shifts – Computer networks used in education affect the usual time patterns of education. Many courses delivered across networks are asynchronous.
- Place – The introduction of mobile and ubiquitous computing devices have begun to make the idea of education occurring at anytime, anyplace, and anywhere seem more feasible.
- Digital preservation – The outputs of synchronous and asynchronous activity are easily preserved in transcripts, logs and a variety of other forms including the archiving of web casts and audio interviews/podcasts.
- Public/Private boundaries – The preservation of what would otherwise be ephemeral materials alters the boundaries between what is public and what is private. Tutors can now view and preserve the details of student's interactions during group activities, making these available as tools for assessment.
- Forms of literacy – The still largely text based world of networked learning has generated new forms of writing that are neither simple text replications of informal conversation nor are they formal written texts. The integration of images and audio into digital environments has suggested new forms of multimedia literacy.
- Content – The boundary between content and process is shifting. Blogs and wikis can provide elements of content and cut and paste re-use is common practice. The idea that there is a clear distinction between activity/process and artefact/ content is becoming strained.

Overall a claim can be made that computer networks disrupt and disturb traditional boundaries in education. If this is so then it is important to consider how this might affect the parameters of design.

We have argued that networked learning is necessarily learning mediated by technologies. Orlikowski has suggested that it may be helpful to make an analytical distinction between the *use* of technology and the *artefacts*, that is the bundle of material and symbolic properties such as hardware, software, techniques, etc. (Orlikowski, 2000, p. 408). This distinction is important for networked learning as it directs our attention to the way in which technologies are deployed and the complex nature of their use in education with both teachers and students having different claims to be considered as the primary users of any system, both of which need to be considered. She demonstrates that the same artefact used in different institutional contexts and by different social actors can evoke very different actions and she makes a distinction between two discrete approaches (Orlikowski, 2000, p. 405):

– An approach which posits technology as embodying structures (built in by designers during technological development), which are then appropriated by users during their use of the technology
– An approach based on an understanding in which structures are emergent growing out of recursive interactions between people, technologies, and social action in which it's not the properties of the technology, per se, but through a process of enactment, that people constitute and reconstitute a structure of technology use (Orlikowski, 2000, p. 410).

These distinctions are important for the practice of design because technologies are designed with certain purposes in mind and they embody certain properties and features intended for particular kinds of use. Networked learning environments contain technologies that as a consequence reflect certain understandings of communication, interaction, collaboration, teaching, and learning that are incorporated in their design. These properties of technologies which are the outcome of design intentions are not themselves determinant of the uses made of them, but later we discuss the ways that certain features of technologies can become available as *affordances* in use, and so make certain kinds of practice more available than others.

INFRASTRUCTURE FOR LEARNING

One of the ways in which networked learning environments present themselves to potential users is as an infrastructure. The traditional conception of an infrastructure is something that is already in place, ready-to-use, completely transparent and not requiring consideration such as the water system, the electricity supply, the railway, the mail services and more recently the Internet. Infrastructure though often out of sight comes into sharp focus when it fails. The plight of New Orleans after hurricane Katrina was a classic example of infrastructures failing and as a consequence of that failure immediately becoming highly visible. Infrastructures viewed in this way are arguably a defining characteristic of the modern era and the digital infrastructures of the current period are potentially a defining characteristic of the post-modern. This understanding focuses on infrastructure as an object, something that is built and maintained and then sinks into relative invisibility in the background. In physical universities the lecture theatre with tiered rows of seating is rarely questioned as a form of physical room arrangement, yet it enables and constrains the use of space. Similarly the filing cabinets and memos that surround a university administration are often largely invisible components in the organising and arranging of university activities. It follows from this that the activities around the infrastructure are heavily shaped by its structure. In a way this is exactly the kind of infrastructure we want in an educational setting, something that just works, supporting learning activities and communicative practices.

In order to discuss how something becomes an infrastructure, the design and re-design of infrastructure and the question of how the infrastructure should or could be, we need to focus on the processes of maintenance and development. Edwards (2003) discusses infrastructures as socio-technical systems, which are reliant on

complex organisational practices for maintenance and for making the infrastructure meaningful. Edwards makes the point that the way infrastructures reside in the 'background' is in some sense definitional for an infrastructure.

> … the fact is that mature technological systems – cars, roads, municipal water supplies, sewers, telephones, railroads, weather forecasting, buildings, even computers in the majority of their uses – reside in a naturalized background, as ordinary and unremarkable to us as trees, daylight, and dirt. Our civilizations fundamentally depend on them, yet we notice them mainly when they fail, which they rarely do. They are the connective tissues and the circulatory systems of modernity. In short, these systems have become infrastructures (Edwards, 2003, p. 186).

As socio-technical systems they rely on an integration of artefacts of various scales and kinds with social and organisational features in a constant dialectical process.

The perspective we present on infrastructure draws on the works of Susan Leigh Star and Karen Ruhleder (Star & Ruhleder, 1994; 1996) and it is developed further in Bygholm & Nyvang (this volume) and Guribye & Lindström (this volume). Star and Ruhleder suggest that we interpret information and communication technologies in use as infrastructures that shape and are shaped by practice and in this sense we understand infrastructure as a relational concept, stressing the fact that it is only when artefacts are brought into use and become part of a practice that they become an infrastructure. In order to characterize the relational side of infrastructure Star & Ruhleder suggest eight dimensions:

- Embeddedness (integrated in social structures and practices)
- Transparency (can be used without removing focus from the task)
- Reach or scope (goes beyond individual tasks or processes)
- Learned as part of membership (an inherent part of an organization)
- Links with conventions of practice (shapes and is shaped by practice)
- Embodiment of standards (builds on standards and conventions)
- Build on an installed base (must relate to existing technologies)
- Visible upon breakdown (loses transparency and is drawn into focus when it breaks down) (Star and Ruhleder, 1996, p. 113).

These dimensions are quite general in character and they could be used to characterize phenomena such as language, all of which points to the ambiguity and complexity of seeing infrastructure as a relational concept. They argue that an infrastructure occurs when the tension between local and global is resolved. That is, an infrastructure occurs when local practices are afforded by a larger-scale technology, which can then be used in a natural, ready-to-hand fashion (Star and Ruhleder, 1996, p. 114). Setting up an infrastructure is not a once and for all procedure, it is an ongoing and dynamic process.

In dealing with the balance between practice and technology and the problems that arise in the emergence of infrastructure Star and Ruhleder draw on Bateson's (2000) understanding of communicative systems (For a fuller discussion see Bygholm and Nyvang, this volume). Bateson's approach identifies three levels of communication

as relevant for understanding the problems involved in the process of creating and re-creating an infrastructure.

– Level one problems appear as matter of fact problems, such as not knowing how to get a user name, or publish a message in the system or not understanding what is wrong when the server go down.
– Level two problems are concerned with how to use the system properly, for example what kind of messages should be published and to whom. Thus level two is concerned with classifying and with discussion and reflection about the type of problems involved in using, supporting and running the system in the context of use.
– Level three is one further step more abstract, and involves questions such as what kind of learning goals we want to pursue using information and communication technologies or the general politics involved in the choice of platform (e.g. commercial vendor locked or open source). We would say that the issues raised on level three are concerned with the fundamental issues and values of educational practice.

The use of infrastructure in this volume takes a somewhat different approach to the metaphoric use of infrastructure found in Bielaczyc (2001 and 2006) and Lakkala et al. (2008). These authors take a particular stance in relation to the design of aspects of a learning setting to which they apply the term infrastructure. Bielaczyc (2001 and 2006) concentrates on dimensions of social infrastructure including cultural beliefs, practices, socio-techno-spatial relations and interaction with the outside world. In addition Lakkala et al. (2008) introduce what they describe as a 'more comprehensive set of components' including a cognitive infrastructure. They also propose a 'Pedagogical Infrastructure Framework' initially aimed at providing a tool for analysis but potentially offering a tool for design. The location of infrastructure in these accounts is at a local and micro design level whereas the concept if infrastructure used in this volume remains at the macro and meso levels in which infrastructures largely take the form of being given elements of local design and not a part of the day-to-day design process (Jones et al., 2006). This implies a relationship between design and learning in which infrastructures for learning aren't directly designed by the academic staff who are involved in the detailed pedagogic design of courses and programs.

AFFORDANCE

In this chapter we have been using the term affordance without a full explanation of its meaning. However we will argue that this key term needs to be developed through the discussion and critique of its recent interpretations within the field of TEL (Technology Enhanced Learning). We present a different understanding of the concept which we contend is both more in line with the original Gibsonian concept, and permits a more fruitful conceptualization of the design and use of digital networked technologies for learning. This different understanding of affordance is outlined here and is considered in more detail in the chapter by Kaptelinin and Hedestig (this volume) and in our discussion in the concluding section of the book.

> The concept of affordance has been applied to technology in the sense that: technologies possess different affordances, and these affordances constrain the ways that they can possibly be 'written' or 'read' (Hutchby, 2001, p. 447).

The concept of affordance, used in this way, allows for the possibility that technologies can have effects on users and that particular technologies can as a consequence constrain users in definite ways. The idea has its origins in the work of Gibson (1977) who was interested in the psychology of perception. Gibson argued for a non-dualist understanding of perception. His main interest was studying perception as an integrated or ecological activity. Affordances in Gibson's view might vary in relation to the nature of the user but they were not freely variable; the affordances of a rock differed from those of a stream, even though different animals might see the affordances of each differently.

Since Norman's application of the term to the design and use of artefacts (Norman, 1988), the concept of affordance has been central to research on human computer interaction. However, beneath the acceptance of the analytical force of the concept lies a disagreement as to the ontological nature and epistemological status of an affordance. Thus, a fundamentally contentious point is whether a distinction should be drawn between 'real affordances' and 'perceived affordances' (Norman, 1999) or between affordances and perceptions (Gaver, 1991; McGrenere & Ho, 2000). Gibson's view is strongly relational and differs in significant ways from the later application of the idea of affordance by Norman (1990, 1999). Norman takes what can be understood to be an essentialist and dualist approach in which technologies possess affordances and users perceive them. Other researchers, most notably McGrenere and Ho (2000), emphasize the need to re-introduce and further develop the original Gibsonian concept of affordance. According to McGrenere and Ho returning to the original Gibsonian notion would mean acknowledging that affordances are "independent of the actor's experience, knowledge, culture, and ability to perceive" (McGrenere and Ho, 2000). This claim has been echoed by Torenvliet, who observed that Gibson's view was that affordance was a characteristic of the environment that exists relative to an object but that it exists independently of perception (Torenvliet, 2003). This discussion is further developed by Kaptelinin and Hedestig (this volume) who argue that culture and experience cannot be separated from affordances and develop this point in relation to activity theory. Elsewhere Derry in a critical commentary on the recent use of the term in educational contexts comments that:

> The leap from ideas originating in perceptual psychology linking perception and action in a non-cognitive relation of organism and environment to an educational context dependent on interactions between humans, is at the very least questionable (Derry, 2007, p. 504).

In light of this the view the interpretation of the term that we propose for understanding networked learning environments and the relationship between technological infrastructure and activity is one that treats affordance as a *relational* property and returns to a broadly Gibsonian and ecological stance. In this way of thinking about affordances, properties exist *in* relationships between artefacts and active agents.

We need to be clear that Gibson specifically emphasized that the issue for a theory of affordance is not whether or not affordances exist or are real, but whether or not optical information makes it possible to perceive them (Gibson, 1979). This observation is non-essentialist and non-dualist and affordances in this view could be discerned in a relationship between different elements in a setting whether the potential user of an affordance perceives the affordance or not. As noted by Derry (2007) in networked learning environments we are likely to be concerned with reflexive social relationships. Gibson's understanding of perception still leaves the possibility that the second order nature of meaning is understated. A relational view of affordance would suggest that we could analytically discern features of the setting apart from the perceptions of particular groups of users, but any actual group of users would have varied perceptions and understandings and they could draw out significantly different meanings from the setting. As a consequence designers can only have direct influence over those abstract elements that may become affordances while educators involved in the process might be able to assist participants by suggesting how they might 'read' the affordances.

THE INDIRECT NATURE OF DESIGN

Design is the second key term in our conceptual framework and we choose to use the term because it implies an approach that engages in an activity informed by theory but one also deeply engaged in practice. We do not think of design as a bridging activity *between* theory and practice (See Beetham and Sharpe, 2007). Rather in our view design is immediately both theory and practice; a social practice that is explicitly informed by theory and a form of praxis (DeLaat and Lally, 2003). Design involves a systematic approach, which may involve rules and protocols derived from evidence, and a set of local and context based practices that are dependant on circumstances. As a consequence design is a skilful and creative activity which, although it is not predictable, can be open to improvement and development resulting from the application of research and scholarship.

Design is also related to the introduction of new technologies and the impact of extremely mediated forms of social activity (Suchman, 2007; Beetham and Sharpe, 2007). Design is an activity that is fundamental to discussions about the nature of knowledge in networked societies. Societies in which knowledge is understood to be relational to the way it is used and to its users. University teaching has always involved the use of artefacts, preparation and planning and these can be considered as proto-typical elements of design. The use of all kinds of technologies in the 20th century and the development of digital and networked technologies from the late 20th century onwards implies a greater need for systematic design. Digital and networked technologies require forethought and more explicit representations of the tasks that learners and teachers are expected to undertake. However the take up and use of technologies cannot be guaranteed by design and teaching practices have proved remarkably resilient to technological change (Cuban, 1986, 2001; Suchman, 2007).

The relationship between planning and design in tertiary education and the situated actions in which teachers and students engage has become increasingly problematic. Policy pressures have been added to technological changes with the effect of promoting increasingly formal rational planning approaches to design. In this book we are concerned with practitioners, who are rarely involved in the design of the technological and institutional infrastructures in which they work. We are interested in design as a process of mobilising what are largely given elements to create productive networked learning environments. We argue that learning can never be directly designed, only designed for (i.e. planned in advance). (See also Jones, 2007; Beetham and Sharpe, 2007; Wenger, 1998). Learning itself is only indirectly related to what we design and plan, indeed we argue that it is at least two steps removed. The activities, spaces and organisations that we design rely on being inhabited by the teachers and learners who will 'enact' our designs. Goodyear et al. (2001) have summarised these distinctions as an indirect approach to learning and their relationships are shown in figure 2.

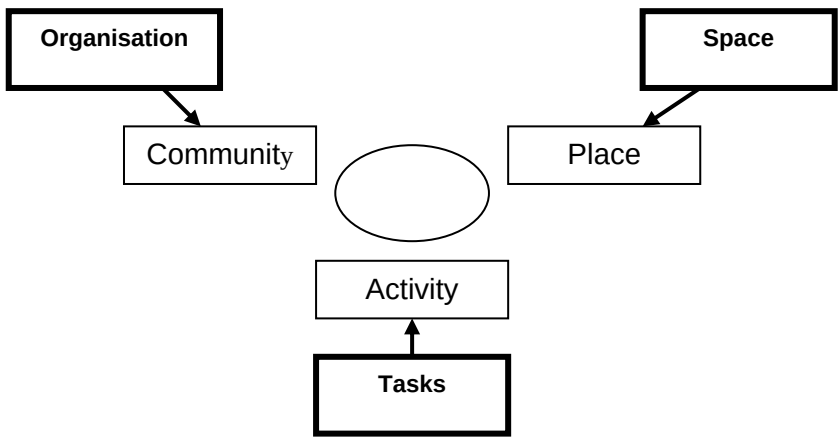

Figure 2. Indirect approach to learning. (Goodyear et al., 2001)

TASK AND ACTIVITY

The distinction between tasks and activities forms part of the broader design philosophy outlined above. Because students constitute their own learning context it should be expected that students' activity will often differ from the task that initiated it. Goodyear et al. following the French ergonomist Alain Wisner, draw a distinction between 'task' and 'activity' (Wisner, 1995). Designers set tasks, prescriptions for the work the students are expected to do, activity on the other hand is what people actually do. Teachers set the tasks but learners then have to interpret the specifications of the task. The subsequent activity of students is a more or less rational response to the task when understood as a part of the student's overall context. Students constitute their setting, their own learning context, out of the technology and infrastructure, parallel tasks they have to conduct at the same

time, other calls on their time, their past experiences and their understanding of what their teachers actually value. It is to be expected that the activity students undertake is likely to be different from the task which initiated it.

We would also like to extend and refine the notion of activity found in Goodyear's work by adding to it some of the concepts found in the work of Vygotsky (1978) and under the banner of activity theory. Activity in the Vygotskian theoretical tradition is not simply a series of actions, a state of being active or a string of linked behaviours. Activity is always conditioned by the circumstances in which it takes place, both the circumstances of the person themselves and the external circumstances within which the person acts. Particular actions may become routinized and automatic operations that require little or no intentionality. Even so activities and the actions that combine to form them are more than simply operations because they are intentional and motivated by a purpose with the aim of achieving an objective. For our purposes the relationships we identify as activity are the more or less intentional actions that take place when students engage in tasks set as part of designs for learning in a networked learning environment.

ORGANISATION

In a networked learning environment the way organisation is enacted is often related to a variety of social theories and approaches to learning including 'computer supported collaborative learning' (CSCL) and 'communities of practice'. Goodyear himself suggests that organisation indirectly relates to community. Our approach differs from both of these approaches in that it does not privilege strong relationships such as cooperation and collaboration or the close relations of community. Unlike these approaches the definition of networked learning, provided earlier in this chapter, has the potential to draw attention to relationships based on weak rather than strong ties. (For a further elaboration of this view see Jones, 2004, 2004 b; Jones and Esnault, 2004).

One of the most commonly adopted notions of community, 'communities of practice', has developed from the apprenticeship model proposed by Brown, Collins and Duguid (1989), and the idea of learning as legitimate peripheral participation developed by Lave & Wenger (1991). It is most commonly associated with the work of Wenger (1998). For Wenger, networks are not necessarily in opposition to the ideas of communities of practice. Indeed Wenger suggests that a network with strong ties resembles a community.

> Communities of practice could in fact be viewed as nodes of "strong ties" in interpersonal networks (Wenger, 1998, p. 283)

However, he also stresses the difference in purpose between networks and communities of practice:

> …but again the emphasis is different. What is of interest for me is not so much the nature of interpersonal relationships through which information flows as the nature of what is shared and learned and becomes a source of cohesion – that is, the structure and content of practice (ibid. p. 283).

In other words, Wenger is not only concerned with the flow of information between nodes, he also emphasizes the differences in what flows across the network.

Communities of practice are characterized by three related structural properties, that of a shared enterprise, mutual engagement, and a shared repertoire (Wenger, 1998, p. 72 ff), while networks are characterized as interconnected nodes (Castells, 1996/2000) or the connections between learners, learners and tutors, and between a learning community and its resources (Goodyear et al., 2004). As such networked learning is concerned both with establishing connections, and defined relationships whereas a learning environment based on communities of practice is concerned with the establishment of a shared practice. An area of common ground between network analysis and communities of practice may be found in the idea of networks of practice proposed by Brown and Duguid (2001) which deals with relationships that are too broad and diffuse to be considered communities of practice.

Networked learning might suggest that strong notions of community ignore the importance of the strength of weak ties. The idea of the strength of weak ties originates in a paper written by Granovetter (1973) in which he argues that previous network theory had implicitly prioritized strong ties that were primarily within small well defined groups. Weak ties he argued would allow for the analysis of interaction *between* groups and for the analysis of social activity that was not confined to primary social groups. Weak ties are in consequence a potentially interesting topic to explore in relation to digital networks and networked learning. Networked learning environments bring together a variety of elements that extend beyond the local or small closely bound group and draw these elements together in organizational units that are large and relatively diffuse in which there may be no clear boundaries.

Granovetter offered the following definition of the strength of an 'interpersonal' tie:

> The strength of a tie is a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie. (Granovetter, 1973, p. 1361)

It should be born in mind that Granovetter's work preceded digital networks by some years and that the kinds of relationship he discusses are limited by the usual geographical and temporal constraints of a face-to-face environment. Granovetter is also concerned with individuals, and networks in this view are composed of persons who form the nodes and the links are the relationships between these people. Currently networks composed of digital media are more likely to be thought of as comprising nodes of various types, including individuals, small, medium and large organizations, technological artefacts and systems etc. The stance Granovetter takes is also one that tends towards a reductive essentialism, describing networks as collections of individuals, and suggesting that the networks are what individual nodes make of them. This view can be contrasted with a more relational view of networks, which we favour, in which the individual components of networks, whether persons, groups or institutions are themselves emergent in their character, conditioned by their position in the network. Networks in this second view cannot be reduced to the characteristics of the component nodes as the nodes' character is itself dependant on its position and role in the network.

The notion of networked learning and the practical application of the design of networked learning environments raise several questions:

– Should researchers in CSCL and education more generally serve as critical opponents to the overall trends in the networked society as expressed by Castells and stand up against 'networked individualism', or should the design of CSCL and networked learning reflect these trends?
– Which models, networked models or community of practice models, are more productive with respect to the learning of the individual participant and under what conditions? Is it, for example, more productive for busy professionals to be organized through a pedagogical model based on relatively weak ties among the participants, or is it more productive to be organized in accordance with a pedagogical model facilitating the development of the strong ties in a community of practice or perhaps even a blend of both?

SPACE AND PLACE

In a networked learning environment place and space become highly contingent factors. As a consequence they have become a focus of attention for the design of all types of learning environments that are affected by digital networks, whether learners are co-located, distant or in a combination of the two (see, for example, Goodyear et al., 2001; Jamieson et al., 2000; Ponti & Ryberg, 2004). Other authors have noted that we should expect students to customize designed learning spaces and make their own "local habitations" (Nardi & O'Day, 1999) or "learning nests" (Crook, 2002). More generally we argue for a distinction to be made between space, which is understood as a relatively stable and potentially designed environment, and place, understood as contingent and locally inhabited. We argue that fostering a sense of place in networked learning environments is necessary in order to develop a social and emotional context to sustain social interactions and collaboration, whether these interactions are composed of either strong or weak ties.

The idea of space has been developed strongly in relation to network technologies, most particularly in terms of 'cyberspace'. The term cyberspace, originating in the works of William Gibson and particularly in his 1984 novel *Neuromancer*, came into common usage in the 1990s to capture the new sense of something beyond the computer interface that was being developed in the emerging digital networks. This sense of a new kind of space was reinforced with the development of the World Wide Web and the sense that through the use of hypertext and uniform resources locations a spatially referenced environment was developing in which we used *addresses* to visit *sites*. The spatial metaphor has been a powerful force in network development with designers making use of easily understood spatial references for the design of interfaces and in order to explain the move from the computer as s stand alone tool to the computer as one of a number of devices that can be used to access a networked digital environment.

Participants in a computer network whilst they are simultaneously situated at a real point in time and space are also displaced from that physical point in a virtual

space configured through the network. Lash (2001) has argued that technology, in particular Internet technology has resulted in an abstraction from place:

> Technological forms of life are disembedded, they are somehow 'lifted out'. As lifted out, they take on increasingly less and less the characteristic of any particular place, and can be anyplace or indeed no place. This lifted-out space of placelessness is a generic space…It is not any particular space, but a generic space. Its context is no context at all. Its difference is indifference…The Internet is a generic space. It is no particular space. Indeed, networks are themselves by definition lifted-out spaces (Lash, 2001, p. 113).

In contrast Hine (2000) points out that despite the generic nature of Internet spaces the local is very much embedded in particular uses of the Internet, e.g., homepages or social networking site profiles such as those on Bebo, Facebook, and MySpace. In practice people using network spaces are never completely disembedded or separated from their off-line activities and spatial locations. Rather offline spaces interpenetrate online netscapes and together they configure new hybrid forms. Moreover the properties of space as experienced offline are used to inform the design of online environments.

Harrison and Dourish (1996) pointed to the way that software designers had exploited the properties of space to provide a spatial structure for people's online activities. They had designed online features that allowed users to orient themselves through an interaction with digital objects and thus understand the configuration of the virtual landscape. As Harrison and Dourish (1996) put it, "space is the opportunity, place is the understood reality". They suggest that the meaning and usefulness of a space increases when people build a history of experiences that allows the space to obtain the richer quality of 'place.' This change involves supporting the development of "appropriate behavioral framing"; that is the emergent patterns of human behaviour and interaction that offer understandings of the space. Harrison and Dourish refer to both physical environments and to media spaces, which would include information spaces, and hybrids of the physical and the virtual. The great flexibility of virtual spaces, with their potential sense of transience and impermanence, requires participants to engage in a process of re-creation of meanings to cope with uncertainty. In so doing, they become involved in a process of place-making, which is necessary in order to appreciate the online environment and to develop conditions for sustained and meaningful social interaction (Lee, Danis, Miller & Jung, 2001). The adoption of the notion of place has theoretical and methodological implications because it influences the range of concerns that are involved in field studies, and the range of methods that are used to relate to the users' lived experience of place in networked learning environments (Ciolfi and Bannon, 2003). We argue that using a concept of place as distinct from space could improve the conceptual development and design of networked learning environments. It is important to understand the way human beings may experience designed spaces and the potentials that exist for users to constitute their own places for the designers to be able to understand the way novel elements could change, interact with and shape the original designed space.

CONCLUDING REMARK

Following this introduction we present twelve case studies which are developed in relation to the framework presented earlier and in the final section of the book we return to discuss the framework in response to the material presented in the case studies. Each of the case studies whilst able to be read in their own right were developed iteratively with the framework and in some ways they therefore formed the basis on which this introduction was written. The process of developing the ideas found in this book should be seen as a collaborative process and an expression of a collective effort, although the authors of the Introduction take sole responsibility for the final formulation. As with all social knowledge the case studies reflect times that have already past or are just passing, because as Hegel remarked, the owl of Minerva spreads its wings only with the falling of the dusk (Hegel, 1820 Preface). In the final section we explicitly address the changes that are currently taking place in networked learning and the wider technological environment, bringing our reflections to a conclusion and linking them with current developments. We argue that this process of reflection on the recent past through the use of case studies is essential if we are not to be driven solely by novelty and a constant re-invention in the wake of each wave of technological change.

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ANN BYGHOLM AND TOM NYVANG

AN INFRASTRUCTURAL PERSPECTIVE ON IMPLEMENTING NEW EDUCATIONAL TECHNOLOGY

The Case of Human Centred Informatics

Technology changes in steps – practice with technology in organisations evolves over time and across generations of technology.

INTRODUCTION

In this chapter we analyse the implementation of new technology for communication and collaboration in Human Centred Informatics, a bachelors and masters program at the faculty of humanities at Aalborg University. Our focus is on the organisational implementation (meaning that we focus on change in organisations – not on programming software which is another context where you will meet the term). Our aim is to explicate and understand the problems and possibilities in the implementation process at the meso-level. We use the concept of infrastructure as the unit of analysis to focus on the relationship between technology, educational practice, organisation, and knowledge involved in shaping educational practice with technology in organisations. The aim is to understand the variety of problems that are attached to the implementation of new technology within a learning environment that encompasses several hundred people, all with very different roles, tasks and practices.

In a review of research on the application of technology to collaborative learning in higher education, conducted by Resta and Laferrière (2007), six sets of recommendations are identified, one of them being concerned with organisational issues. Thus they state that:

> Research is needed on the organisational issues related to implementing CSCL in higher education to determine the essentials conditions that must be in place for effective faculty use of CSCL (with particular attention to the level of support provided). (Resta & Laferrière, 2007, p. 76)

They furthermore argue that such research will lead to the development of viable designs for adoption strategies within organisations. Jones, Dirckinck-Holmfeld and Lindström (2006) have identified a similar need for research at the meso-level

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of collaborative learning. The meso-level is placed between the macro and the micro and is characterized as follows: Meso would identify interactions in and with the settings beyond the small group, but still with a local focus that was open to routine control and intervention (Jones et al., 2006, p. 37).

More generally they suggest that differentiating between macro-, meso-, and micro-level assists us in identifying the details of the learning environment. Moreover, that attention at the meso-level helps us in understanding the basic conditions that allow for collaborative learning and collaboratively driven change at the institutional level. A focus on the meso-level thus implies a focus on the relationship between the basic elements involved in a learning environment.

To emphasise the importance of the relationship between practice and technology is not new to research in information systems, nor is infrastructure the only concept or theoretical construct that pursues this focus. As was commented in Management Information Quarterly (MISQ):

> …research in the information systems field examines more than just the technological system, or just the social system, or even the two side by side; in addition, it investigates the phenomena that emerge when the two interact. (Lee, 2001, p. iii)

Indeed the significance of focusing on the phenomena that emerge when the social and the technical system interact has been recognised and conceptualised in several ways, as also mentioned in the introduction to this volume. E.g. by distinction between technology as artefact and technology in use (Orlikowski, 2000); by the distinction between affordances per se and perceived affordances (Norman, 1999); by application of activity theory that encompasses both motive, artefact and the social context in order to understand practice (Nardi, 1996); by introducing actor-network theory which links the act with all of its influencing factors producing an network, where elements of any kind may be included: humans, technological artefacts, organisations, institutions, etc. (Latour, 1999); and by using the concept of genre (drawing upon activity theory) to embrace both artefact type and tradition (Spinuzzi, 2003).

With this chapter we aim to carry out meso-level analysis of organisational implementation of technology by means of the concept of infrastructure. Meso-level analysis addresses questions and issues that go beyond the individual or small group learning experience and focuses on the conditions that allow for learning in a specific learning environment. The concept of infrastructure furthermore strengthens the attention on the relationship between the elements involved. In so doing, we identify and label the challenges of organisational implementation of ICT for learning in higher education. Thus in the following section we introduce and discuss the concept of infrastructure, present our case and the analysis and finally conclude in regards to organisational implementation.

INFRASTRUCTURAL PERSPECTIVE

The traditional concept of an infrastructure is something that is just there, ready-to-use, completely transparent and often taken for granted (for example, the water or electricity supplies, the railway, the mail services and the internet). Under this concept there is a tendency to perceive infrastructure as 'hardware' – implying something that is built and maintained and which then sinks into the invisible background, to be noticed only when it breaks down. But as Edwards (2003) points out, infrastructures are socio-technical in nature, meaning that to qualify as an infrastructure a system requires not only hardware but also organisations, socially communicated background knowledge, general acceptance, reliance and near ubiquitous accessibility.

According to Wiktionary (http://en.wiktionary.org) an infrastructure is "an underlying base or foundation especially for an organisation or system" and "the basic facilities, services and installations needed for the functioning of a community or society". This definition points to the fact that for the understanding of infrastructure the development or evolvement of ways to deal with this underlying base is equally important. For example, telephony is possible not only because signals can be transmitted over a distance using electromagnetic waves via electronic transmitters, but also because of the invention of an appropriate appliance – the telephone – which can be used for the purpose of transmission. Importantly, the system is not successful simply because the technology works, but because enough people want to use, own and pay for a phone with which to communicate with others. It works because the whole service is highly organised, making sure that it is possible to make calls to the people you want to talk to. Furthermore it is difficult to separate the development of the 'base' infrastructure from the development of services and regulations that support its functionality. Infrastructures, therefore, includes technologies that are socially co-defined by their use and are always under a process of development or change; they grow through their use, and it is their use that defines whether or not something becomes an infrastructure.

Star & Ruhledger (1996) and Hanseth (2000) (among others) discuss the infrastructural aspects of IT systems. They both suggest different dimensions to characterise an infrastructure. While focusing on use and practice Star and Ruhledger mention eight different characteristics that are: *embeddedness* (integrated in social structures and practices); *transparency* (can be used without removing focus from the task); *reach or scope* (goes beyond individual tasks or processes); *learned as part of membership* (an inherent part of an organisation); *links with conventions of practice* (shapes and is shaped by practice); *embodiment of standards* (builds on standards and conventions); *build on an installed base* (must relate to existing technologies); and *visible upon breakdown* (looses transparency and is drawn in focus when it breaks down). Very much in line with this, but with slightly more emphasis on the technical prerequisite for an infrastructure to function as such, Hanseth (2000) suggests that an infrastructure is *evolving* (evolves continuously); *shared* (must function as a shared resource or foundation for a community); *open* (lack of borders in how many elements it may include, how many users may be using it and also in the sense that there are no limits to who might contribute to its

design and deployment, and that the development time has no beginning and no ending); *heterogeneous* (including sub-infrastructures based on different versions of the same standard or different standards covering the same functionality); *builds on an installed base* (backward compatibility, which also means that the existing heavily influences how the new can be designed and that infrastructures are considered as existing already, never having been developed from scratch).

These dimensions suggest "an infrastructure, which is without absolute boundary or a priori definition" (Star and Ruhledger, 1996) and they also point to the fact that infrastructures cannot be understood independently of their use. An IT system, then, becomes an infrastructure in relation to the technical and social elements of an organised practice within which it functions. It is evolving over (a long) time, it does not have a fixed group of users and it is a dynamic, ongoing process with no fixed centre of control. It both forms and is formed by use. The infrastructural perspective places in the foreground the fact that IT systems are never designed from scratch, they always build upon exiting tools and practices. To put emphasis on this dynamic Hanseth proposes the term "cultivation" instead of design, and draws attention to the resemblance to a living organism. In this he is drawing on Dahlbom and Janlert's (1996) distinction between construction and cultivation as two very different ways of thinking of design; construction denoting the process of selecting, putting together and arranging a number of objects to form a system, whereas in cultivating we interfere with, support and control a natural process.

To get a deeper understanding of the sort of problems arising in this natural process Star and Ruhledger turn to Bateson (2000) and his understanding of communicative systems. Communication, in Bateson's terms, is an extensive and far reaching concept referring to the kinds of phenomena that cannot be understood in terms of physical laws. His study of communicative behaviour included problems from very different domains, e.g. schizophrenia, alcoholism and the communicative system of whales and dolphins. Regardless of the particularities in the domain involved, Bateson's focus was on the understanding of the general laws and patterns of communication. Inspired by Bertrand Russell's theory of logical types, Bateson has pointed out that the human communication operates at several levels of abstraction. The levels are organised in a hierarchical structure, such that each level is communication about it's sublevel. The level that is communication about communication is called meta-communication, and the level that is communication about meta-communication is called meta-meta-communication, and so forth. In the distinction between the content and relationship level of a message.the relationship or meta-communicative level is used to classify the content level of the communication, to inform on how to understand the message. Bateson points out that there is a gulf between the meta-message and the message. A gulf that is of the same nature as the gulf between a thing and the word that stands for it, or between the member of a class and the name of the class. Bateson's understanding of learning corresponds to his theory of communication in the sense that learning is communication and, like all communicational phenomena, should be understood as a hierarchy (i.e. having different levels).

The number of levels that are possible to identify in human communication is not fixed, but like Star and Ruhleder we use three; these being relevant to understanding the problems of implementing new technology for communication and collaboration within the educational setting of Human Centred Informatics. Level one problems appear as 'matter of fact' problems, like not knowing how to get a user name, or publish a message in the system or not understanding what is wrong when the server goes down. Level two problems are those of using the system properly, knowing what kind of messages should be published and to whom. Thus, level two is concerned with classifying, with discussion and reflection on the type of problems that arise in using, supporting, and running the system in the use context. Level three is one step more abstract, and poses questions about the values and bases of the work done, like what kind of learning goals are to be pursued, or the general politics of the choice of platform (vendor locked or open source). Issues raised on level three are concerned with the fundamental issues and values of the specific practice.

The above discussion indicates that applying an infrastructural perspective to technology as opposed to regarding it as system or tool, affords an understanding of the complexity of relations between technology and the way it is used. Additionally, the levels borrowed from Bateson help in sorting out, analytically, the types of problems that arise from changing the learning environment as seen from the meso-level. But while the infrastructural levels are useful in labelling implementation challenges and organising them in different categories, they do not support identification of and distinguishing between practices involved. First and foremost, there are two practices that stand out: these are the pedagogical practice of facilitating learning and the practice of supplying ICT in the organisation – research in ICT and learning do tend to focus on the pedagogical use of ICT, including specific designs, and not so much where the technology comes from. Support in relation to both technology and pedagogy is a third process or practice that, as stressed by Resta and Laferriére (2007) and Kanstrup (2005), is crucial in organisational implementation of educational technology. We thus suggest that pedagogy, technology and support are core practices in a learning environment. In reality, pedagogy, technology and support are woven together, but for analytical purposes we suggest they are regarded as separate but interdependent elements of an educational infrastructure.

Having explicated the infrastructural perspective and core practices we want to pursue the overall aim of identifying and labeling the challenges that are part of the organisational implementation of ICT for learning in higher education. More specifically, we want to investigate the following questions:

- Pedagogical practice: how, when, and why does communication change under the new technological conditions?
- Support practice: what kind of support is needed and which challenges do the supporters meet?
- Technology practice: what kinds of problems are involved in acquiring, operating and maintaining new ICT?

In the next section we describe our case and methodology before going into the analysis of the questions.

CASE STUDY

Human Centred Informatics is an educational program within the Faculty of Humanities, offering bachelor (3 years), master level (bachelor + 2 years) and Ph.D. level (master + 3 years) education, and has approximately 500 students. It combines communication, organisation and ICT studies, equipping students with the tools to become critical yet constructive participants in the evaluation and construction of ICT and new media. Human Centered Informatics already uses ICT supported learning, but primarily in educational programs placed off-campus.

The pedagogical foundation of Human Centered Informatics is the variant of problem based learning (PBL) known as problem oriented project pedagogy (POPP) (Dirckinck-Holmfeld, 2002). In practice, students spend approximately 50 per cent of their time on coursework and 50 per cent on supervised, group organised, problem based projects. This means that educational technology must support collaboration and community building involving both students and faculty.

This study is part of a larger action research project that has been divided into three phases, moving from implementation of ICT in a semester with relatively few students (21) and faculty (6) involved, to a semester involving more students (80) and faculty (20), and finally to a full scale implementation. Phase one was used to uncover the practical problems implementing different kinds of ICT, and to study faculty implementing ICT in individual courses with little coordination. Phase two focused on using ICT to improve coherence, flexibility, transparency and quality in teaching and learning. The degree of coordination in the use of ICT was higher in the second phase. Among other things this meant that a common platform was implemented across all courses and activities in the relevant semester. Lotus Quickplace was chosen because of the flexibility it offered in tying all activities together within a common structure, but which could remain open to local re-design by faculty, students or administrators. In the third phase the Quickplace based structure from phase two was refined and expanded and implemented across the Human Centered Informatics program.

This investigation is designed as a case study and was carried out after one semester with full scale implementation (spring 2004). To document the implementation process we monitored the use of the Quickplace environment over one semester and conducted semi-structured research interviews with key figures. A key figure is here defined as a person that seems to have played an important role in the process or showed an above average devotion to the use of Quickplace. We thus selected members of the faculty (3), administrators (2), students (1), Quickplace support staff (3) and system administrators (2) for interviews. In the interviews the discussion was centred on knowledge, competencies and opinions in relation to aspects of practice affected by the implementation of Quickplace.

The transcripts of the interviews were reorganised according to the theoretical framework and according to themes that emerged across the interviews.

ANALYSIS AND DISCUSSION

Analysis and discussion is structured around the analytical framework and research questions presented earlier in this chapter. In our analysis of the pedagogical practice we use data from interviews with faculty, students, and secretaries. Quickplace support staff provided data for our analysis of the support practice, while data for the analysis of technological practice came from the system administrators. We use the levels extracted from Bateson's work on communication, and also used by Star and Ruhledger (1996) to identify and label the different categories of problems involved in each practice.

Pedagogical Practice

In the present case the implementation of new educational technology is closely linked with the emergence of a new pattern of communication within the pedagogical environment. The members of faculty we interviewed were especially concerned with two issues: change in conditions for communication with students, and change in their own work conditions. Thus, one of the interviewed faculty members stressed that good communication no matter if it is verbal or textual is richer than that offered by the new system, which is based on text based asynchronous communication. Being a coordinator of the first semester of Human Centred Informatics she points out that in her opinion good communication and rich social interaction are even more important with new students:

> The first semester presented some completely different problems to others because you [students] have to be integrated into a culture that has yet to be established. But then the question is: what tools do we need to communicate during the first semester and how can we show that we are in a department of communication? (faculty, semester coordinator, line 17–23).

However, this is not the only problem that she experienced during the introduction and use of the new system. Before the system was implemented most of the communication between faculty, students and the coordinator of the semester took place via a secretary who came to know almost everything about the semester. This was about to change because all parties got easier access to communicate directly in the system, with the result that no one really had an overview any longer. At the same time an old discussion about the division of labour between different groups of university employees re-emerged, because the system called for a review of decisions on who does what.

The other faculty members we interviewed, who were coordinators of higher semesters in the same programme, agreed that the possibility for communication and dialog were restrictive in the new system (compared to face-to-face), and added that on-line communication changed their work conditions. The new system

made it possible for students to ask questions 24 hours a day, to expect written comments on papers instead of oral responses, and require on-line publication of PowerPoint presentations and lecture notes. Each of those requests may have seemed reasonable, but the faculty members we interviewed argued that this was all part of a transformation of their work conditions and demands. They felt they were forced to take on new tasks, due to the expanded facility for communication online, but did not manage to get rid of any existing tasks by way of compensation. Furthermore, they felt that the system had made their work and communication more visible, transparent and less private in a way that was at times quite troublesome. In general, they had nothing to say against transparency and visibility, but felt that many problems they had regarded as inevitable during the course of a semester were, thanks to the virtual environment, made public in an unreasonable way. In a specific case, complaints from individual students were posted in a shared forum and even though the matter was out of the hands of the coordinators they felt unhappy about the situation – not only because the problem existed, but because the complaints, though unjustified, made them look responsible for it, so causing them loss of face.

To facilitate the kind of rich social interaction they sought to promote, the faculty members advocated the use of a real life classroom, complete with physical teaching aids such as notice boards and paper. If students have to find information e.g. on boards outside the offices of the faculty, then these boards, say the faculty members, become the centre of informal gatherings, where students and faculty staff meet to discuss important issues. In the faculty members' opinion, this kind of informal gathering and interaction is not yet afforded by the new system.

None of the problems pointed out by the faculty members had anything to do with the use of the system, what we call level one problems; that is, gaining access to it, publishing documents etc. This could be because there were no such problems, but it could also be that, for the faculty members we interviewed, second and third order issues were more significant. It may be that some of these problems had more to do with finding the right balance between the forms of communication available, as the use of the new system does not necessarily exclude the use of other media, such as notice board and paper.

While the faculty members focused on the problems of good communication, the role of dialog and their own work load, the secretaries and students were more concerned with the potential of the new system. The student we interviewed argues that one integrated ICT based platform for communication and collaboration will make it far easier to keep track of all relevant information. As for the secretaries, they maintained that the system had actually reduced their work load. The secretaries' responsibility to students is primarily to keep them informed on such matters as class schedules, cancellation, enrolment for exams etc. Once the implementation was complete they could just post all this information on the system and their part of the work was done. In principle, the students could reply and ask questions to at least some of these messages, although the secretaries pointed out that they did not have the time to check the systems for messages and reply to them. They did mention a need for educating the students in actually accessing the information on

the system, as a lot of them missed the deadline for exam enrolment, but basically the secretaries were content with the new, predominantly one-way, communication form.

The faculty members, secretaries and students all pointed to different possibilities and problems connected with the use of the system. The students wanted a common on-line structure, giving easy access at anytime and from any place. The secretaries and faculty added that students also want the greatest possible amount of help and service. The secretaries want to reach as many students as possible in as fast and easy a way as possible. The faculty members on the other hand stress that as professional experts in communication they see a need for a more diverse pattern of communication than the virtual environment offers. They also stress that the degree of service and flexibility that students find convenient may not be advisable or possible, from their professional point of view.

It seems that implementation of a new system for communication and collaborating also created a need for renegotiating the communicative practice within the educational setting. During its introduction the faculty members, secretaries and faculty members were all shown how to operate it, but there was no explicit discussion about what the new conditions for communication meant for their respective work practices.

Support Practice

The support team consisted of one full time e-learning consultant (although his time was not 'fully' on this project) and two part time student assistants. The students were enrolled in Human Centered Informatics and were thus students in the program they were supporting as well.

From the beginning of the project the assumption made by researchers, project management and the support staff was that it had to be an iterative project, where evaluations were fed back into the implementation process continuously. That decision was made based on experience, the available literature and prior studies that suggested that implementation of ICT could be understood as a learning process (Nyvang, 2004). The iterative approach was both a solution and a challenge to the support staff. A solution because it also presented a way to develop their knowledge base, and a challenge because learning from iterations is also complicated; the reason being that each iteration throws up many different and contradicting views on the right way to use the system and the right way to support the users. In other words iteration was a level one activity in the support practice, but reflections on how to be iterative and how to learn from iterations were level two and three problems. We do not in our data see simple, easy and unproblematic solutions to these challenges, but as the next paragraphs show, the support team developed a practice that attempted to handle the challenges.

First of all, the support team played a different role in different parts of the process. They started with the design of the structure and went on to the design of interface of the Quickplace environment, based on experience from a pilot project

and their own knowledge relevant to the task at hand. One of the student assistants describes it this way:

> At first we looked at how it had been running so far. I had been in the semester in which it was used [part of the pilot project]. [Student assistant 2] had been a supporter there and then we talked about the things we would like to change, wrote a list and then started on the design; the layout of a page. There were some things that we thought should be done differently. And then we made different models. (Quickplace support staff, student assistant 1 line 103–114)…Regarding the structure and similar issues, we talked to the semester coordinators to find out what their needs were –whether there was a specific need in individual semesters (student assistant 2 line 267–271).

Here we see that the design and support team had a pretty clear idea about how to solve the level two problem of obtaining the specific knowledge needed for designing and implementing a structure within the web-environment. However, they did encounter a level one problem when it came to the implementation of a single sign-on, which was intended to give the users unrestricted access from a single signing in process. Fortunately the server administrators solved this problem.

When the support team had the design in place it was made available to the users prior to the start of a new semester. The top priority of the support team in the next phase – the period just before and immediately after the semester commenced – was to solve or avoid level one problems among the members of the pedagogical practice, as well as the students and administrative staff. This they achieved by answering questions and solving problems for individual users and by offering short courses to groups of users. The courses gave a short introduction to the new platform and practical exercises. This course did not pay much attention to the level two problems of the users – very little was done to introduce proper and efficient use of the platform to the users. The guidance given to individual members of the faculty did pay more attention to the level two issues.

The support team noted several challenges in the way things were done during the implementation of the new platform. First of all, they were in a different organisational unit (a research lab) to the system administrators and felt that the chain of command was unclear. They felt that a clearer division of responsibility could have made some of their work easier because it had enabled them to make faster decisions on some issues. The supporters also underlined that even though the new platform was widely known and widely used in the organisation there was still work to do to on pedagogical and didactical innovation, and on the utilisation of all the features offered by the platform (e.g. the support for collaborative work and learning). The student we talked to supported this statement. He saw a great need for using it in a more innovative fashion in order to harvest some of the real potential benefits.

Level three problems did not seem to be discussed much when it came to support. It turned out to be an underlying assumption that support was something required in a project like this and that the present support was functioning well and assumed to be sufficient in this case. However, we saw an emerging discussion

about the definition of flat and hierarchical structures. The design and support team believed they had designed a flat structure, whereas one of the semester coordinators thought it was hierarchical. This was a clear indication of a need to negotiate the meaning of specific words, so as to ensure a better communication across practices. It also indicated a need to negotiate the structural needs across the pedagogical and support practice. We also heard different opinions on the role of the support. Some thought that support should just take care of technical problems while others suggested a more integral approach to technical problems *and* the development of practice with the technology. In the present case the supporters had knowledge about the program they were supporting, as well as in-depth knowledge about the technology and the use of ICT in learning and teaching. With this background in mind we suggest that support is seen as a mediator that promotes the use of new technology by solving actual problems for users and by guiding them towards efficient and innovative use.

Technology Practice

What kinds of problem are involved in acquiring, operating and maintaining new ICT? To illustrate the complexity of the problems we will look at an example from the Human Centered Informatics case from the perspective of the system administrator's office. It is a story that highlights how solving a relatively simple technical problem can become an extremely complex process, involving all sorts of issues – technical and non-technical.

During the first months of its full scale implementation the system went down frequently. This was of course very inconvenient and confusing for the users, many of whom had just started to use the system. Apart from restating the server, which made the system functional once again, the system administrator's office began to investigate the cause of the problem and how to solve it. It had not occurred during the former phases of use and so attention was given to what made this implementation special. In contrast to previous phases, the system had on this occasion been integrated with the general catalogue of users, which was kept in the system administrators' office in order to avoid entering all the names manually. This integration was possible according to the system documentation. Nevertheless, it was thought that the problem had something to do with the system losing contact with the user catalogue, making it impossible to log in. At this point help was sought from the systems' supplier who, as it turned out, had a comprehensive web based support system, which was able to offer a solution. However, access to the online fix was delayed, due to the fact that the university had acquired the Quickplace system through a joint research project with the supplier, and thus did not have the customer ID needed by the online support system. While struggling to obtain a customer ID, the system administrator's office decided as a temporary solution to restart the server every night. They also put up a surveillance system in order to detect exactly when the problem occurred. Eventually it transpired that the supplier knew of the problem and how to solve it.

In the end it turned out to be merely a level one problem, but the process of solving it, getting the right information and installing the fix, involved several investigations at levels two and three. The idea of putting up a surveillance system is an example of a level two decision, thus a consideration on how to act when something is not working. Also, the service and maintenance of the system was brought into question. There was no explicit decision concerning system surveillance outside normal working hours, which meant that if the server went down outside normal working hours it would not be restarted right away. However, it became apparent that there was in fact a need for a round-the-clock watch, because the system was being used at all hours. Should the server go down during the night without being monitored it would not otherwise get re-started before next morning at eight, when the system administrator's office was back at work. Working with the server problem also identified some level three questions (e.g. the discussion on platforms). It was difficult for the system administrator's office to actually work with the problem because they had no access to the system's code (and for a period no access to the supplier either, as mentioned above). They would have preferred an open source system with a large user community, as this would have allowed access to the code and to other users with the necessary technical insight. Besides this there were some organisational considerations concerning, for example, who was going to decide how much to spend on a solution, and how it was to be paid for.

The technology practice had no formalised goals for system functionality, stability, or server surveillance – nor had it a formalised policy for choosing and implementing new systems. It was clearly stated in an interview with the manager of the system administrator's office, though, that the system administrator's office wanted test software before it was rolled out to end users, in order to avoid problems and that they also wanted surveillance systems outside normal working hours to be able to find and solve critical problems as soon as possible. When it came to identifying the most critical problems the answer could not be found within the technology practice because the end users are not there. They are in for instance the pedagogical practice. This again brings us to conclude that considerations and negotiations across more than one practice are needed to identify the most prominent challenges.

FINDINGS AND LESSONS LEARNED

Infrastructure defined as something that is just there, ready at hand and transparent did not emerge in the Human Centered Informatics case. The technology we studied did, however, develop towards representation and support of the work of staff and students, which is another quality of an infrastructure (Star & Bowker, 1995). What is interesting then, on top of our original research questions, is why the infrastructure did not emerge?

The analysis has been conducted under the headings of pedagogical practice, support practice and technology practice. In the matrix below we have grouped the findings in a hierarchy of the three levels suggested by Star & Ruhledger (1996). The matrix[1] points to the fact that the problems and issues involved in accomplishing an infrastructure for networked learning are manifold and of diverse nature.

Table 1. Critical questions and problems linked to the implementation of educational technology in the case of Human Centred Informatics.

	Pedagogical practice	Support practice	Technology practice
Level 1	Lack of ability to sign-on and publish messages.	Lack of single sign-on.	Server breaks down.
Level 2	Which kind of communication is relevant in which media?	On what knowledge base is the support and structure for networked learning designed?	How is the technological stability and reliability ensured?
Level 3	What is the role of dialogue?	What is support and what is the relationship between support and other practices?	Who owns, controls, and has access to the source code of the software? What is technological stability and reliability?

The level one challenges were the most specific. They are also likely to be the most case specific and the easiest to deal with, and in our case they were all solved. However, they were not entirely uncomplicated, because what appeared to be a simple problem on level one is influenced by the values, cultures and knowledge inherent in the levels two and three. It is for instance only a problem that the server is off-line if it is generally agreed that the server must always be on-line. The level two and three challenges were more difficult to deal with, because they were in the form of open ended questions that could only be dealt with through negotiation, alignment and coordination – often across more than one practice. Level two is a good example: The negotiations within the pedagogical practice about relevant communication and media were influenced by design decisions made by the supporters within the support practice. The technology practice and reliability of the software also influenced the media/communication negotiation; the argument being that a medium that is not technically stable cannot be used for important messages. For their part, the members of the technology practice were a little reluctant to throw a lot of effort into stabilising a system with little importance to the users and the organisation. Fortunately, the members of the technology practice understood that the lack of stability was exactly what kept the new system from gaining in importance, and a double-bind across the practices were avoided.

Another argument from a participant in the pedagogical practice was that communication in a physical space had higher value, more validity and more important social side effects in comparison to communication in virtual spaces. That perspective on communication contradicted some of the level two and three reflections made by other members of the same practice, and just as importantly it contradicted the views of the members of the support practice, who worked with the knowledge (and conviction) that communication in virtual spaces has a significant pedagogical potential.

In conclusion, level two and three challenges are the most demanding, since they cannot be solved or handled by solely by individuals within the organisation, only by collectives – if we want an infrastructure with the qualities described by Star & Ruhledger (1996). The success of the infrastructure depended on the way these issues were handled. This brings us back to the question of meso-level analysis and design. The designer has to design for learning by supporting negotiation about the process and goal/value related issues in the organisation. By supporting learning the designer also to supports the fine weaving together of existing practices and emerging new practices in the organisation. Also, the dimensions used by (Star & Ruhleder, 1999; Hanseth, 2000), to characterise infrastructure – the emphasis on embeddedness, on backward compatibility, the embodiments of standards, and the link to conventions of practise – point to the fact that the infrastructural perspective is more about smaller steps of continuous evolution than it is about sudden revolution (Star & Bowker, 2002). Of course, the educational organisation may decide it wants a revolutionary change in technology, but it is hard to imagine the day-to-day emergence of a new infrastructure. The alignment of individual contributions to one or more practices and the handling of contradictions is time and resource consuming. As a general lesson to inform meso-level design the infrastructural perspective puts emphasis on the already existing – and evolving – nature of technology use.

As for the further work with the specific problems elucidated upon in this study, we would like to stress the importance of organisational structures that support not only the use of the technology, but also discussions about the proper use of the technology within its intended context, and discussions about the goals and values. Once again we draw on the work of Kanstrup (2005), who stresses the importance of simulteneous membership of different practices (also called multi-membership) in the educational organisation as a means to mediate between different practices and thus support the emergence of new infrastructures within the organisation. Kanstrup goes as far as to talk about gardening inspired by an ecological perspective. Only by means of a gardener and a gardening approach within the organisation can practice evolve over time. Even though gardening is not a term associated with the original meaning of the word infrastructure we find it useful in supporting our understanding of the emergence of an educational infrastructure.

NOTES

[1] A former version of this matrix were presented in (Bygholm & Nyvang, 2004)

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