

# ***Finding the appropriate network for learning***

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## **Abstract**

In this paper, we examine one aspect of the organizational conditions for networked learning in educational institutions: What are the conditions under which institutional actors decide upon Information and Communication Technology (ICT)-strategies for networked learning purposes? The question is discussed within the frame of a case study of the decision process during a shift from one learning platform to another in an education at Aalborg University. The aim is to explicate and understand the multiplicity of issues involved and to point to possible ways of handling such decision processes. In the case in question, networked learning is already well integrated, supported by management and professionally operated by a special section of the ICT department in this institution. We thus distinguish between three major activities mediated by technology, namely operation and support; management and learning practices; each characterized by different motives; and goals and conditions. The study is based on data from interviews with students, teachers, management and personnel from operation and support combined with data demonstrating the existing practice. On the one hand, the analysis shows that the predominant reasons for deciding to change are dissatisfaction with the existing system which is slow due to (too) many levels, lack of aesthetic design, lack of coherence in practices and, generally, lack of relevant content. On the other hand, the predominant arguments for choosing the new system are more related to issues of operation, support and management (e.g. that a body of knowledge and facilities to run the new system already exist in the organisation: i.e. modern open source, and commitment in the organisation to experiment and be up-front in technology issues. We argue that the issues of dissatisfaction with the existing system will not automatically be solved by implementing a new one; that many of the problems with the existing system are related to the way it is used; that the role of the system is vaguely defined in the organisation thus leaving decisions on form and content to individual teachers; and, that there is a need for explicit guidelines and user support on the one hand and, on the other hand, an explicit discussion about the role of the system in the educational practice.

## **Keywords**

Networked learning, higher education, implementation, organisational change.

## **Introduction**

Networked learning, understood as the use of information and communication technology to support and enhance learning practices, has become an integrate part of university education. It has developed from being an isolated and uncoordinated endeavour of single technology interested teacher to being an institutional commitment. A similar tendency can be seen in the area of workplace learning. Thus, according to a report published by e-skills UK (2007), we are approaching a point where learning technologies are stable, the workforce are IT literate, and the benefit of e-learning can finally be realized. The study, which is based on data from more than 200 organisations and included 1000 individuals, maps the maturity of e-learning in six categories as steps going from the novice through the sporadic user, the developing user, the established user, the embedded user to the innovator. Another maturity model from the US (Bersin, 2005) for workplace e-learning identifies four stages of e-learning as well as the main characteristics, challenges and benefits of each of them. A sign of maturity is that e-learning is embedded, reflected in business strategy, supported by management, and integrated with other communication and knowledge management tools used in the organisation. These studies reflect an understanding of maturity as steps on a ladder and explicate the key elements on the road to maturity as being issues of organisational integration in terms of proper support and management.

In the same way as institutions has matured in regards to integrating networked learning so have the systems and technology available for networked learning. For example, it has been suggested that software products go through four predictable stages with different focus on issues such as performance, functionality and usability (Spool 1997). In the first stage, called Raw Iron, the focus is on delivering the basic capabilities, technical issues, and the fact that the product is working. The next stage, Checklist Battle, is about adding features and having the right functionality. Examples on such features of functionalities for networked learning system could be e.g. possibilities for both asynchronous and synchronous communication, access both through client-server and web, shared workspaces, participant list, who is online functions, glossary, quizzes, wikis, various forms of subgroups and so forth. As pointed out by Spool, this stage ends when designers and vendors run out of functions that make a difference for users. The third stage, Productivity Wars, characterizes a situation where the differences between systems have to do with ease of use, maintenance, support, and integration with other systems. In the fourth stage, the product becomes invisible, taken for granted as something that just works, and turns into a commodity. Without a doubt much time have been used in institutions of higher education to compare functionalities of different systems and platforms for networked learning in order to identify the “right” functionalities, but we are now moving towards the third phase with focus on integration, maintenance and support. Thus, on one hand, most functionalities are present in most systems and on the other hand there is a growing understanding that functionalities in themselves do not determine specific use patterns.

Whereas systems and technology available for networked learning might very well end as commodities, the top stage of technical maturity, where technical requirements become more or less self evident, the maturity models mentioned so far still leave the question of what happens when you reach the top level of the ladder. This question calls for another kind of thinking about maturity. As opposed to the understanding of maturity as steps on a ladder, the e-learning maturity model (Marshall and Mitchell, 2002, Marshall 2006, Marshall 2008) identifies maturity within a framework of processes and practices. The model is based on process improvement methodologies for software development and the intention is to provide ways in which institutions can access and compare their capability to sustainably develop, deploy and support e-learning. The e-learning maturity model identifies five major groups of processes each of them characterised by five dimensions which again are broken down into practices that describe how the institutions can achieve the outcome of the process. The processes, dimensions and practices in the framework have been identified with input from a series of workshops with participants coming from a wide range of backgrounds and institutions and comprising academics, librarians, technologists and managers. It is stressed that the aspects used in the framework will inevitably change, thus the e-learning maturity model has developed into a second version. The e-learning maturity model is comprehensive and specifies in detail how to assess e-learning in an educational institution. The five main processes; learning, development, support, evaluation, and organisation, are divided into sub processes adding up to 35 processes in total. Each sub process is described in terms of the five dimensions, that is delivery, planning, definition, management and optimisation. Thus, all in all, 175 aspects are provided to assess and guide the development of e-learning.

Our intention is not to use the 175 aspects to assess or even benchmark the status of networked learning in our case institution (we do however share the idea that maturity is an ongoing endeavour, not a final stage). Instead we aim to uncover the conditions under which institutional actors decide upon ICT strategies for networked learning purposes. We chose to do so because we suspect that the decisions are not always founded in the same kind of strict rationality as the maturity models. We also suspect that decisions are often made in an ecology of multiple actors, tools and intentions. To develop leadership in and around networked learning we thus experience a need to develop insights that are qualitative in nature and supplementary to the very detailed and quite prescriptive maturity models.

In the following sections, we will present our case study methodology, our analysis and discuss our findings.

## **Human Centered Informatics - Case Study Design**

The case study focuses on implementation of ICT in the programme Human Centered Informatics, a programme within the humanities at Aalborg University. The programme offers bachelor and master level educations and has approximately 700 students distributed across two campuses, one in Aalborg and another in Ballerup (which in a Danish context is far away from Aalborg). The programme combines studies in communication, organisation, learning and ICT.

The present case study is a follow-up to another case study committed 4-8 years ago when Human Centered Informatics went through a development process ending with the implementation of Lotus Quickplace (later renamed Lotus Quickr), an information and communication system to be used by administration, students and teachers. According to Nyvang (2008), the early stages of the project aimed to uncover the existing ICT related practice in the organisation. The project also aimed to identify the goals to be pursued by using ICT in the organisation. In the end, the goals were transparency, coherence, flexibility and quality in teaching and learning - these were however also at a high level and open for interpretation. At a more concrete level, the new ICT were supposed to support problem based learning approaches to teaching and learning (Nyvang & Tolsby, 2004; Tolsby, Nyvang, & Dirckinck-Holmfeld, 2002). The latter had a significant influence on the choice of Lotus Quickplace because it supported group collaboration. Lotus Quickplace was however also chosen for its flexibility as a content management system which meant that it could be rearranged to manage course related communication too. In that respect, the technology had reached the second level of maturity in Spool's terms - the organisation spent time on deciding which functionality to give priority. The case study conducted 4-8 years ago also focused very much on the implementation process - on the change from a myriad of different systems and ways of communicating to one common system and way of communicating across the organisation (Bygholm & Nyvang, 2009; Nyvang, 2006; Nyvang & Roseeuw Poulsen, 2007): What were the needs of the different members of the organisation? How were ICT adopted and adapted? What were the main influences on the many decisions made on different levels and by different actors in the organisation? The main influences were ICT already used in the organisation, ICT known from other contexts, culture and pedagogical model, and the existing division of labour between teachers, students and administration (Nyvang, 2008). Members of the organisation discussed whether one common tool for all students, teachers and administrators would be the most productive way to proceed. Those discussions never came to any concrete conclusion. Lotus Quickplace was chosen as a common framework, but many teachers and students chose other ways to communicate and collaborate, and discussions and negotiations kept bringing the technology to the forefront of attention in the organisation.

The present case study investigates under which conditions actors in institutions decide upon which Information and Communication Technology (ICT) to use for networked learning purposes? The occasion is that Human Centered Informatics has decided to discard Lotus Quickplace and implement a suite of tools with Moodle at the centre instead. From an overall perspective, it seems unclear what the organisation has learned about networked learning so far and how it affects the decision to implement Moodle and the day-to-day decisions on how to use Moodle. Our working hypothesis is that the tools, infrastructures and technologies we use will never permanently step into the background. From time to time, they will require attention for one reason or another and it is when they spring into attention we have a special opportunity to gain a deeper insight in the practices and challenges of networked learning in the organisation. Tyre and Orlikowski support the hypothesis that times of change are relatively short when new systems are implemented in organisations and that the windows of opportunity for studying change are equally small (1994). Research by Flores et al. (1988) supports the hypothesis from a different perspective - namely by suggesting that the situations when tools or practices fail and thus come to the forefront of attention offer access to information that is usually invisible or resembles silent knowledge.

The case study methodology and analysis used in the Human Centered Informatics case is rooted in the theoretical framework activity theory. Such approaches have been reported in several research papers and books. Early works by Vygotsky (1978) used case studies to develop activity theory, but from these works, we cannot learn much about the methodology. One of the major contributors to activity theory based methodology, Engeström, did however take his developmental research a step further by claiming that research based on activity theory should involve the researcher in action research like developmental cycles to fully uncover the nature of development (1987). Kaptelinin et al. (1999) went on to suggest an activity check-list aimed at studies of human computer interaction - not specifically calling it case studies, but from their description of the check-list they were obviously a tool for organizing studies of cases of human computer interaction. Later on, Kaptelinin & Nardi (2006) and Spinuzzi (2003) have developed more comprehensive methods for organizing analysis and design processes aimed at different instances of human computer interaction. These methods thus fall into the action research tradition of Engeström, but they also contribute to the body of methodological knowledge by developing tools with a specific domain in mind - and by developing tools aimed at both practitioners and researchers.

For the research reported in this paper, we draw on the analytical tools provided by Kaptelinin et al. (1999). Our choice is based on the simple and yet knowledge generating nature of the methodology. This means that we have the following foci when designing data collection and analysis:

**Means/ends:** Deals with the hierarchical nature of an activity – conditions, goals and motives for activities in the organisation.

**Environment:** Deals with the objects in the context of an activity – tools and technologies used in the organisation and by its members.

**Learning/cognition/articulation:** Deals with the exchange between internal mental processes and external processes – ways of thinking and how they interact with technological potential for representation in the world.

**Development:** Factors influencing change in the organisation – the history of core activities and how they shape present changes.

In our data collection, we have focused on all of the four major issues of the activity check-list when asking questions in interviews, reading documents and examining ICT that are in use in the organisation. For data collection, we have conducted qualitative interviews with key members of staff. In our search for key members of staff we look for what von Hippel (1986) defines as lead users. Lead users are users with the special quality that they can identify the needs of a larger population before the rest of the population does so. In our search for lead users we have also focused on finding the influential members of staff. We ended up with a teacher that is a networked learning expert, two designer/supporters responsible for the design and support of networked learning systems, and the head of the study programme Human Centered Informatics. We have also met 80 third semester students in a workshop-like situation where the students were asked questions, discussed these, and returned short answers in writing. Finally, we have studied existing documents (research mentioned earlier in this section) and the primary system used so far: Lotus Quickplace.

**Table 1. Data collection Human Centered Informatics.**

	Data collection method	Questions
Management	Interview with the head of programme.	Why and how should the programme use ICT in teaching and learning? What influenced the decision to shift from Lotus Quickplace to Moodle?
Teachers	Interview, 1 teacher. Document study of primary networked learning environment.	Why and how do teachers use ICT for teaching related purposes? What do teachers identify as core possibilities and problems with regards to ICT? How do teachers experience the decision to implement Moodle?
Students	Questions to 80 students Document study of primary networked learning environment.	Why and how do students use ICT for study related purposes? What do the students identify as core problems and solutions to core problems?
ICT supporters	Interviews, 2 supporters	How is the support and design organized? What do the supported regard as the most important design and support issues?

## Analysis

The data analysis has been organized in two steps – firstly we read and coded our data with the activity checklist in mind and, secondly, we identified the core themes across all data and reorganized data according to those themes. The three themes are management, operation & support and learning practices. In our report of the analysis, we will go through the themes with focus on the means and ends – the hierarchical structure of the activity.

## Management

The first theme, management, was informed by all interviews and by the students, but primarily by the interview with the manager of the programme. This excerpt from the interview transcription (our translation) gives an impression of the statements of the head of programme:

My only opinion is that we need to have a system that is super useful and super efficient for the students [...] but we also need a system that matches the ambitions we have [...] we need something that match these and I am told and can see myself that Moodle perhaps meets this requirement better than Quickplace. And also it may be argued that Moodle, which we agreed on relatively fast, is more scalable and easy to handle in terms of implementing supplementary systems as ELG or Mahara [...] which we also have ambitions to do.

Head of programme

The motives directly or implicitly expressed by the head of programme stress branding by use of state of the art systems for networked learning. Since state of the art shifts, he implicitly expresses a positive attitude towards change and implementation of a new technology. The head of programme also emphasizes the students whom we interpret as his major concerns in the excerpt and in the interview in general. Emphasis on students is perhaps not surprising, but he could however also have chosen a more indirect approach to the students by bringing the working conditions of his administrative or teaching staff to the forefront of attention.

Lower in the hierarchical structure, we find the more concrete activity and goals of the management. He admits that he has only used the existing platform very little. He has, however, experienced some of the problems with the platform reported by others: Often response times are rather slow (and worse if you use the wrong browsers and operating systems) and from an aesthetic point of view he regards the platform as a disaster. In relation to the change of infrastructure for networked learning he has put together an expert group of researchers and support staff to help him choose a new platform for networked learning. What the head of programme wants from the new platform in terms of actual use is, however, unclear and, based on the interview, it is our impression that he likes it that way. He wants the experts to tell him and the teachers how to proceed.

When managing Human Centered Informatics, the research done by the teachers in the programme is a prominent condition. It is so in more ways; firstly a relatively large research center in the department researches networked e-learning; secondly another research center in the department researches media and aesthetics, and thirdly, research based programmes have to develop content (and form) as time goes by and research develops new insights. These conditions altogether pose a context that influences the management towards choosing state of the art networked learning environments – and perhaps also to put more emphasis on the aesthetics of the networked learning environments. Other prominent conditions are the pedagogical culture and the organisational readiness to implement new systems. These conditions will be further discussed in the following sections.

## Operation and support

The operation and support of the learning platform is divided into two different tasks, the operation of the server and the support of users, that is students, teachers and administrative staff, using the platform. The support task is taken care of by a special section and the following is primarily informed by our interview with two people from this section. The people working in the section have the overall responsibility for organizing the support task and they use a group of (hired) students to take care of much of the actual support. The following excerpt from the interview transcription (our translation) gives an impression on the issues that are emphasized by the support section.

Our role has been to organize the support. What kind of support and how should we deliver it? Who is going to do what? And so on. We have a group of student employees, how do we divide tasks, coordinate the duty roster, etc. [...] we use mail lists and similar to communicate internally [...] part of the support is to document procedures, we have produced a manual on how to handle support, shift in semesters and so on, on e.g. Human Centered Informatics.

ICT supporters

The original design/appropriation of Lotus Quickplace was based on a questionnaire to students which revealed a wish for a flat structure with relatively immediate access to the particular places in the platform. Principles of immediate access and relevant overview have also guided the further appropriation of the platform, thus a major reorganisation gave the users from Human Centered Informatics their own Lotus Quickplace with a common notice board and a room for each semester, recently a sms service have been added in order to provide users with relevant information.

The ongoing support “peaks” every time a new semester is beginning and a major task for the support section is to make sure that all the semester forums/rooms on Lotus Quickplace are allocated with the right students, teachers and courses. In the interview, the support people mention that they often hear students complain about the very different ways in which the system is used by the teachers. In other words, there are huge differences in the way the courses are organized, several teachers do not use it at all, etc., and that the students would like the teachers to follow a more uniform pattern of use. The support section have tried to accommodate these needs by developing a course forum template indicating the basic demands for content and offering support to teachers in setting up the courses. Without much success though as the teachers have shown no interest.

Much effort in the support section has been done to systematize and standardize the support task. Thus, a help list has been implemented to take care of the day-to-day support, FAQ-lists, list of general rules for use, formulas for requesting rooms for project groups and a task-divisions list for internal use in the support section. Also documentation of the various practices has been developed.

The target actions of the support section are the ongoing day-to-day support of the users and also an appropriation of the system. The main concern is on the day-to-day support and they try to organize this as effectively as possible. The overall goal or motive is to deliver effective, useful and prompt support and, in order to do so, they have developed tools and procedures to follow both for the users and for themselves. Questions concerning how to use the systems, e.g. the dissatisfactions expressed by students about the teachers’ use of the system and the teachers’ lack of interest are of less concern.

## Learning Practices

The third theme, learning practices, was informed by all interviews, by input from the students and by our reading of the Lotus Quickplace platform. The primary insights did, however, emerge from the teacher interview and from the inputs from the students. This excerpt from the interview transcription (our translation) gives an impression of the statements of the teacher:

I would have liked to have more dialogue in Quickplace – I believed that I would have been able to make the students more active and thus I had planned to make a café [...] for informal talks [...]. My experience from other settings is that if you add some fun elements it may motivate students to log in just from curiosity to see what is going on [...]. Some of them did not want to blog, just out of principle because they were forced to do so [...]. But as the course was about basic ICT we have also used other tools [...].  
Teacher.

The motives directly or implicitly expressed by the teacher points towards the pedagogical model of the programme (problem based learning) as a core motivation. She stresses the importance of student involvement and active participation in the learning processes. The motive of the teacher is, however, challenged by students that repeatedly argue for more standardized teacher generated input – e.g. lectures and readings. We interpret this as the students strive for a reduction of the uncertainty and stress that may follow when teachers hand over the responsibility for tasks and problem solving to the students.

At the activity and goal-oriented level of the activity, much attention from both teachers and students seemed to be given to day-to-day planning and accomplishment of teaching and learning activities. The teacher structured activities and published information to students. Sometimes she also searched for information about the content of other courses, but was often unsuccessful. The students spent time on finding out which activities they were expected to take part in and on preparing for the activities by reading or meeting with others students to work on tasks or projects. The busy lives on both the teacher side as well as on the student side might lead to a contradiction founded in the division of labour: The teacher pushed tasks to the students and the students pushed

tasks to teachers and administration. The input from students and from the interview with the support staff told us that a lot of students used the virtual group rooms in Lotus Quickplace to support collaboration in the project group work. Apparently, this practice was invisible to the management since a new facility for group collaboration was given less priority in the Moodle implementation (in spite of the emphasis on collaborative problem based learning) than the course management.

The conditions for teaching and learning practices indeed include the official pedagogical model of the organisation: Problem based learning in different shapes and forms is very difficult to avoid. The platform for networked learning offered is another important condition – today, it is Lotus Quickplace and, in the future, it will be Moodle. Platforms of different kinds that teachers and students use in other contexts also influence the way they interpret the needs of Human Centered Informatics. The teacher we interviewed knew the platform Firstclass from another programme and likes the way it supports dialogue – and the students point towards Facebook for a well functioning platform for communication and collaboration.

## Discussion

It appears from the analysis that a multitude of issues, practices and opinions form the experience of the system in use and the decision to implement a new one. Different kinds of dissatisfaction have been expressed. A prevalent issue echoed in almost all interviews is that the existing system is inflexible meaning that there are too many levels to go through in order to get the desired information in e.g. a specific course room. Also in general, the users find the system slow in use, response time being too long and too many operations are required in order to perform relatively simple actions as posting a piece of information. This experience forms a contrast to the intention of support staff to ease the user's access and overview. This points to the fact that overview is highly sensitive to the actual context, but perhaps also that reproducing the structure from the physical context, e.g. semesters and courses, might not be the best solution. Another issue of dissatisfaction is expressed in the students' request for a more consistent and homogeneous use of the system on the teachers' part. Differences in use span from rather sparsely information, like a link to another system or perhaps a course plan to comprehensive use from some teachers with lots of material, interactions and dialogue opportunities distributed in several sub rooms. Hence, there is a contradiction between the students' needs for uniformity and a clear line of direction in where to find what is expected on the one hand, and, on the other hand, the teachers' need for doing things in their own way. This contradiction that exists on the organisational level will of course not be solved by implementing a new system. Instead, it points to a basic discussion of what kind of role the "official" system should have. Different systems and different use practices in educational activities are tolerated which on the one hand gives the opportunity to experiment, to innovate or to do next to nothing, on the other hand this also means that the students have to tolerate a wide variety of systems and use practices. Although the organisational use of networked learning is mature in the sense that it is integrated, supported and has the attention of management, it is not at all clear how networked learning more specifically is supposed to support the teaching practice.

If Tyre and Orlikowski (1994) are right, then Human Centered Informatics only have a small window of opportunity in which the existing unsatisfactory practices can be changed. The present case study compared to earlier case studies in the same organization also suggests that Tyre and Orlikowski are right – very few changes have actually happened since the early days of the implementation of Lotus Quickplace. This suggests a need to work systematically with the development of new practices around the implementation of Moodle. What a suitable approach to development of practices looks like depends on which perspective on change the organization adopts. De Freitas and Oliver (2005) lists five different perspectives represented by five models: The fordist model, the evolutionary model, the ecological model, the community of practice model and the discourse oriented model. The fordist model implies a strong management and emphasis on division of labour whereas the evolutionary, ecological, community of practice and discourse models imply a focus on learning (e.g. through a series of smaller developmental steps over time) and the importance of communication in the organisation. In the present case, one could argue that the evolutionary learning oriented model has failed so far since the pure bottom-up approach to development by means of Lotus Quickplace has failed. This also indicates that some sort of management intervention is desirable if the organisation is to secure an implementation of Moodle that helps to develop teaching and learning practice in Human Centered Informatics. Drawing on the inspiration from de Freitas and Oliver (2005), it seems reasonable to aim for a process model that combines management intervention with structures actively supporting the organisation in learning how to use networked learning in a productive manner. Drawing on the inspiration from the activity checklist (Kaptelinin et al., 1999)

and keeping in mind the critique expressed by management, teacher(-s) and students regarding the lack of shared visions for the use of networked learning, it becomes increasingly evident that Human Centered Informatics needs to work on both the why (why networked learning?) and the how (how are we going to use networked learning?). Further research is, however, needed before we can present such process oriented tools to educational institutions.

## References

- Bersin, J. (2005). E-learning - a maturity model for online corporate training.: 56.
- Bygholm, A., & Nyvang, T. (2009). An infrastructural perspective on implementing new educational technology. In L. Dirckinck-Holmfeld, C. Jones & B. Lindström (Eds.), *Analysing networked learning practices in higher education and continuing professional development*. Rotterdam/Boston/Taipei: Sense Publishers.
- de Freitas, S., & Oliver, M. (2005). Does e-learning policy drive change in higher education? A case study relating models of organisational change to e-learning implementation. *Journal of Higher Education Policy & Management*, 27(1), 81.
- e-skills UK (2007). Towards Maturity: Insights for Employers and Training Providers, e-skills UK: 91.
- Flores, F., Graves, M., Hartfield, B., & Winograd, T. (1988). Computer systems and the design of organizational interaction. *ACM Trans. Inf. Syst.*, 6(2), 153-172.
- Kaptelinin, V., & Nardi, B. A. (2006). *Activity theory and interaction design*. MIT Press.
- Kaptelinin, V., Nardi, B. A., & Macaulay, C. (1999). Methods & tools: The activity checklist: A tool for representing the “space” of context. *Interactions*, 6(4), 27-39.
- Marshall, S., and Mitchell, G. (2002): An E-Learning Maturity Model?. Proceedings of the 19th Annual Conference of the Australian Society for Computers in Learning in Tertiary Education, Auckland, New Zealand.
- Marshall, S. (2006). E-Learning Maturity Model Version Two: New Zealand Tertiary Institution E-Learning Capability: Informing and Guiding E-Learning Architectural Change and Development Project Report. Report to the New Zealand Ministry of Education.
- Marshall, S. J. (2008). What are the key factors that lead to effective adoption and support of e-learning by institutions? In Proceedings of HERDSA 2008 (Rotorua, New Zealand, HERDSA).
- Nyvang, T. (2006). *Implementation of ict in higher education*. Paper presented at the Networked Learning 2006, Lancaster.
- Nyvang, T. (2008). *Ibrugtagning af ict i universitetsuddannelse (implementation of ict in higher education)*. Unpublished Ph.D., Aalborg University, Aalborg.
- Nyvang, T., & Roseeuw Poulsen, C. (2007). Implementation of ict in government organizations - user driven og management driven? In A. M. Kanstrup, T. Nyvang & E. M. Sørensen (Eds.), *Perspectives on e-government: Technology & infrastructure, politics & organization, and interaction & communication*. Aalborg: Aalborg University Press.
- Nyvang, T., & Tolsby, H. (2004). *Students designing ict support for collaborative learning in practice*. Paper presented at the Networked Learning 2004.
- Spinuzzi, C. (2003). *Tracing genres through organizations - a sociocultural approach to information design*. Cambridge, Massachusetts: The MIT Press.
- Spool, J. M. (1997). Market maturity, User Interface Engineering: [http://www.uie.com/articles/market\\_maturity/](http://www.uie.com/articles/market_maturity/).
- Tolsby, H., Nyvang, T., & Dirckinck-Holmfeld, L. (2002). *A survey of technologies supporting virtual project based learning*. Paper presented at the the third international conference on networked learning, Sheffield, England.
- Tyre, M. J., & Orlikowski, W. J. (1994). Windows of opportunity: Temporal patterns of technological adaptation in organizations. *Organization Science*, 5(198-118).
- von Hippel, E. (1986). Lead Users: A Source of Novel Product Concepts. *Management Science* 32(7):791–806.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge: Harvard University Press.