STS GOES TO SCHOOL
Spatial imaginaries of
technology, knowledge and presence

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The design and research of Femedit and FEMTEDIM is a result of close collaboration between a large group of people involved in 5th Dimension Copenhagen, of whom I am especially thankful to Nina Armand, Agnete Husted-Andersen, Kenneth Jensen, Tine Jensen and Morten Jack for inspiring and rewarding teamwork. I am also grateful to the 5th Dimension groups in Ronneby and Barcelona for fruitful discussions and collaboration in the EU-project “School of Tomorrow”.

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The thesis applies a theoretical approach developed through Science & Technology Studies (STS) on a new empirical field: primary school. This move is developed through empirical investigations and theoretical discussions. The thesis asks how an online 3D virtual environment participates in school practice and which performative effects its way of participating has on school practices. Thus, technology is not studied as an instrument for human purposes but as a participant taking part in practice on a par with humans. The theoretical background of this approach is especially found in Actor-Network Theory (ANT).

The primary empirical research field is a virtual environment project in a 4th grade primary school class in Copenhagen. The field work was carried out as participant observation and observing participation during the implementation of the project as well as during the design processes prior to the implementation and parallel to it as well. I first describe the design that was added to the virtual environment and contributed to forming it. I show how the design was formed through a construction process which rendered it stable and robust enough to stay intact even after the meeting with school practices. I call this characterization of the design a network imaginary. The description of the network imaginary shows that the design came to be the way it was by folding human and nonhuman efforts into it, including the efforts of the virtual environment’s own materiality. Thus, the stability and specific character of the technology is not to be understood with reference to the technology ‘an sich’ but including the investments of an assemblage of entities. The network imaginary furthermore shows that as long as its parts stay in place and do their work the design is capable of keeping its shape even after encountering school practice.

The network imaginary is an apparently comprehensive description of the design. However, I show that there are elements that did not fit into the network imaginary. Parts of the design did not work according to the plan, elements had to be repaired, and new and surprising entities was brought into and started forming the design. I describe how this happened, and I call this characterization a fluid imaginary. With this description I furthermore turn from what I call classic-ANT to after-ANT. The latter is a further development of the Actor-Network Theory, which contrary to classic-ANT highlights technology as mutable, transformative and temporary. In consonance with after-ANT I argue for an understanding of technology that is sensitive to the fluid characters of technology.
I use the term *spatial imaginaries* to characterize the way of describing technology as network and fluid. This strategy focuses on how entities taking part in practice are mutually related, contrary to describing the content or meaning of practice. It is the *patterns of relations* that are in focus. The imaginary of design as network or fluid depicts design as different ways in which human and nonhuman entities are related and take part to contribute to forming the design.

The first part of the thesis discusses and applies this approach to describe technology. In part two and three I turn to some of the *performative effects* of the way in which the virtual environment technology participated in school practice. The second part of the thesis concentrates on *forms of knowledge* performed through the patterns of relations constituted with the virtual environment technology, while part three discusses *forms of presence*. I especially focus on the performative effects of fluid patterns of relations of the virtual environment. The reason for this focus is that the literature mainly focuses on the standardising and stabilizing effects of technology, while descriptions of transforming and ephemeral effects of technologies have been given low priority or even overseen.

Part two and three compare the participation of the virtual environment with the ways in which traditional low technology learning materials take part in classroom practices. Classroom observations from the 4th grade primary school class that participated in the project with the virtual environment constitute an additional source of data for these two latter parts of the thesis.

Part two describes how a ruler, textbooks and other materials in the classroom contributed to performing a *representational* and a *communal* form of knowledge. I compare the material arrangement of the classroom with Boyle’s experimental set-up in the mid-17th century and I draw parallels between the forms of knowledge performed the two places. I turn to the virtual environment and show that this technology due to its lack of stability was incapable of contributing to performing *representational* and *communal* forms of knowledge. Consequently, the integration into school practices of this form of knowledge, and this technology, caused problems. However, the *liquid form of knowledge* performed continued into the lives of children outside of school and engaged a stream of practice as object of learning.

Part three turns towards forms of presence and compares like part two the classroom’s traditional learning materials with the participation of the virtual environment. I show how especially the blackboard contributed to establishing separations in the shape of a *boundary* between pupils and the teacher. I characterize the different forms of presence performed by and through
this pattern of relations as an authority and subjects, respectively – each on one side of the boundary. Such a boundary was not performed with the virtual environment. Pupils and teachers were related in a more symmetric way. I characterize this form of presence as agential. In part three I particularly look for separations performed through the fluid patterns of relations of the virtual environment. The reason for this is my scepticism towards after-ANT’s characterization of fluid patterns of relations as capable of including nearly any entity and tolerating almost any transformation, as if no separations and no limitations were performed. I show that separations were indeed performed with the fluid patterns of relations even though they did not take the shape of boundaries. The separations performed with the virtual environment were formed as discontinuities. These complicated lasting relations between the agents, I argue.

Concluding the thesis I argue that it throughout the chapters has become increasingly clearer how intimately technology is involved in performing practice, knowledge and presence. The thesis thereby contributes to a post-human approach to practice. Furthermore, the thesis contributes with an understanding of technology as multiple and varying. It adds to the current literature on fluid patterns of relations with a further development of its empirical foundation as well as with revisions of the celebration of this pattern of relations. The thesis finishes by discussing two issues of the current educational debates on schools in Denmark. Thereby, I show how the results of this thesis may contribute with a new approach to this debate and to the organizing of school practices in general. It is an approach that takes into account the participation of technology and technology’s contributions to practice, and which hence acknowledges parts of practices, which otherwise tend to be overlooked. I argue for the need of taking into account how technology participates in school practices when doing research, planning lessons, making educational politics, and in learning itself.
STS i skolen. Rummelige forestillinger om teknologi, viden og tilstedeværelse


foranderlig og temporær. I tråd med after-ANT argumenterer jeg for en forståelse af teknologi, der kan rumme, at teknologi kan bære såvel netværks som flydende karakteristika.

Jeg kalder den beskrivelses-strategi, der giver anledning til at beskrive teknologi som både netværk og flydende, for **rummelige forestillinger**. Dette henviser til en beskrivelsesstrategi, der i stedet for at se efter f.eks. praksissers indhold, betydning eller mening beskriver, hvordan de enheder, der indgår i en praksis, er indbyrdes forbundet. Det er de **forbindelsesmønstre**, der former sig ’rummeligt’, som beskrives. Forestillingen om design som netværk eller flydende beskriver således forskellige måder hvorpå de humane og nonhuman enheder, der indgår i designet, er forbundet på.

Efter i afhandlingens første del at have diskuteret og anvendt denne tilgang til at beskrive teknologi, vender jeg mig i del to og tre mod nogle konsekvenser, som disse forskellige måder, teknologien deltager på, fik for skolepraksisen i det empiriske forløb, jeg gennemførte i forbindelse med dette forskningsprojekt. Afhandlingens anden del ser på de **vidensformer**, der opstod som effekt af de forbindelsesmønstre, som teknologiens deltagelse udfoldedes i, mens afhandlingens tredje del ser på de **tilstedeværelsesvidensformer**, som opstod. Der lægges især vægt på at beskrive konsekvenserne af de flydende forbindelsesmønstre, som den virtuelle verdens deltagelse resulterede i. Dette valg er begrundet i, at litteraturen ofte har beskæftiget sig med teknologis standardiserende, ensrettende og stabiliserende effekter, hvorimod beskrivelser af foranderlige og temporære effekter af teknologi har været underprioriteret, måske endda overdådt. Denne del af afhandlingen henter således data fra en klasseværelses observatio – men kun i den samme 4. klasse som det øvrige data materiale er hentet fra.

Del to beskriver, hvordan en **repræsentationel** og en **netværks-vidensform** udformedes i klasseværelset med udgangspunkt i linealer, lærebøger og andre materialer. Jeg sammenligner klassens materielle arrangemetn med Boyle’s experimentelle set-up i midten af det 17. århundrede og viser paralleller mellem de vidensformer, der produceredes de to steder. Jeg bevæger mig derefter til de virtuelle verdener, og viser, hvordan dette teknologiske design ikke leverede den stabilitet, der var nødvendig for at etablere repræsentationelle eller netværks-vidensformer, hvilket betød, at den havde vanskeligt ved at indgå i skolens praksisser. Til gengæld strak denne **løbende vidensform** sig ind i børnenes liv udenfor skolen og engagerede en strøm af praksis som objekt for læring.
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Chapter 1

Introduction

I am reading a book on classroom observation. There is a list of “illustrative examples” of research questions. Some of them are:

1. What do teachers and pupils do in the classroom?
2. How do teachers manage their classes?
3. What do pupils learn?
4. What is a school day like from a pupil’s point of view?
5. What happens to particularly able pupils?
6. How are classroom decisions made?
7. What happens when pupils disrupt lessons?
8. How can I improve my own teaching?
9. Is there continuity and coherence in the curriculum?
10. Do teachers in one school have similar or different practices?
11. Do teachers and children perceive the same events?
12. How is pupils’ work monitored and assessed?
13. What happens when children work in small groups?

Excerpts from Wragg 1999 p.110-111

These questions are indeed illustrative of educational research. I note that they all concern teachers or pupils. That there are no questions about learning materials, about the layout of the classroom, about technology. Educational research is wholeheartedly humanist. It studies human practice. This thesis is an attempt to suggest an alternative. It studies school practices but focuses neither on pupils nor on teachers. It focuses on technologies. It is fuelled by the observation that humans are not entirely in control of practices. That what happens in schools is not simply due to the pedagogy, authority or style of teachers, children’s motivations and abilities, modes of interactions, planning and structuring of lessons, etc. The thesis is carried by the assumption that high and low technologies also take part in, and contribute to, forming school practices.

Thus preoccupied, the question I pose is how technologies participate in school practices and what is performed through these ways of participating. More specifically the question of this thesis is how online 3D virtual environments take part in school practices and with what effects. An online 3D virtual environment is a computer program that runs on online PCs. It creates the illusion of a landscape in which the user can move around a graphic character and create graphic scenarios. You can meet other people online in the virtual environment and you can communicate with them electronically through chat and by way of your character’s gestures (see figure 1).
There is a large body of literature on educational technology which in addition to studying humans in school practice is concerned with technology. More than anything research in educational technology asks how we can use technology to make learning more efficient, more interesting, more diverse or how collaboration can be supported by technology, etc. These are good questions, and they are indeed important questions. But note how they limit the study of technology. When the focus is on learning efficiency, on motivation, collaboration, etc. the only part made available for technology to play in the research accounts is that of a means to a social, psychological or pedagogic end. The answers we get tell us about the ways in which the technologies in question are suitable or not for serving human aims. Human aims play the leading part; technology the secondary. In this thesis I want to let technology play the leading role, or at least be on the same footing as humans. I want to explore what technologies do, how they participate in practice, and what they do to humans, among other things.

Consider this story from the history of technology: In the 1870s Graham Bell made public demonstrations of the telephone. Audiences would hear Watson through the telephone reading the news in a nearby city. This early use of the telephone for broadcasting is very different from the two-way one-to-one communication that later became the primary use of the telephone.
There are several examples in the history of technology showing that the designer's original expectation of how a device would be used largely diverged from how the devise eventually came to be used.

Research in educational technology, however, rarely takes into account that the technologies they study might have their own ways of participating; that they might not follow the aims of their creators or of the researchers. That an online 3D virtual environment might be suitable for, or contribute to, performing quite different practices than what researchers had in mind. As the title of this work indicates the thesis is about applying the Science, Technology and Society (STS) approach on an empirical field which has not yet received much attention by STS scholars. STS is an interdisciplinary research community that seeks to understand the relationships among technology, science, political systems, social relations and human values and to describe how these relationships are influenced by science and technology, and in turn, how these relationships affect science and technology (e.g. Sismondo 2004). Over the past decade STS has moved from exploring mainly scientific (including medicine) and engineering practices to covering empirical fields like financial markets and legal practices. With this thesis I turn to yet another field: school practice, which like science is about producing knowledge, and like engineering is about producing machines that operate in certain ways, only are the ‘machines’ in question human beings. Drawing on STS and especially on Actor-Network Theory (ANT) this thesis is driven by a wish to contribute an alternative approach to the literature on educational technology. Instead of focusing on online software as a means for human purposes, I turn the issue of which part this online software plays in practice into an empirical question.

**Participation**

What does it mean to study a computer program empirically? How can we understand that a virtual environment participates in practice? In reference to personal participation, psychologist and scholar of subject science Ole Dreier identifies the notion of participation by the following features:

- it indicates that a participant is always already involved in practice.
- it emphasizes the particularity and practical nature of the participant.
- it points to the partial aspect of practice.
- it indicates that a participant is always part of practice, even when not re-producing but disagreeing with or changing it (Dreier 1999 pp.5-7).
For Dreier the participant is always a person (Dreier 1993; 2005). Because my aim is to study the participation of technology and not personal participation I depart from Dreier’s theory and, applying the Actor-Network Theory’s principle of symmetry (e.g. Callon & Law 1997; Johnson (a.k.a. Latour) 1995; Latour 1999a), I take participant and participation to apply to nonhumans as well as to humans. This altered notion of participation invites us to study a computer program as one of the entities entangled in the practical accomplishment of particular practices. Stefan Hirschauer is a sociologist who is especially interested in the study of bodies in social sciences. He remarks that:

*Artefacts (a. o.) are not actors but participants of social processes. Suggesting this notion does not point to a set of situated participants as in Symbolic Interactionism nor the partakers in a democratic process (participation) as in political theory*, but to all entities that are involved in accomplishing practices in a way that is specific for them. The talk of participants lies ‘on the linguistic level’ of the talk of doing culture. Notably, the English *doing* is grammatically a present participle. It belongs to the so-called infinite verb forms that contrary to the finite forms are undefined in person and numbers. The actor is unimportant for the infinite verbs: Something stays ‘smoking’ – even if it is human, Colt, chimney or volcano.

_Hirschauer 2004 p.74-75; my translation_

While Dreier’s four points emphasize the participant’s entanglement in practice, Hirschauer uses the notion to render “all entities that are involved in accomplishing practices” pivotal in the study of technology (artefacts) and to keep the actor or participant in the background. We may call “all the entities that are involved in accomplishing practices” the *assemblage* of participants. If we translate Dreier’s four points through Hirschauer’s observations when we are talking about the participation of a computer program, we find that instead of studying the computer program as a more or less well-delimited object or actor, our description of the software becomes focused upon it as the *assemblage of participants involved in accomplishing technological practices*. The practical assemblages of which the online software is part become the object of study. Discussing virtual environments in terms of participation is a way of creating sensitivity to how these applications participated in practice in different, surprising and unforeseen ways.

The thesis is comprised of three parts. The first part (chapter 2-4) is concerned with technology. It discusses how to study technology and it explores how the online software in focus in this thesis participated in practices. Part two and three deal with the second part of the research question, with what is performed through the ways of participating discussed in part one. Two

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1 Nor, I would like to add, as a partaker of a democratic design process as in Participatory Design.
sets of performative effects of the way in which the technology participated in practice are explored: part two (chapter 6-7) discusses *forms of knowledge* while part three (chapter 8-9) deals with *forms of presence*. I will return to these performative effects after I have presented in more detail ways of dealing with technology.

**Technology**

Discussing information technology as participating in school practice implies a definition of technology that does not *a priori* set the way in which technology takes part in practice. In the frame of Actor-Network Theory sociologist and STS-scholar John Law suggests a definition which turns the question of how technology participates in practice into an empirical question. According to Law a technology is:

> ...a family of methods for associating and channelling other entities and forces, both human and nonhuman... When I say this, I do not mean that the methods [the technology] are somehow different from the forces that they channel. Technology does not act as a kind of traffic policeman that is distinct in nature from the traffic it directs. It is itself nothing other than a set of channelled forces or associated entities.  

*Law 1987 p.115-6, insertion added*

Following Law’s definition the online 3D virtual environment is not to be understood as only the bits and bytes making up this technical application. No, the application should not be studied apart from the school practice within which participates. And furthermore, it should not be

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**Figure 2** Assemblage of the online 3D virtual environment

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2 I have omitted the part of the definition that characterizes technology as a method for construction of relatively *stable* systems. As I discuss in chapter 4, technology may not necessarily be a stable system.
seen as distinct in nature from this practice. A computer program is nothing other than the entities it associates. The online 3D virtual environment in focus of the study associated many heterogeneous entities, as I describe throughout the chapters of this thesis. Figure 2 is meant as a contrast to figure one, depicting an assemblage instead of an isolated computer program. I do not think it is either possible or very helpful to try to create a corresponding representation of the ways in which entities of a socio-material practice are related, and I need to ask the reader not to take figure 2 as such a corresponding representation. However, figure 2 is helpful because as a contrast to figure 1 it invites us to think about technology in a quite different way. It suggests that not only the online 3D virtual environment but a lot of other entities as well are part of the technology: its graphic elements and avatars, the web-log and frame story added to the computer program (which will be discussed in chapter 3), the computer lab and school in which the socio-material practice, including the application, is situated, and distant practices that in one way or the other come to be involved with the technology in question. Following Law’s definition of technology, all these entities are part of the virtual environment technology.

However, the digital technology is not simply the sum of the entities it associates. Law describes a technology as the methods for or the ways in which entities are associated. Thus, in my research I was looking for the ways in which entities involved in school practices are associated by and through the online 3D virtual environment. Participation of a technology is thus characterized by the way in which it is associated with or associates an assemblage of entities.

In order to study the participation of the online software, in collaboration with my research team I designed two versions of an online 3D virtual environment that will be discussed throughout the thesis. We called the first version FEMTEDIM. It participated in a 10-month after-school project with nine to twelve year old children who met once a week to work with

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3 Actor-Network Theory is difficult. It makes us on the one hand understand software as a distributed set of entities and on the other as the object (method) that draws these entities together. When talking about a technology Actor-Network Theory tends to shift nonchalantly between an assembled object and an assemblage of which the object is part. Between the traffic policeman and the traffic of which the traffic policeman is part. The assemblage and the object are described as the same, and at the same time, the object is described as a part of the object. I shall discuss Actor-Network Theory in more detail in chapter 2, and here just raise the warning of this ambiguity in the definitions of technology. You do not need to be schizophrenic to understand this, but it helps to be receptive to the inconsistent nature of the world.

4 Many students and researchers were involved over shorter or longer time in the research projects discussed in this thesis. The following persons took part in the empirical studies I discuss, and constitute the ‘research team’ I refer to several times: Michael Aagaard, PhD student at Southern Danish University, Nina Armand, Agnete Husted-Andersen, Kenneth H. Jensen, MA students at the University of Copenhagen, PhD student Tine Jensen and PhD Erik Axel from University of Roskilde and myself.
the virtual environment. The second version was *Femtedit* which was involved in an in-school project that ran over seven weeks in two 4th grade primary school classes. Because the software is located on the Internet users need not be in the same physical room. Some of the children who participated in FEMTEDIM and Femtedit were situated in the southern Swedish town Ronneby while others logged on from a local school in Copenhagen, Denmark. The descriptions in this thesis of the ways in which FEMTEDIM and Femtedit took part in these school practices are results of ethnographic fieldwork, which is discussed throughout the chapters.

**Spatial Imaginaries**

I call the descriptions of the ways in which the online designs participated in school practices *spatial imaginaries*. I am dealing with the relations between entities. Relation always entails at least two entities that are close to, far from, above or in other ways in relation to each other. Depicted this way, a relation can be described as an extension or a formation in *space*, hence the term *spatial*. *Imaginary* is a notion suggested by anthropologist and ethnographer George Marcus (1998) referring to a readiness, a logic or sensitivity to describe, understand or interact with the world in particular ways embedded in our ways of thinking and acting. It is important to note that imaginaries are constituted in organized fields of social practices and not to be understood as idiosyncratic fantasies. The *spatial imaginaries* in this thesis are descriptions of software as dispersed in space. I want to avoid describing the meaning of the interaction with technology, the content of the computer program, the sense of the technological school practices. I wish to describe simply how the entities making up the technology mutually *connect*. How the graphic elements, the teacher, the chat message, a pupil, the Internet connection, etc. are *related*. It is their practical arrangements, the ways they are organized, the associations of entities that are the focus of this study. Nothing else.

I create this image of technology by describing the pattern, landscape or shape that is formed spatially by and through relations and the entities they connect. The concept of spatiality will be discussed in chapter 2. Here, I want to emphasize that spatial imaginaries are *formal* descriptions. Descriptions that are concerned with the *formations* the interrelations of technology and other participants take. Descriptions that depict the characteristics of the *patterns of relations* between entities which form the digital application. I describe the particularities of the

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5 Formal in the sense of the word of having to do with form or structure, contrary to nature or content, and not in the meaning of according to prescribed or fixed customs, rules, ceremonies, etc.
patterns of relations between the computer program and other participants. How software relates differently in different practices. How these different ways of relating form different patterns. The spatial imaginaries describe how the online application became fixed or flexible, how boundaries and discontinuities were created, how bonds and connections came to be the ways they did, etc.

In the spatial imaginaries presented in this thesis I draw extensively on three spatial metaphors suggested by Law and empirical philosopher Annemarie Mol (Law 1999; Law 2002b; Law & Mol 2001; Mol & Law 1994): Network, fluid and region. I use these as metaphors for characterizing the different patterns of relation in which the computer program participated in practice. The three spatial metaphors form different spatial imaginaries of the digital application. Network indicates the connectedness, fluid the varying character of the ways in which elements are related, and region the grouping of elements in containers. One of the particularly helpful aspects of the spatial metaphors is that they enable us to describe how one and the same technology participates in different ways, forming different patterns of relations. I argue (in chapter 4) that a computer program is a multiple object.

I describe information technology in this particular way because spatial imaginaries never leave the level of technology and its relations, and because it takes the software seriously. This is in contrast to descriptions of technology that focus on the social interests inscribed in technologies, on the meaning of the content of the technology, or on the social sense of the technological practice. Such descriptions take interests, meaning and sense seriously, but they do not take technology seriously. They turn away from technology, to another, interpretive level. You often read about problems with technologies in school practice as teachers’ resistance to information technology, lack of computers in teachers’ training, the undisciplined character of contemporary childhood, the uselessness of computers, etc. In such descriptions the subtle practicalities of how software interrelates with humans and other entities disappear. The focus and explanatory resources are found in something other and apart from the computer program.

*What remains over from the fact that I raise my arm when I subtract the fact that my arm goes up?*

*Wittgenstein ref. Thrift 2000 p.213*

I try to apply the wisdom of this Wittgenstein quote. The wisdom tells me to describe the patterns of relations in which the technology participates in practice without adding any meaning, sense or diagnosis, etc. to it. By describing patterns of relations I hope to get to understand the materiality of the technology, the difference it makes that the particular technology in question
participates in the particular ways it does. I study how online 3D virtual environments participate in school practices. Not as tools for learning, for collaboration, or anything else. Just how.

**Contrasting technologies**

An online 3D virtual environment is the focus of this thesis. However, during the study of FEMTEDIM I kept hearing my colleagues, children, teachers and myself comparing this online software with classroom practices. This made me curious about how traditional learning materials participated in classroom practices differently, similarly, oppositely, or were contradictory, etc. compared to the ways in which I was observing the digital software participating. Consequently, I arranged a short classroom observation study in the 4th grade school class that was going to take part in Femtedit. What I observed that week turned out to be fruitful for not only understanding how traditional low technology learning materials take part in classroom practices, but also for grasping the ways in which the online 3D virtual environment participated.

The classroom study ended up receiving a much more prominent role in this thesis than I had expected. Indeed, it has become one of the points of this thesis to suggest comparisons between traditional low technology learning materials and new high technologies as an important method for studying technology in school practice. As computers were introduced in schools, so the literature on educational technology significantly increased. Paper after paper describes different educational uses of new technology. Very few take into consideration learning materials that have been used in schools for centuries. Thereby much literature on educational technology implicitly creates an image of school practices as having been devoid of technology until the arrival of the computer, and it provides an understanding of digital software as constituting new school practices as a matter of course. It is often argued that digital software overcomes the problematic transmission model of traditional classroom practice (e.g. Hewitt 2001) but it is rarely discussed how the transmission model is accomplished by way of the traditional learning materials of the classroom, and how the practicalities of this accomplishment differs from the ways in which digital technologies participates in school practices. The practicalities of how school practices have to be arranged differently when different technologies are involved thus remains obscure.

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6 Cuban’s work is a notable exception (e.g. Cuban 1986).
Due to the ‘intelligent’ appearance of interactive technology you may be willing to accept it as not only a tool serving human aims but as a participant of socio-material practice. However you may find it more difficult to allow that this may also be the case for low technologies such as a blackboard, a ruler or an exercise book. In this thesis I treat low and high technology symmetrically, describing low technologies in the same way and with the same vocabulary as high technology. By comparing the ways in which digital software and low technology learning materials take part in school practices, as I do in part two and three of this thesis, it has been possible to show quite precisely how their ways of participating differ.

**Fluid patterns of relations**

The fluid participation of the digital application will be discussed in part two and three of the thesis. There are several reasons for this. First of all, because discussing technology in terms of fluidity is interesting since it runs counter to the ways in which we usually think about technology, i.e. as stable, sturdy, and functional. Technologies, however, are not necessarily like that. And technologies are not only like that. Some technologies, as the software in focus in this study, seem especially to display fluid characters: it is transforming, its shape modifies and its components are exchanged. The ways in which information technology produces standards, stability and regularity has received major attention in the literature. Fewer titles are reserved to describe the effects of technologies that vary and change.

Furthermore, describing fluid patterns of relations became relevant during my study as problems were created by the confrontation between the fluid participation of Femtedit and the school. As ANT-scholar, philosopher and anthropologist Bruno Latour (1987) notes, it becomes clear in moments of crises how entities that make up a technology are associated. Therefore, the crisis which occurred as the computer programme interacted with the school created a good object of study for my research. But it is also interesting because the problems that the software encountered display the limits of fluid patterns of relations of virtual environment technology. It teaches us about the working of the online 3D virtual environment and about its limitations. Furthermore, it shows the working of the school and the limitations of the way it works.

Finally, fluidity is interesting as the latest addition to the development of Actor-Network Theory. The thesis follows a kind of Actor-Network Theory history. Part one sets off in chapter 2 by presenting what I call classic-ANT and presents Latours’ vocabulary for the construction of technology. Chapter 3 applies this vocabulary to describe how the stability of the online 3D
virtual environment design was constructed. This indeed was the focus of classic-ANT in the 80s: to describe how technologies (as well as facts and other objects) were not given in the order of things, but came to be as they were through heterogeneous construction processes. In the last chapter of part one, chapter 4, I describe the online application as fluid. I present the critique of the network metaphor and, following the suggestions of after-ANT authors, I argue that technology is not only and not necessarily a final result of a construction process, as classic-ANT implies. Technology may perform other patterns of relations. Thus positioning myself with after-ANT scholars, the interest becomes to study the non-standard, ephemeral, ‘other’ effects of technologies. Therefore, the focus of part two and three of the thesis is on the performative effects of fluid patterns of relations. With these discussions I contribute to a more subtle and more empirically informed understanding of fluid patterns of relations. I also question the celebration of fluidity which proliferates in after-ANT literature.

**Performative effects**

Throughout part one, I have been concerned with how technologies participate in school practice. However, in this thesis I do not only characterize the online software’s *ways of participating*. In part two and three I ask about the *performative effects* of the fluid participation of Femtedit. As I explain in chapter 2, performative effects can be understood as what is *done*. Apart from characterizing the patterns of relations of the computer program’s participations I also characterize the effects of these participations.

The performative effects in focus are the forms of *knowledge* and forms of *human presence* that are performed by and through fluid or other patterns of relations. These are compared to the forms of knowledge and the forms of presence performed in the classroom with traditional learning materials.

Part two (chapter 6-7) discusses forms of knowledge. I show in chapter 6 how different learning materials in the classroom are involved in different socio-material practices, how these enrol different entities in different ways, and how knowledge comes to take different forms depending on the ways in which learning materials participate in the classroom practices. I characterize these forms of knowledge as representational knowledge and communal knowledge. Chapter 7 turns to the computer lab and by describing the ways in which the digital technology participates I show that the online 3D virtual environment does not make available the forms of knowledge performed in the classroom. I characterize the form of knowledge performed with the software as performative knowledge.
Knowledge is often thought of as mental, abstract or formal. Over the past decades it has been more and more common to describe the socially distributed character of knowledge. Through part two I show that technologies are also involved in performing knowledge. Furthermore, the descriptions in part two show that knowledge may take different forms. I show how representational knowledge, which is what we usually think of as knowledge, is performed as a very specific practice, and that other forms of knowledge do indeed exist.

Part three discusses different forms of presence performed with different technologies in the classroom and in the computer lab. By presence I mean how humans take part in, are performed or appear in practice. Some authors discuss this in terms of subjectivity, identity or agency. I use the term presence as an overall notion of the ways in which a human is part of practice. Terms like subjectivity, individuality, and agency are then different forms of presence that I describe empirically. I show how some technologies contribute to performing subjects and an authority. Others contribute to connecting technologies and humans in other ways and equal agents are performed.

It is widely accepted that human presence is a social construction contrary to being an effect of purely individual processes. However, it is more rarely argued that technologies contribute to performing human presence. With part three of this thesis I present the insight that it is not only humans who contribute to creating technologies. Technologies indeed contribute to performing humans.

Conclusion

I conclude the thesis by describing the ways in which this thesis has contributed to the understanding of technology. Moreover, I turn to the question of the practical use of the spatial imaginaries delivered. I argue that we indeed need another understanding of normativity than seeing it as lying partly in the foundational principles or theories of the researcher, partly in establishing a hierarchy of orders. On this basis I turn to two current issues in the Danish debates on educational politics, and argue that it suffers from a blindness to the fact that technologies contribute to performing school practices.
This first part of the thesis asks what a technology is, and how to describe and characterize technology. I start out by asking how the online software in focus in this thesis became a research object. Telling the construction story of the design describes the materiality of the technology, I argue. Chapter 2 mainly presents the methodology and my theoretical approach. In chapter 3, I ask how the online technology was designed to be able to encounter school practices without breaking apart. This is what characterizes the design as a network. However, chapter 4 finds things that do not fit into the network patterns of relations, and describes the design as fluid. This leads to a discussion of multiplicity which closes part one.
Chapter 2

Making Matter Matter in Empirical Research

This thesis describes how technology participates in practice and with what effects. Where does such a description start? Qualitative studies are often introduced by presenting the research object and research field as elements chosen prior to the study, and hence not issues for further discussion. Sometimes, problems of enlisting informants and getting access to the research field are discussed as issues requiring certain ethical, behavioural and theoretical precautions (e.g. Spradley 1979). Other researchers emphasize that the initial interactions with the research field and research objects may lead researchers to look at entirely other domains than expected, which again changes the research field and the object of research (Hammersley & Atkinson 1995; Winthereik et al. 2002). These interactions, it is emphasized, are not just preparation measures prior to the actual study, but already data informing us about the characteristics of the research field and research object. Field and object are constructed through the researcher’s interaction with the field. I agree with this view, and I shall show how the method applied in this thesis performs ‘method’ as something that is not settled at the outset of the study, that is not about applying standardized scientific prescriptions. It is rather a ‘plan’ as in anthropologist of technology Lucy Suchman’s (1987) sense, embedded in practice as a resource on par with other resources and continuously worked on and adjusted during the research process.

The current study goes one step further (and one step back). I start at a point at which the technology in focus still had to turn into a research object. This involved more than adjusting foci and sensitivities, modifying research questions and changing ways of interacting. It involved more than human adaptation. It was a matter of the virtual environment itself becoming a research object. The software existed in other versions prior to this study. But in these versions it was not a research object. How did it become a research object, I ask. In laboratory studies many authors have studied how other scientists turn objects into research objects. Contrary to these, I pose this question to my own research.

The computer program that became the research object of this study was an object of art when I first encountered it. In other relations the virtual environment technology was an edu-
cational object, a technological object, an administrative object, an object of edutainment\(^7\), a game and other. The virtual environment had to be designed in order to become a research object, and it had to be situated in an appropriate research field. I did not ‘visit’ it in the field like anthropologists have visited laboratories (eg. Latour & Woolgar 1986) or like ethnographers have visited the Internet (Miller & Slater 2000). I constructed it. In this chapter I describe the construction of the research object and its association with a research field. The next chapter goes into more detail about how the virtual environment was designed in order to meet school practices.

This chapter has a double aim. It describes how the particular research object, field and research design were constructed, and secondly it presents a vocabulary developed within Actor-Network Theory (e.g. Latour 1987) for describing how technology participates in practice. The chapter shows how a computer program step-by-step became entangled in relations to other entities which eventually made it a research object. Through entangling yet more entities an after-school setting came to be the research field.

The chapter furthermore presents the metaphor of spatial imaginaries which plays a pivotal role in the descriptions of this thesis. Spatial imaginaries, it is argued, it an attempt to do research within the performative turn in social sciences. The implications of enrolling the Actor-Network Theory (ANT) vocabulary, the metaphor of spatial imaginaries and the performative turn in an empirical study of how technology participates in practice is discussed and the research design for this first part of the thesis is presented. I conclude the chapter by suggesting that immersion in an ongoing trial of the research object is a crucial element of a method, which makes matter matter (Barad 1998) in empirical research. Thereby this method is appropriate for studying how technology participates in practice and with what effects.

**Turning an object into a research object**

FEMTEDIM and Femtedit were based on the *Active Worlds* online 3D\(^8\) virtual environment platform, which I present in this section. I had first come to know Active Worlds as I, together with a few colleagues, made a series of online TV-programs in collaboration with the Danish

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\(^7\) Mixing ‘education’ and ‘entertainment’ the notion of ‘edutainment’ refers to computer programs that integrate aspects from computer games and from educational software.

\(^8\) Commonly Active Worlds virtual environment technology are described as 3D even though it is not based on 3D graphics, but on the so-called 2½D images, which are computer images that display apparent 3dimensionality, and that can be rotated on the screen.
artist group Superflex\(^9\). Superflex was using Active Worlds in their *Karlskrona*\(^2\) (later also *Wolfsburg*\(^2\)) project\(^10\). Karlskrona is a Swedish town. Karlskrona\(^2\) was a town on the Internet built on the Active Worlds 3D virtual environment platform whose centre was a stylised three-dimensional model of the Karlskrona town centre. Citizens of Karlskrona could log on to Karlskrona\(^2\) on the Internet and, by striking the arrow keys, move around in the virtual town – walking down streets, turning corners, crossing squares, etc. The Karlskrona citizens could add new buildings, means of transport, parks, etc. to the Karlskrona\(^2\) town centre. They could play around with the make-up of their town. Using the chat function of the virtual environment they could moreover discuss the town matters with their fellow citizens.

When logged into Active Worlds, the user travels the virtual environment by moving a little figure - an *avatar* - that is located in the centre of the computer screen (see figure 3). This way,
two or more users can walk up to and face one another in the virtual environment. Or rather, the avatars face each other in the virtual environment, and on the computer screen each user sees the other user’s avatar facing his own. The pictures in figure 3 show the screen shots from two users, whose avatars are facing each other in Active Worlds. There may be many more than two users/avatars interacting simultaneously. Users can write what they wish to say to the other online users in the chat writing window. When sentences are sent by striking the enter key they appear in the chat window on the screen below the graphics window. Little by little the messages form a written dialogue.

When a world-owner enters her Active Worlds online 3D virtual environment for the first time, she encounters a basically empty land. One of the distinctive characteristics of the Active Worlds virtual environments is that users can build inside the virtual world. Active Worlds places approximately 2000 building blocks – walls, sofas, trees, fire extinguishers, water, etc. – at the users’ disposal. Apart from arranging building blocks users can define colours and textures, animate objects (make them move, flash, change or disappear when clicked on or bumped into, etc.) and with additional tools create new building blocks and avatars. Furthermore, a web browser is integrated into the Active Worlds platform and it is possible to create a hyperlink from an object in the online 3D virtual environment to a web page which will appear in the web browser when the object is clicked on, bumped into or simply appears in the visual field of the avatar. Similarly, jpg images and audio files can be added to the virtual environment appearing either constantly or at specific commands.

Active Worlds is used for many purposes. This is possible because the virtual environment offers a wide range of functions while at the same time being quite undefined. Whatever practice Active Worlds takes part in, it becomes something different. Not simply as a ‘social construction’ (e.g. Pinch 1989; Sismondo 2004), but because it needs to be designed ‘materially’ to fit into each specific practice. This way Active Worlds made itself available as a technology to be studied in particular practices. Describing Active Worlds in general abstracted from any particular practice does not make much sense.

I was in the phase of planning my PhD project concerning how technology participates in practice and with what effects. I was looking for a technology to study. Up till this point, my

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11 Other online 3D virtual environments available at the time were Blaxxun Contact (http://www.blaxxun.de) and Onlive! Traveler (http://www.onlive.com), which has the specific characteristic that users can speak to each others when microphone and loudspeakers are connected to the PC. Adobe Atmosphere (http://www.adobe.com/products/atmosphere/main.html) appeared in a beta version in 2001 but was discontinued in December 2004 due to market conditions and customer feedback.
PhD study and Active Worlds had nothing to do with each other. They were living entirely separate lives. In Latour’s (1987) vocabulary, they were *disinterested*. But Active Worlds caught my interest – or rather, it caught the interest of my PhD project. The invitation of the Active Worlds platform to be studied in practice as well as its availability for design matched my interest in studying technology in practice. Not only ‘practice’ connected the two. The designing options put construction processes up front in the research project. Enrolling Active Worlds in my research project implied that I had to go through the process of designing or constructing, which would give me an excellent position for studying how technology is formed to be part of practice.

A moment ago Active Worlds and my PhD project were disinterested. Now, they had caught mutual interest by identifying connection points. Points that could connect them due to a match in terms of ‘practice’ and ‘design’. Their mutual connection formed the two. Active Worlds was not a game, not an edutainment project, not an art project. It was turned into a laboratory for studying how technology participates in practice. My research project was turned into a design study. Not a study in which I would displace myself to visit the research object in its field but a study in which I would enrol myself in design processes. The connection between Active Worlds and my PhD project also separated Active Worlds from the art network, which it was bound up with a moment ago. Active Worlds was cut (Strathern 1996) from the art network, and hence from its art identity. Being *enrolled* (Latour 1987) in a research project quickly changed Active Worlds into the more general online 3D virtual environments. Of interest is not the Active Worlds platform per se. It is its availability for design, the online location of the technology and the ‘environment’ quality as a space for human and nonhuman interaction. This led to a specification of the research question: *How do online 3D virtual environments take part in practice and with what effects?*

In descriptions of qualitative studies it is often like this, that you meet the research question for the first time: At the point when the research object has already become a research object situated in a research question. However, the process by which Karlskrona was turned into online 3D virtual environment already provided data about the research object. It taught us about ways in which it connected to my PhD project: By being available for designing, and through its blankness fitting to research in practice. The ways in which a technology connects

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12 Criticizing Latour’s notion of *network* for being all-inclusive, anthropologist Marilyn Strathern describes how disconnections or cuts are crucial in building networks.
to other entities or assemblages is an important point of this thesis. I characterize the way in which entities connect as the materiality of the entities. Consequently, I do not treat materiality as an essential quality of the object. Materiality is formed through the ways in which the entity relates to other human and nonhuman entities.

Let me make four points about what describing how an entity comes to be a research object shows us: First, describing this process teaches us about the materiality of a technology, which in my understanding means that we learn about how the technology can connect to other entities.

A second point is that describing how a research object comes to be the way it does shows that the way in which entities connect is not simply a result of human action. The virtual environment software connected to my PhD project because it was available for designing. This was the software’s contribution, not the humans’. In order to connect the entities – no matter if they are human or nonhuman – need to have the materiality that enables them to connect.

Thirdly, describing the construction of the research object teaches us that research object is a result of an interaction process. Its materiality is achieved through interaction between various ‘social’ and ‘material’ entities, including the online 3D virtual environment’s own achieved materiality.

Fourthly, we realize through describing how a research object comes to be the way it is that materiality change is not something given in advance. Karlskrona2 was a quite different object from the online 3D virtual environment that became the research object of this thesis. Karlskrona2 was connected to some entities in particular ways and step-by-step these connections and entities were replaced by others and the materiality became another.

I could have left out of the description the practicalities of turning Karlskrona2 into online 3D virtual environment and started by stating that this thesis is about an online 3D virtual environment in practice. This would black box (Latour 1987) the materialities of the online 3D virtual environment, which would appear as an object ‘in itself’ not already entangled in a network which set its materiality and the ways in which it could relate to other entities.

**Classic-ANT**

I have described how objects were separated and connected in order to turn Active Worlds into a research object. I have used Latour’s (1987) notions of disinterest, interesting, enrolment and black boxing to describe this process. It is a vocabulary that emphasizes relationality. Objects become what they are as an effect of socio-material relations. As such the ANT vocabulary can
connect to my study of online 3D virtual environments because it implies describing an object that became the way it did as an effect of socio-material relations. The ANT vocabulary is developed through STS analyses of how scientific facts and technologies come to be the way they are (eg. Latour 1987; Latour 1988; Latour & Woolgar 1986). Technologies – like a camera for instance – are often taken as automatons that work by themselves. “Clic, clac, merci Kodak” they say in France (Latour 1987 p.115), indicating that you simply push the button and the camera does the rest. STS studies have shown that technologies are far from autonomous. They only work because they are intimately entangled (e.g. Callon 1998) in larger assemblages. They are constructed not only by welding metal and connecting electrical circuits, but also by establishing infrastructures (e.g. Star 2002).

The camera only does a minor part of the work necessary for you to take a picture. The rest of the work is done by humans and things circulating in an infrastructure of film developing laboratories with all their machinery and staff, security measures and continuous delivery of chemicals, etc., a system for collecting film and returning pictures as well as an arrangement for transporting films and pictures between laboratories and shops, masses of people interested in photographing making available mass production of cameras and film-developing, legal regulations of markets, economic systems, etc. The sum of the efforts invested into establishing such an infrastructure of tightly bound socio-material objects, which allows entities to circulate, is what Latour calls a network (Latour 1987; Latour 1999d; Latour 1999a).

A pivotal methodological conclusion I draw from such STS studies is that in describing a technology you have to decentre from the object you are holding in your hand, and study the socio-material network in which it is entangled. Just as I have described the research object by decentring from the object ‘itself’ and looking at the relations of which it was a part or came to be a part.

Latour (1987) advises us to study technologies by describing the process through which they are constructed or by looking at them in a state of crisis. At these points, he states, the network is fragile and the objects involved in making it come into view. Studying technologies

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13 From another theoretical standpoint Dreier (Dreier 1993) has suggested this notion in his studies of psychological treatment, emphasizing the need to zoom out (decentre) from the narrow focus on the individual and the psychotherapeutic practice to look at the psychosocial life in which personal problems are embedded. In 2002 the notion of decentring appears in STS. More precisely as a central notion in Law’s book on Aircraft Stories (Law 2002a), suggesting a decentring of the object in science studies. One of the crucial differences between the two is indeed that Dreier emphasizes the decentred subject while Law’s endeavour is to decentre the object.
Latour’s technique is to make use of detailed descriptions of how objects come to be the way they are, of their career (Scheffer 2003) towards being settled. Bingham & Thrift describe ANT as concentrating:

...on movement, on process, on the constant hum of the world as the different elements of it are brought into relation with one another, often in new styles and unconsidered combinations.

Bingham & Thrift 2000 p.281

The vocabulary suggested by Latour is introduced to create such descriptions. Apart from the notion of network (discussed further in chapter 3), Latour introduces among others the notions of disinterest, interesting, enrolling and black boxing to make sequential descriptions of how things come to be the way they are. First, objects are disinterested, without any influence on each other. Then, they develop new goals to make each other interested in joining forces. This enables both to enrol in a common network that will eventually be black boxed. By this it takes the shape of one thing, making invisible the assemblage of heterogeneous objects and the process through which it is composed. Just as a research object, a camera and other technologies usually take the shape of black boxed autonomous things with essential properties which can be approached and studied or used in ‘themselves’. The network metaphor invites us to open up these black boxes of essentialist descriptions of for instance technologies and focus on the networks making them up.

5th Dimension – the becoming of a research field

As suggested by Latour I started out by describing the research object as a result of its construction process. I described the components that made an online software connect with my PhD. But I left the description as it turned into an online 3D virtual environment and became a research object. Describing how the computer program came to be a research object, however, is far from all there is to say about the construction of the research object. They have to be maintained in order to stay the same. Similarly, my research object had to be maintained. As a computer program associated with a research interest its identity was fragile. If I didn’t pick up on it shortly, if I didn’t do something with it, my PhD would start enrolling other objects, extending its assemblage in other directions, leaving behind the online application as its research object. Keeping the virtual environment as a research object implied binding it up with more objects; it implied extending the network.
Together with research groups at Blekinge Institute of Technology and Universitat Autònoma de Barcelona I had applied for and was granted funding from the EU’s 5th Frame Program pool “School of Tomorrow”. The three research groups were all more or less tightly associated with the international research network of 5th Dimension. 5th Dimension is a concept for a combined research field and after-school computer activity for children, originally established on an Activity Theory basis by literacy scholar Peg Griffin and cultural psychologist Michael Cole (e.g. Cole 1996) in California in the mid-80s, and since then spread to several other places in mainly the US, but also Europe, Australia and South America. Under the title of “Local Learning in a Global World” the aim of the EU funded research program was to study the possibilities of introducing the principles developed through research in 5th Dimension after-school activities to in-school activities.

I was the project leader for the Copenhagen research team. For the research in the EU project, we were going to set up first a 5th Dimension after-school activity and later an in-school activity. Connecting to the 5th Dimension research association the research object would ally itself with an extended network which would make up a research field in which the research object would be located. This would maintain the research object as such. The research object would be woven into an assemblage much tighter than when simply associated with my research interest. For a research object to become robust it needs a research field. The possible research field for the online 3D virtual environment when connecting with 5th Dimension were school practices – after-school as well as in-school. Thus, the research question was further specified, asking how online 3D virtual environments take part in school practices and with what effects.

A computer program, however, is not simply ‘put’ into practice without effort or friction. First of all, technology and practice each must have the materiality that enables them to connect. Being freeware and easy to use Active Worlds was indeed suitable for the reality of schools having on the one hand virtually no money for software and on the other teachers and children who were only moderately trained in digital technology. Furthermore, standard educational programs usually contain fixed tasks and assignments with – if at all – possibilities of

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14 Among others Berthel Sutter, School of Management; Monica Nilsson, School of Health Science; Carina Anderson and Rosita Anderson, Learning Lab.
15 Among others José Luis Laluzza Sazatornil and Sònia Sanchez Busquès, Department of Basic, Developmental and Educational Psychology; Marc Bria Ramirez, DEHISI.
16 This thesis is not directly part of the EU project which is why I do not discuss its aims, methods and theories. For further literature on this EU project, see Jensen et al (Jensen et al. 2005), Nocon (Nocon 2005), Sørensen (Sørensen 2003a) and http://www.5D.org
17 Freeware is software that can be used free of charge.
customising only in terms of degrees of difficulty, appearance, duration of tasks, etc. (see Druin & Solomon 1996). I expected the designing possibilities of Active Worlds virtual environments to be interesting for schools with their continuous pressure to tailor education in the direction of local/individual needs (Krogh-Jespersen & Striib 1993; see also p.163 n.60 below). I contacted the headmaster of St. Marc Street School\textsuperscript{18} in Copenhagen with whom I had collaborated on an earlier research project. The headmaster showed great interest in the project and invited us to make a 5\textsuperscript{th} Dimension after-school activity one and a half hours every Monday afternoon in the computer lab for children from 4\textsuperscript{th} to 6\textsuperscript{th} grade which was the age group with the least organized afternoon activities.

In order to be able to use the Active Worlds platform it was necessary to obtain permission from Eduverse\textsuperscript{19} who offered virtual worlds free of charge for educational or research purposes. Eduverse\textsuperscript{19} is the educational department of Active Worlds. We applied for and received a virtual world in the Eduverse Universe\textsuperscript{20}. We called our 3D virtual world \textit{FEMTEDIM}. A year later we received another virtual environment in the Eduverse Universe, the \textit{Femtedit} world.

That Active Worlds had an educational department offering virtual worlds free of charge for research purposes was a very nice contingent but crucial final connecting point which drew the online application together with my research project. Thereby, the research object became entangled with an EU project, economic and competence reality of schools, designing possibilities of the online 3D virtual environment, educational interests, St. Marc Street School and its computer lab. All these practicalities and objects more or less strategic, more or less contingent came together and made up the research field for the online 3D virtual environment research object.

\textbf{Describing technology with spatial imaginaries}

More important than Latour’s vocabulary presented above are the spatial imaginaries ANT implies. This thesis is not only about how technology participates in practice. It is also about how

\textsuperscript{18} The name of the school is a pseudonym.

\textsuperscript{19} http://www.activeworlds.com/edu

\textsuperscript{20} A universe in Active Worlds contains a number of virtual worlds. When logging on to Active Worlds, you have to choose which universe to log on to. While you cannot jump from one universe to another, it is possible to move between worlds within a universe. All universes are built on the Active Worlds platform. The Active Worlds universe is one of these universes, which consists mainly of virtual worlds made for entertainment purposes, while the Eduverse universe contains worlds with educational or research aims. Karlskrona\textsuperscript{2} and Wolfsburg\textsuperscript{2} were both universes with only one world (which means that you do not notice the difference between universe and world).
Making matter matter in empirical research

to study this, and thus about how to describe how a technology participates in school practice. Because we are used to talking about technology as something we design or use or in other ways do something with, the words and phrases available create an imaginary of humans and technology as clearly separated entities: of humans as active and technologies as passive, of humans doing and technologies being done something to. When we start approaching technology as part of practice, just as we approach humans, the words and phrases available start sounding out of tune with the approach. This is how the question of describing technology becomes an issue in its own right. We need a new vocabulary. I have presented Latour’s. With this comes a new imaginary. The imaginary of technology and humans as clearly separate entities will not do any longer. I take the notion of imaginary from Marcus (1998), who defines it as “sensibility… that informs the way research ideas are formulated and actual fieldwork projects are conceived” (p.10). I furthermore like the notion of imaginary because it suggests a visual apprehension which helps when producing a spatial descriptions. In what follows, I argue for what I call spatial imaginaries as helpful for approaching technology as part of practice. I use the notion of spatial imaginaries in the plural because there may be more spaces and different spaces and with them multiple and different imaginaries.

While the notion of spatial imaginaries is mine, the discussions folded into it are taken from different ANT and poststructuralist authors (e.g. Crang & Thrift 2000; Thrift 1996). Spatiality is more or less explicit in the ANT literature. Examples of the ‘more explicit’ authors are Law and Mol (e.g. Law 1999; Law 2002b; Law & Mol 2001; Mol & Law 1994), whose work I will discuss throughout the thesis. However, a spatial imaginary is also present in poststructuralist philosopher Michel Foucault’s writing. I find it helpful to start here.

Foucault’s spatial imaginary

I would argue that when Foucault gazes out on the social world of the past, he sees not the order of (say) a mode of production determining the lines of class struggle nor the order of (say) a worldview energising everything from how the economy functions to how the most beautiful mural is painted: rather, he sees the spaces of dispersion through which the things under study are scattered across a landscape and are related one to another simply through their geography, the only order that there is here is discernible, by being near to one another or far away, by being positioned in certain locations or associated with certain types of environment, by being arranged in certain way or possessed of a certain appearance thanks to their plans and architecture.

Philo 2000 p.220-1 (emphasis added)

Geographer Chris Philo (2000) argues that a pivotal aspect of Foucault’s theory is that he approaches social life and especially history in spatial terms instead of viewing history as a tempo-
Foucault criticized what he calls total history, which implied a critique of developmentalism (history) and a critique of coherence (total). In Philo’s reading Foucault solves both problems through applying spatial strategies. I go along with Philo in the following discussion of Foucault’s spatial strategies.

Foucault moves away from describing history (or technology) as a series of progressive developmental stages by describing the spatial relations deeply implicated in historical processes: the distribution and arrangement of people, activities, and buildings. Similarly, in order to describe the participation of a computer program in school practice I refrain from approaching the technology as a (more or less successful) stage in the development of better education. I study technology as an effect of the distribution and arrangement of humans and things; how the software is connected to other entities thus creating descriptions of how the relations, in which the software is entangled, are extended spatially.

Spatial imaginaries do not imply that time cannot be part of the study. Foucault is not interested in excluding time from social research but he fights against a particular depiction of time, namely time as an singular, orderly progression. I have described how my research object and research field came to be the way they did as a chain of encounters between entities. But note that it is not a description of a development from more simple to more complex or from more primitive to more advanced, but from being entangled in one network to becoming entangled in another – a spatial movement rather than a temporal progression. Rather than ignoring time, a spatial imaginary is about conceptualising time differently from that of a progression, just as it is about conceptualising space in a new way, as I return to shortly.

Secondly, Philo notes that Foucault’s critique of coherence targets the tendency of historical accounts to produce an overall form of civilisation, a singular principle of society, a unitary significance common to all phenomena of a period. Analogous to this, descriptions of technology are often total in character, focusing on the functioning of a machine in definite and singular terms, often presented by the view of the designer. According to Philo, Foucault finds such total descriptions suspect because of the measure of order they introduce:

...smoothes over the specific confusions, contradictions, and conflicts which have been the very ‘stuff’ of the lives led by ‘real’ historical people, powerful and powerless alike.

Philo 2000 p.210
Total description remain alien to the details and differences of practice at particular times and particular places. It creates an order in which everything fits to everything else, where all elements have their right place. In his assault on what Philo calls ‘the castle of coherence’ Foucault proposes the method of general description as an alternative to total descriptions:

*A total description draws all phenomena around a single centre – a principle, a meaning, a spirit, a world-view, an overall shape; a general history, on the contrary, would deploy the space of a dispersion.*

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Foucault 1972 p.10

By noting that general descriptions deploy the space of a dispersion Foucault introduces a spatial imaginary of objects located over, below, on the top of, just to the right of, along the road, further ahead, beyond your imagination, apart from, a little closer, inside, etc. Applying a spatial view instead of a view on order, principles or significance Foucault creates descriptions at the level of socio-material interactions rather than elevating them to a level of meaning, ideas or generalities.

Think of Foucault’s *Discipline and Punish* (Foucault 1979). Think of the way he describes the arrangement of schools by moving from the division of children into classes of same age, over to the division of subjects and sorting of these according to precise time tables, and further on to the classification of curriculum in increasing levels of difficulty, to the ordering of pupils at designated desks arranged in rows facing the teacher, and to the sanctioning of some body movements and the exercising of others, on the teacher’s voice or stick tap signals, and so on. He takes up an entity, describes how it is related to others and how it contributes to forming entities and relations, moves along these relations onto an adjoining entity and studies the unfolding of similar techniques and the relations between entities and how they influence each other. Foucault does not follow a chronological principle, nor the effects of a central power or ‘heroes’, nor the governing of one logic or principle. Instead of trying to describe the object of study relative to one principle, one meaning or in any way to a singular point or direction, Foucault’s spatial approach describes the distribution of objects relative to one another. He moves from object to object along their mutual relations, and thereby step-by-step describing the space that this particular arrangement of objects deploys or performs.21

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21 Foucault applied spatial strategies in his attack on progressive time as well as in his critique of totality. While the attack on progressive time seems quite convincing in his own and followers’ writing the same works have demonstrated that the totalising of descriptions is not necessarily overcome by applying spatial techniques. As I shall discuss later when presenting the critique of Latour’s network metaphor (chapter 4), it is indeed possible to create singular spatial descriptions ‘from above’ with a ‘god’s eye view’. Indeed, in his studies of power Foucault did not look at one singular totalising power as the source of
Following Foucault in the attempt of creating spatial descriptions is thereby not an attempt to localize elements in space, measure their geographic distance or localize them in a certain place. It is about describing relations in spatial terms and looking at patterns these spatial relations form. A spatial imaginary is like a genre of description that has the readiness of depicting entities as related in space and discussing how spaces are created. A spatial imaginary is useful to avoid delimiting the description of technology to be about technology as a human utility or as a factor influencing learning or in other ways basing descriptions on imaginaries that pre-set the ways in which technology and humans can be part of practice.

**Spaces as patterns of relations**

The notion of space in spatial imaginaries differs from how we usually conceive of space as a point, a place, a location, a distance, a room or in other ways as something that can be measured in metric terms. Let me clarify this difference. Webster’s Dictionary’s entry on *space* states:

1. **a)** the three-dimensional, continuous expanse extending in all directions and containing all matter: variously thought of as boundless or indeterminately finite
   **b)** OUTER SPACE
2. **a)** the distance, expanse, or area between, over, within, etc. things **b)** area or room sufficient for or allotted to something a parking space

...  
7. Math. a set of points or elements assumed to satisfy a given set of postulates (Ex.: *space* of one dimension is a line and of two dimensions is a plane)

Webster’s 1997

The ways in which I use the notion of space is *not* as it is defined in point one and two in Webster’s Dictionary. It is not three-dimensional. It is not an area. It is not a room or a distance we can walk or measure. Well, it could be. This could be one spatial formation but in the spatial imaginaries applied here space is much more than that. Spatial imaginaries are imaginaries for thinking about different spatial formations. We can think of objects in three dimensions, in rooms but we can also think of them performing the space of the relations that make them up, which may not necessarily be three-dimensional. The mathematical definition is closer to what I am thinking of (even though “assumed to satisfy” has problematic connotations). Especially the examples are good: space of one dimension is a line. A line performs a space of one dimension. A plane performs a space of two dimensions. Thus, an imaginary with at least three different kinds of spaces can be envisaged. Spaces that are defined by the elements of the space history, but his accounts do seem to add up to describing one – the disciplinary – power as an effect of contingencies, practicalities and particular located practices. As I shall discuss in chapter 4 a solution to this risk of producing total spatial description can be to apply multiple spatial metaphors, which imply that spaces never perform only one singular, total pattern of relations.
and their mutual relations. This is what spatial imaginaries are about: describing what we study in terms of how the elements involved are related. They may be related in terms of dimensions, as the mathematical definition in Webster’s dictionary suggests. But this research is in social science, and spaces are more often described in other terms than that of dimensions: in terms of knowledge or in terms of human presence, for instance, as I do in part two and three of this thesis. Here, spaces are constituted by the entities and their relations, which make up particular knowledges and particular presences. By understanding knowledge and human presence as spaces. I can study them by describing the entities and relations involved in making them up. Of which technology constitutes some of the entities and some of the relations. Furthermore, I can study knowledge and presence by describing how technology in different ways takes part in the space making up knowledge or human presence and how technology in different ways contributes to forming knowledges and presences.

In my understanding of spatial imaginary I follow Law and Mol in their inquiries into spatiality (e.g. Laet & Mol 2000; Law 2002b; Law & Mol 2001; Mol & Law 1994). They especially emphasize spatiality as a way to describe how entities and relations may come together in different ways, forming different assemblages. What is next to, above, beyond, apart from, etc. is not necessarily defined in terms of metric distances, but may be defined in terms of identity, functionality, familiarity or other. Law & Mol discuss different spatial types in terms of topology:

Unlike anatomy, topology doesn’t localize objects in terms of a given set of coordinates. Instead, it articulates different rules for localizing in a variety of coordinate systems. Thus it doesn’t limit itself to the three standard axes X, Y and Z, but invents alternative systems of axes. In each of these, another set of mathematical operations is permitted, which generates its own ‘points’ and ‘lines’.

Mol & Law 1994 p.643

Explaining what their spatial topology is not, they add in a footnote:

One could say that anatomy is a topography, a map-making practice. Like geographical topographies, it localizes its objects within a set of coordinates, taking these coordinates as tools, rather than as an object of reflection.

Mol & Law 1994 p.665 n.5

This is the point I want to make clear which I have found very difficult when discussing spatiality over the past years. I have repeatedly experienced my descriptions as being understood in terms of point one or two from the Webster’s dictionary above. They were taken as if I were discussing positions of objects within the three standard axes X, Y and Z. However, what I am attempting to do is not anatomy, topography or geography but to describe different alternative ‘coordinate systems’ and how these are formed in particular practices. Mol & Law have devel-
oped four *spatial metaphors* (region, network, fluid, fire) to emphasize that there is not one space – the Euclidian ‘X-Y-Z space’. The aim with the four metaphors is to create sensitivities to different kinds of spaces, to make it available to describe technological practices as performing more than one pattern of relations. Mol and Law’s – and my – interest is to explore the different kinds of spaces performed through different practices. To explore, describe and characterize the different spaces performed by and through elements relating in different ways. I use and discuss three of the four spatial metaphors (leaving out fire space) throughout the chapters of this thesis.

Because the notion of space used this way is very different from the common understanding of the term, it sometimes causes confusion. In order to avoid confusion I limit the use of the term ‘space’ to refer to spatial imaginaries and spatial metaphors. Elsewhere, I replace ‘space’ with *pattern of relations*. A particular space is identified by the relations that make it up and the principles they perform for what counts as an object, for what count as differences and similarities, as continuities and breaks. Describing an online 3D virtual environment in spatial terms is a matter of following the objects as they relate and describe the *pattern* that these relations form. In these terms, the spatial imaginary is about describing objects as *patterns of relations*. Anthropologists of education Varenne & McDermott (1998 p.12) note that entities that together make a pattern gain their particularities because of the ways they are arranged with other entities. Even though Varenne & McDermott are not writing in spatial terms, their description is useful for my purposes. Spatial imaginaries are about describing the patterns in which entities are arranged or relate, which is a way of characterizing the particularities of the object of study. It is not, as the notion of patterns is sometimes understood, an attempt to generalize. On the contrary, it is a sensitivity to describe particularities as effects of relations. We may understand patterns of relations as the ‘coordinate systems’ Mol & Law talk about. Not as *one* general or universal coordinate system, but the particular coordinate systems performed by and through...

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22 Hence, ‘metaphor’ is not to be understood as an expression of pre-linguistic entities that structure our understanding, as Lakoff & Johnson (Lakoff & Johnson 1980) do. Neither do I take ‘metaphor’ as representations that map already existing understandings as Quinn (Quinn 1991) suggests. No, Law and Mol’s spatial metaphors are images that create sensitivities to think about certain patterns of relations. A network makes us think about elements that are connected, regions makes us think of fields containing homogeneous entities, and fluid makes us sensitive to relations that are varying and transforming. Hence, ‘metaphor’ is close to my understanding of imaginary. However, while ‘metaphor’ seems to refer specifically to the verbal expression ‘network’, ‘region’, etc. ‘imaginary’ refers to the logic, systematic or syntax implied by the metaphor. A way to think about the difference between metaphor and imaginary is to compare it with the difference between how legal language differs between the ‘word’ of a law and the ‘spirit’ of the law.
particular practices. What I am interested in is how such different patterns of relations are performed.

Performative turn

In spatial imaginaries an entity described is the pattern of relations it performs. The entity is not in a pattern of relations it is a pattern of relations. I follow the performative turn in the social sciences (e.g. Barad 1998; Butler 1990; Haraway 1997; Law 2002a; Law & Singleton 2000). I write that objects are performed as patterns of relations. Let’s consult Webster’s Dictionary again:

SYN.—perform, often a mere formal equivalent for do, is usually used of a more or less involved process rather than a single act [to perform an experiment]; execute implies a putting into effect or completing that which has been planned or ordered [to execute a law]; accomplish suggests effort and perseverance in carrying out a plan or purpose [to accomplish a mission]; ... fulfill, in strict discrimination, implies the full realization of what is expected or demanded [to fulfill a promise]

Webster’s 1997

I like the way Webster’s Dictionary describes the verb perform, and the ways in which it is distinguished from other synonyms. The dictionary notes that ‘perform’ is equivalent to do. Talking about entities that are performed as patterns of relations, I mean that these entities are done the ways these patterns of relations describe. A pattern of relations is not like a context in which the entity is located. The entity is not in a pattern of relations it is a pattern of relations. The way in which elements are related and entangled spatially is the way in which the entity is. This may make it easier to understand that spatial imaginaries are not about positioning an entity – like for instance knowledge – in individuals, in the computer, in the school or elsewhere in a pre-defined ‘coordinate system’ or space. It is about studying how an entity is performed by and through particular patterns of relations that are co-produced with the entity. These patterns might form boundaries between humans and technology and they might locate knowledge within some of those boundaries. That is an empirical question, and they might just as well do otherwise.

Secondly, the dictionary emphasizes that performance is rather an involved process than a single act. This is important. While ‘action’ is a process with a temporal extension from its beginning to its end (Hirschauer 2004), I use the notion of performance to describe the involvement of a variety of elements that are spatially related.
I will repeatedly use phrases with more or less this structure: “The pattern of relations performs the entity as such and such” or “an entity is performed by and through the pattern of relations”. But I will also sometimes write that “a pattern of relations is performed by and through the entity” or that “an entity contributes to performing a pattern of relations”. The entity performs a pattern of relations and a pattern of relations performs the entity. Due to the spatial character of the descriptions, there is no temporal or causal relationship between the two that may determine whether the entity or the pattern of relations comes first, and which one follows. There is no cause and effect.

Performance has nothing to do with theatre or with staging in everyday life as it is known from micro-sociologist Erving Goffman’s work (e.g. Goffman 1971). Goffman distinguishes between presentations of self on the one hand and self as a hidden reality lying behind and producing those presentations on the other. This is quite different from the notion of performativity developed within ANT. Here, the ‘presentation of self’ can be seen as a performance but so can whatever might be lying ‘behind’. In what ways is it made to lie behind? In what ways is this behindness performed, you might ask. How does the pattern of relations look that put some presentations on the stages and some behind?

Hence, performance is not presentation or re-presentation of reality. What is performed is real. It prolongs (Despret 2004a) a pre-existing reality which does not make it more or less real than the pre-existing reality. This is one of the crucial moves in the performative turn: the attempt to ‘make matter matter’ (Barad 1998) by staying on the level of socio-material practices and not turn them into perspectives, interpretations or representations. There is no ‘real’ thing ‘behind’ a representation. A performance and its pre-existing reality are different versions (Despret 2004a; Mol 1999) of the real, of which there is no original, but only these different versions (see also Latour 1999c).

Because the notion of performance in Goffman’s and others’ uses have inappropriate connotations Mol suggests we instead talk about enactment (Mol 2002). However, social psychologist and ANT-scholar Torben Elgaard Jensen (2001) notes that Weick uses this term to describe human sense making, which is a just as inappropriate connotation of performance. Systems design analyst Dixi Henriksen (2003) notes that Orlikowski uses the term enactment in a structurational approach. So, Elgaard Jensen continues, “the dream of a relatively ‘unspoiled’ concept is scattered once again” (2001 p.89). I will follow Elgaard Jensen’s suggestion, and stick to the notion of performance.
Method

I am now equipped with a research object (an online 3D virtual environment), a research field (school practices), a spatial imaginary and the notions of patterns of relations and performativity for studying how an online 3D virtual environment takes part in school practices and with what effects. This study is described throughout the three parts of the thesis. The first part describes the design of Femtedit. Femtedit was a second version of FEMTEDIM, which will be discussed as a kind of pilot project to Femtedit, even though it was much more extensive than Femtedit. The Femtedit in-school activity and a classroom observation are the studies discussed in the second and third. As we will see, the way in which ‘method’ is conceptualised and performed in this thesis is not like a set of prescriptions for how to proceed in a research project. It is rather a kind of methodology that sets some rules, which however are object of ongoing negotiation.

Ethnography

These different studies together make up a multi-sited ethnography (Marcus 1998). Seen isolated, parts of this study do probably not deserve the notion of ethnography since this is usually reserved for long-term engagements with a certain practice (e.g. Hammersley & Atkinson 1995; Hastrup & Ovesen 1985). My classroom study, for instance, only lasted one week. While the FEMTEDIM study was stretched over 10 months. However, together these different studies provide a rich variety of materials to describe how an online 3D virtual environment took part in school practice, as I hope to show over the following chapters of this thesis. I take the liberty to understand ethnography as involving a broader range of methods, which have in common that they study their objects as they appear (in terms of being ‘constructed, ‘expressed’, ‘given meaning’, ‘performed’, ‘produced’ or other depending on approach) in what is often called everyday practices23 as opposed to for instance controlled experimental settings. This definition highlights the empirical commitment to constructivism as opposed to essentialism, and thereby the study of how the involved participants in a particular local setting contribute to constructing the setting as it is. This productive aspects of human practice is generally highlighted by ethnographers:

23 For discussions and use of the term ‘everyday’, see Highmore (Highmore, Ben 2002) and Lave & Wenger (Lave & Wenger 1991). The related term everyday thinking is explored and discussed in Lave (Lave 1988 p.77 ff). For a different discussion and critique of the concept of everyday, see Latour (Latour 1996).
In each setting we focus on a few seconds or minutes in order to be continually reminded that people about whom we write are not enacting dumberly a script they do not understand. People are active, at work, and the culture that came before them would not remain alive without their activity... This type of intense gaze on what people do in the detail of their everyday life is what we understand as ethnography...

Varenne & McDermott 1998 p.15

Childhood researcher and governmentality scholar Kenneth Hultqvist (2004) criticizes the strong focus on the subject in ethnography, asking if the ethnographer while exploring the local and particular isn’t involved in the production of a very specific human being, namely the ‘advanced liberal subject’. Yes, I believe he is. And I believe one way of avoiding this is to study practice not as produced by social actors, but as a result of socio-material participations. The material aspect makes the ‘local’ less local and the ‘particular’ more than particular, just as participation emphasizes the aspect of being involved in practice rather than being the creator of practice. Furthermore, by decentring from one single practice and comprising more sites that the object of study in different ways is related to, the focus on and thereby creation of a strong subject is avoided.

Anthropologist and STS scholar Marianne de Laet (2000) notes that in classical ethnography culture (the anthropological object) and field map precisely onto each other. “The ethnographer goes someplace that he or she assumes to be marked by an idiosyncratic culture. He or she studies the intricacies of that culture, and brings knowledge of the culture back ‘home’” (p.149). Studying patents de Laet remarks that her ethnography is not on fixed cultures, but on travelling objects. Like de Laet I do ethnography on objects. Not travelling objects, but objects becoming and changing in design processes and on objects participating in different practices.

Making available a world for the research object

In the recent years, there has been – mainly French-speaking – efforts to develop new empirical methods inspired by STS. While traditional methods in social science (for instance methods like the social psychological experiment or quantitative surveys) seek to control their research design in order to limit the possible outcome of their studies to a range of different values of pre-defined variables, Latour (2004) argues for a method that is open for surprises and unanticipated events, not only coming from the research subject but from all (human and nonhuman) participants involved. It is a method that generates more and new questions contrary to traditional experiment aiming at reducing uncertainties.
Generating new questions is not only about the literal formulation of the research question or the interaction between experimenter and experimental subject but also about what in philosopher and psychologist Vinciane Despret’s (2004b) terms is *made available* in the interaction of the very research program, the technical apparatus, the protocol, the experimental practice, etc. By focusing on what is made available Despret emphasizes the interaction between the research setting and the research subjects (and objects, I think it is necessary to add). She notes that the T. mazes used in experiments with white coated rats are probably not the best set-up to make an appropriate rat world available for these animals, and hence it is questionable how much such experiments teach us about an appropriate rat life or rat behaviour. Setting up our research design we have to consider which behaviour or practice we make available for our research objects to take part in performing. Considering the T. maze experiments with white coated rats, Despret continues that we on the other hand do not know how to define what makes a world for white coated rats unless we give them the chance to help us learn it. The research design constitutes a proposal for the research objects to make a world of which the research design is part. Despret emphasizes that this implies establishing a research setting as an *ongoing trial* with a point of departure in what is available, which may very often be poor and in retrospect incredible primitive or even mistaken. But in order to learn about the involved participants, we need to set up practices that makes it available for the involved participants to experience their own and others’ becoming through mutual interaction and learn from not only confirmation or falsification of pre-established hypotheses but also from surprises and failures that we may encounter as participants engaged in the research project.

This, sociologist of science Emile Gomart (2004) notes, puts the researcher in the position of an apprentice, who by engaging in the research practice gradually gets to learn about the research objects by allowing themselves to be transformed by it. The focus is not “Do you answer ‘yes’ or ‘no’ when I ask you this question?” but rather “am I asking you the right questions?” In this understanding the goal of the ongoing trial, which constitutes the research process, cannot be settled in advance but becomes a practical problem that can only be decided upon temporarily. Like the other involved participants, the goal of the research process must be available to new becomings. I find it important to add that this emphasis on becomings is a focus on solutions rather than on problems; on future rather than on past. The outcome of such a research process cannot be about classifying identities, ontologies, problematic behaviour, etc., but has to be about *how to move on*, along which paths to continue, what to do next. It is about performance rather than representation.
Research design

Making my research question of how an online 3D virtual environment takes part in school practice operational in accordance with the methodological suggestions of the authors discussed above the empirical focus turns into a question of how to design appropriate school practices for an online 3D virtual environment to take part in, and which effects this will have. In the current project designing school practices was done through designing an online 3D virtual environment. This is the focus of part one of this thesis, while part two and three discuss some effects of the participation of online design in school practices. I shall discuss the research designs used in these latter two parts in chapter 5, and here concentrate on the research designs used for studying the design of FEMTEDIM and Femtedit.

Following the methodological suggestions presented above designing an online 3D virtual environment for school practices was about experimenting with how this technology might take part in these practices; not in the sense of a controlled experiment, but in the sense of experimenting as exploring. It was a procedure of trying to make the best out of the online 3D virtual environment for this practice. Of designing the online 3D virtual environment in a way that made it unfold as well as possible in the concerned practice. The designing of FEMTEDIM and Femtedit is the focus of chapter 3. Since the design of the online 3D virtual environment is a central aspect of the research design, what is presented in this chapter is rather an overview over the design elements and procedures, without any accounts of how they came to be this way. How they came to be is described in chapter 3. Here, I present the informants enrolled, the data collection process and the type of data collected.

Informants

The FEMTEDIM project started on St. Marc Street School in September 2000 and ran through to the end of the school year in June 2001. In October 2000, a group of eight children and two researchers from Blekinge Institute of Technology joined our project. The Swedish children logged on from a computer lab at their institute and settled in the virtual world FEMTEDIM alongside the Danish children. Femtedit was a joint project between Danish and Swedish researchers and teachers from St. Marc Street School in Copenhagen and Pine Valley School in the smaller Southern Swedish town Ronneby. It ran from October to December 2001, whilst the planning and designing of Femtedit, took place from June to October 2001.

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Because Pine Valley School and its pupils and teachers are not discussed much in this thesis, I do not present them further. Below, I first present the informants of the FEMTEDIM project, and subsequently those of Femtedit.

We got permission to carry out the FEMTEDIM project in the computer lab of St. Marc Street School through contact with the headmaster. St. Marc Street School is located in a lower-middle class area of Copenhagen with (in a Danish context) a high concentration of immigrants. The school has been quite pro-active in creating a progressive pedagogic profile. This has attracted many ethnic Danish parents and positioned St. Marc Street School as one of the ‘white’ schools of the area with only approximately 35 percent children of immigrants. St. Marc Street School is a small school with only one class at each level. Denmark has a ‘unified school system’ which means that pupils follow the same class from the voluntary pre-school (5-6 year olds) or first grade to 9th grade after which pupils conclude primary school with 15-16 years.

In order to enrol children to take part in FEMTEDIM, I presented the project at a morning gathering for the whole school and my research team hung posters in the school informing about the project. Furthermore, we visited each of the 4th, 5th and 6th grade classes once during the school day and told them briefly about the FEMTEDIM project. This was all done in agreement with the headmaster and with the teachers of each class. We distributed a project description on a sheet of paper for each pupil to take home. The sheet also included an enrolment form where children were asked to fill in their own and parent’s name, their grade and whether they agreed to take part in a research project which involved being filmed on video and anonymously described in research reports. The form was to be signed by the child and by a parent and returned to teachers, from whom one of my colleagues collected them a few days later.

28 nine to twelve year old children signed up for the FEMTEDIM project. Several of these only came the first few times, other children enrolled later and many children came on and off. We appreciated it when children attended continuously but we did not require regular attendance and while we let children who had been missing know that we welcomed their return, we never questioned their absence. A total of 38 children attended the FEMTEDIT afternoon activity, which took place every Monday afternoon from 1:30 to 3 pm. A group of 17 children were more or less regular attendees of whom 11 were boys and 6 were girls, which is a relatively high number of girls for a computer activity. In this thesis all children’s and teachers’ names are pseudonyms, while the researchers’ and avatars’ names are the names these were actually given.
In this thesis the FEMTEDIM project will have the character of a pilot study. I do not go into any detailed discussion of how the project unfolded. In order to limit the proportions of this study, I have in part two and three exclusively focused on the unfolding of the Femtedit project. The designing of Femtedit, however, heavily rested on the FEMTEDIM design as well as on the 10-month FEMTEDIM after-school activity and FEMTEDIM will be discussed in chapter 3.

Femtedit was a follow-up on the FEMTEDIM project. We gained access to the 4th grade class within which the Femtedit project took place through its two teachers who approached my colleagues as they presented the FEMTEDIM project at a staff meeting at St. Marc Street School. The teaching at St. Marc Street School was organized in teacher teams, which meant that each class had only two teachers, who collaborated closely and shared all the teaching of the class except for the physical education. The 4th grade teachers became involved in the preparation of the Femtedit project through three planning meetings. During the project they each attended the Femtedit project with half of the class at a time, while the other teacher was in the classroom with the other half of the class. The Femtedit sessions took place every Tuesday morning from 9:45 to 11:15 in the computer lab of St. Marc Street School over a period of 6 weeks from October to December 2001.

There were 24 nine to ten year old children in the 4th grade class. Of these 12 were girls and 16 were of an ethnic Danish background. All children and a parent of each signed a form of informed consent to take part in a research project, to be video filmed and to be described anonymously in research reports.

Data collection of FEMTEDIM and Femtedit sessions

During the FEMTEDIM and Femtedit projects the involved researchers were observant participants (Hammersley & Atkinson 1995). We were planning the sessions and worked as a kind of teacher during the FEMTEDIM and Femtedit sessions. Our roles in front of the children were as ‘encouragers’. We were to help children whenever they needed it, but also to support and encourage them to go on with whatever they were doing. The different forms of presence this created are described further in part three.

Assisting the children in this way and thereby being engaged participants of the Femtedim and Femtedit projects contributed to the ‘everydayness’ of the situation compared to the styl-

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25 For more detailed discussions on our research positions, see Jensen (Jensen 2005b; Jensen 2005a).
ised situations of laboratory experiments. But it also implied some difficulties for doing re-
search. The research position of an observing participant is in general at risk of losing the dis-
tance of the observer to the immersed engagement of the participant (op cit). Distance is im-
portant for making ethnographic observations, and the observing participant needs to manage a
delicate balance between participating and observing. It is however not only up to the re-
searcher to manage this balance. As it will be discussed in more detail in chapter 9 the online
3D virtual environment contributed to establishing a pattern of relations in which overview of
the whole online application or the whole class was not available. This made each researcher’s
perspective quite narrow, concerning mainly the particular participation he or she had engaged
in. This was especially the case in Femtedit. While the researchers in FEMTEDIM moved
around in the computer lab, attending different children and different computers, our positions
in the Femtedit project were strongly regulated. We divided the children among us so that each
of us was mainly engaged with two individual or pairs of children at a time. Since only half of
the class was attending the Femtedit at a time, each researcher engaged with four individuals or
pairs in total (for further discussion of the reasons for these divisions, see p.47). My participant
observations in Femtedit concerned mainly six children.

The observations we made during both FEMTEDIM and Femtedit were collected in field
notes which each researcher wrote after each session. I typically wrote 8-10 pages on my com-
puter which often took most of a day. I made as detailed, as ‘thick descriptions’ as possible of
how the practice had unfolded without any specific focus. I tried to ‘register’ as much as possi-
ble in the field notes by starting at the beginning of the session – often from when the research-
ers met – and thoroughly describing all I remembered about what was taking place: Who and
what were the participants, how did they interact, what was said, what did I feel or think while
being engaged in these events, etc. I tried to describe the present as I had experienced it. This
implied that whenever my writing of the field notes inspired other thoughts, understandings or
analyses of what had taken place – of what I was writing – I noted these in a separate section at
the end of the field note. I tried not to get too many of such ‘after thoughts’, I tried not to re-
fect on what I was writing. This was quite difficult. It required that I as far as possible ignored
my embodied presence of writing field notes and mentally immersed myself in the presence of
the past FEMTEDIM or Femtedit session.

After a few FEMTEDIM sessions I decided to divide the field notes into two parts of which
the first continued the principle of writing the ‘experienced past present’ while the second fo-
cused on describing the design and the ways in which I had experienced, if it had worked well
or not. This had turned out to be necessary for the practical problem of continuing the designing – the trial – of the online 3D virtual environment (see below). And this was also decisive for the continuous designing becoming a central theme of this thesis.

The quite partial view of each researcher’s field notes was in strong contrast to the mosaic or pin board (Law 2002a) of field notes which all the researchers’ field notes formed together. Furthermore, even though field notes became the most consulted data for the analyses, other sources were involved as well. Table 1 lists the sources for the data connected during the FEMTEDIM and Femtedit sessions.

<table>
<thead>
<tr>
<th>Data collected during the studies of FEMTEDIM and Femtedit sessions</th>
</tr>
</thead>
</table>
| ![Table 1](image)

Data collection of design processes

While the above concerned mainly what went on during the FEMTEDIM and Femtedit sessions in the computer lab at St. Marc Street School, there is also a major collection of data from the design process before the projects started and between the sessions when the projects first had started. The processes of designing FEMTEDIM and Femtedit proceeded as interplay between individual work and meetings with the Copenhagen 5th Dimension research team. I wrote several outlines of frame stories that were discussed in the group, and subsequently rewritten mainly by me, discussed in the group again, rewritten again, etc. The data collected through these design periods are listed in table 2. My position as a researcher was hence that of an observing participant (Hammersley & Atkinson 1995). While I during the FEMTEDIM and Femtedit sessions was focusing on what was going on there – giving the children and online 3D virtual environment the most attention – I was during the design process before the projects started and between the individual sessions observing my own and my research team’s design practices.
The process of learning about how to design the online 3D virtual environment for school practice did not end by the beginning of the FEMTEDIM after-school activity. As Gomart (2004; see also p.34 above) suggests, the researchers’ apprenticeship, and with this the designing of the online 3D virtual environment, continued all through the project period. The research design was not settled prior to the study, but was indeed an ongoing trial. During both the FEMTEDIM and Femtedit projects my research group met once a week immediately after the sessions, at which we discussed what we had experienced during the session, and what should be done before next week. We each had different research projects and different research interests. It was a central concern of the research group that it should be possible for the five of us to pursue our own research interests, while the FEMTEDIM and Femtedit activities should carry on as a more or less continuous activity for the children. This way, the projects worked as a kind of boundary object (Star & Griesemer 1989) for our different research interests.

Once the FEMTEDIM activity had started the design process concerned mainly changing graphical elements of the FEMTEDIM virtual environment and writing a plan for the next FEMTEDIM session. On the basis of the discussions at the research group meeting and the researchers’ field notes I wrote the plan and did the graphical alterations. Circulating on email these plans were discussed and revised in the research group before being carried out in practice.

The discussions between the researchers during the Femtedit project proceeded differently. We again had meetings after the sessions and we also wrote field notes. But additionally we shared and discussed our field notes and experiences among Danish and Swedish researchers in

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26 Michael Aagaard studied the online 3D virtual environment as play culture. Agnete Husted-Andersen and Nina Armand studied the element of ‘fun’ in the online 3D virtual environment practice. Kenneth Jensen studied the global aspects of the local project, and Tine Jensen focused on competence and subjectivity.
an online discussion forum, which we set up for the project (see chapter 3). The data collected during the design processes are listed in table 2.

A large amount of data was produced. In the description of the design of FEMTEDIM and Femtedit I have mainly relied on my own field notes. Because I was familiar with all the other data, these worked as a background for my descriptions just as I have occasionally looked into the other researchers’ field notes, video and chat files in order to inform the description and aid my memory of what had taken place.

**Conclusion: making matter matter in empirical research**

I have in this chapter presented the construction of an online 3D virtual environment as the research object and school practice as the research field. I have presented ANT and Latour’s vocabulary for describing the construction of objects and I have described the performative turn and spatial imaginaries, which provide a certain sensitivity that will guide the studies described in this thesis. With inspiration from recent discussions on method in STS I have finally presented the research design of an ongoing trial with the online 3D virtual environment. These are all elements of an empirical study of an online 3D virtual environment, which make ‘matter matter’ (Barad 1998).

I find Despret’s, Gomart’s and Latour’s methodological suggestions fruitful for a project of developing research designs that make matter matter in empirical studies. Construction, designing, achievement and performance are terms that appear again and again in this chapter, and my contribution to developing a research design that makes matter matter in empirical studies is to prioritise construction in the empirical research design. Not by looking at construction processes or visiting them, but by doing them. By performing construction. I study how technology takes part in practice not only by observing or visiting the research object and research field, but by having my hands deeply immersed in the design of the research object. Not literally my hands – or at least not only my hands – but the parts of me that contribute to construction, designing, performance. Not even literally me. As I have described, the materiality of the online 3D virtual environment contributed to ‘deciding’ how it can be studied, and as we shall see in the following chapters, it also contributed to delimiting the ways in which it could be designed. In the study of the online 3D virtual environment it is wrong to nominate me or the online 3D virtual environment as central actors. As Despret and Latour emphasize, the interaction of research object, subjects, researcher and instruments, etc. must be in focus. A process through which the researcher/author is co-produced.
This focus on construction and on the online 3D virtual environment as performed through patterns of relations implies that the technology differs with the assemblages that contribute to making it. It was an art object, it became a research object. I described a journey from Karlskrona2 to online 3D virtual environments. From an object of art to a research object. In a Kantian sense we would probably understand these two objects as essentially the same: as the technology Active Worlds. However, being described as performed also means that the technology changes by every new entity added, cut off or altered in the pattern of relations by and through which it is performed. Describing the construction of technology, research object and method the way I have done means that establishing these is not just a matter of adjusting interactions and adding a few objects. It is about continuously creating technology, research object and method. It is the changes, the different appearances, the becomings made available through the ongoing trial the research project is that are the sources of this study; the sources of the spatial imaginaries. This is what I will describe through the three parts of this thesis. More obviously in part one, which concerns the technology design, but also in part two and three which describe different performances of knowledge and human presence in different practices in which the online 3D virtual environment took part.

This approach implies that the method is not limited to the method chapters. The construction, reconstruction and adjusting of method is an ongoing process, inseparable from the spatial imaginaries presented throughout the chapters of this thesis. The discussion of methods will go on.
Chapter 3

Components and opponents: Designing the Femtedit Network

The research object and the technology in focus of this study was constructed as discussed in chapter 2. But how was it constructed, and how did the entities making up Femtedit connect? What pattern of relations did they form? This is to be explored in the present chapter. Femtedit was a design that had to associate a number of children, teachers and researchers at two remote places, graphic elements and building functions, chat messages, etc. In this chapter I create an imaginary of the online 3D virtual environment as a network that draws together all such humans. I present the Femtedit design and describe it using Law’s (1989) notion of heterogeneous engineering which discusses the construction of technology as a process towards stability. Following the first point about heterogeneous engineering I describe Femtedit as a composition of a number of heterogeneous parts which each took part in the design in their own way and each contributed with their investments, work or efforts to the design. None of the parts alone could do anything on their own. It was only in their combination, by being associated that they gained the strength of the Femtedit design. This is the second point of the heterogeneous engineering. Thirdly, I show how designing Femtedit was not simply about putting elements together. Femtedit had opponents, and it came to be the way it did through trials of strength (Latour 1988; Law 1989) against the forces that threatened to undermine the design. These trials involved also FEMTEDIM, which we also become acquainted with.

The description of the Femtedit design follows Law’s (op cit) line of argument in his descriptions of how Portuguese vessels in the 13th to 15th century were engineered to withstand the strength of the Atlantic, the winds, the Muslims, etc. Networks are built through such heterogeneous engineering. I present and discuss the network metaphor as the first of three spatial metaphors appearing in this thesis. The network metaphor shows us the first spatial imaginary of the online 3D virtual environment. I conclude the chapter by noting the advantages of describing design in terms of network.
Individual design components

Femtedit was an online 3D virtual environment design. It was a design that converted the energy of 44 children into an exploratory operation. It was associated with a frame story about a world and its citizens:

The citizens of Femtedit, the Femteditions, come into being as a result of program errors on the server hosting their virtual world. When they arrive in Femtedit they are curious, but empty. Soon they start building a home and surfing the Internet, and from their homes they make links to web pages they have visited. This fills them up. As an effect of building their homes and linking to web pages, they build up their identities. A Femteditian’s identity is identical with the complete content of the web pages to which they have linked.

Everything was fine in Femtedit until the day a virus attacked the server. Slowly but unmistakably the buildings in Femtedit disappeared and with them the links. The Femteditions’ identities were deleted. Eventually the virus was cleaned away. But Femtedit had already almost vanished and the Femteditions had become empty like zombies, unable to do anything at all. Including saving their own world. Just in time, however, the youngest of the Femteditions, Jaga, managed to write to the researchers asking for help to save Femtedit by building up new homes and reanimate the Femteditions by making hyperlinks from their homes. The researchers realized this as a major task, gathered a Danish and a Swedish 4th grade class, explained the whole story, and entrusted them the rescue operation: Operation Femtedit.

This description is a summary of Jaga’s diary written on the Femtedit website. The frame story grew out of the online 3D virtual environment technology, involving as many of this technology’s functions as possible. Remember, Femtedit was not only a school project, it was also a research object. In order to explore the online 3D virtual environment we had to create a design that made an appropriate school practice available for the online 3D virtual environment. Associating the Femtedit design with this particular frame story contributed to a practice in which building was made available as a crucial activity in the online 3D virtual environment.

Another characteristic quality of the online 3D virtual environment was that it was online, and hence able to connect users from remote geographical places. By enrolling a Swedish and a Danish class in the Femtedit design the online character was put into play. This also made available a third function of the computer program, namely communication through chat, telegrams and avatar gestures, which were rendered necessary in order for the children from remote places to collaborate.

The task of linking from building blocks in the online 3D virtual environment to web pages was a fourth function of the online software, which was made available through the frame story describing the Femteditions as zombies that could be reanimated only by receiving hyperlinks.

27 http://www.psy.ku.dk/5d/femtedit
The building function, the online character, the communication devices and the linking functions were the critical functions of the virtual environment technology gathered in the Femtedit design through the frame story of the Femteditians. The Femtedit design was obviously not just a thing, a collection of bits and pieces, a lifeless substance. It was not just a building function, a linking function, an online location, and communication options. Together with these functions two remote places, two school classes, web pages and the energy of 44 children were enrolled.

This is Law’s first point about heterogeneous engineering: It is about enrolling a number of heterogeneous elements; not only technical, but also human, social or other. Each of these elements takes part in the design in a specific way and each contributes to the design with its particular efforts.

Association of design components

However, the Femtedit design was not just a collection of individual heterogeneous elements. These elements were associated in specific ways in order for the individual components to work. In order to make available the building function the frame story narrated Femtedit into being in need of reconstruction. The destroyed world provided a space for the children to fill out; made it available for the children to connect to the environment as actors or constructors building up the Femtedit world. This, however, was only possible through the building blocks. The frame story, the empty or blank spaces, the children filling them out and the building blocks had to be associated in this specific way in order for the building function to work.

The dramatic moment of the frame story initiating the Femtedit project should also make it available for children to perform a collective readiness to help the Femteditians. The communication necessary for the children to be able to collaborate required written formulations and hence writing abilities. The chat and telegram functions were enabled by associating a dramatic moment with the children’s readiness and their abilities of written communication.

Likewise, there was more to linking than writing a URL in a dialog box. The URLs had to be brought into Femtedit which required that children watched out for them in their daily whereabouts. Already in 2001 as the project took place, URLs were everywhere in public life: In supermarkets, on plastic bags, on clothes and sweets, in newspapers and magazines, on busses, on TV, in everyday conversations, etc. In order for the linking function to work a whole network of components beyond digital components had to be associated: children’s vigilance, notes, clothes and newspapers, conversations, other people, activities beyond the school, etc.
This is the point: The design was not just a collection of individual heterogeneous elements. Law underlines that an individual element is nothing on its own. One element did nothing, could do nothing. It was through an intimate association of children’s readiness and building blocks, chat functions and remote places, links and plastic bags, the Internet and vigilance, frame story and peers, etc. that the energy of 44 children could be converted into a design which by switching on the computers allowed the teacher to make her class engage with a variety of different topics and people, work with them in different creative ways and fill the class with diverse experiences from remote places and diverse materials during school hours as well as beyond.

Thinking about design in Law’s terms of heterogeneous engineering teaches us that it is the association of elements that makes the design what it is. Designing is not just about forming an object, an isolated computer program. It is about building systems. The heterogeneous engineer has to take into account how objects relate to social factors and material infrastructures, to local matters and distant elements.

**Trials of strength in the Femtedit design**

While the heterogeneous engineering approach shares the understanding with a systems-building perspective (e.g. Hughes 1989) that design enrols heterogeneous elements and that these are associated, Law departs from the systems approach on a third point: the emphasis on trials of strength. My understanding of trials of strength goes like this: Components of a design are not only components of that particular design. They are also at the same time components of other networks, which keep these elements in certain shapes. In order to make a particular entity a component of a particular design, the heterogeneous engineer has to engage in a trial of strength between networks to make the element in question connect to the design and stay in place in the design. Therefore, Law suggests the analytical strategy of treating the environment within which a design is created as hostile and its elements as opponents to the design.

There were many opponents and trials of strength involved in designing Femtedit. Several of which were crucial for the formation of the design. Describing these trials of strength is more extensive than the description of the first two points on heterogeneous engineering. At the same time, however, they tell much more about the design, which is why I shall reserve quite some pages for describing four trials of strengths involved in constructing the Femtedit design.
Technical limitations vs. smooth running of Femtedit

Femtedit required that the Active Worlds application ran on the school computers. These computers and Internet connections were obviously not only there for the sake of the Femtedit project, but were part of all the two schools’ computer activities. They had the strength and bandwidth appropriate for the general needs of the schools to the extent of the allowances of the schools’ budgets. The Internet connection from the library of Pine Valley School, where the Swedish part of the Femtedit project was going to take place, had a quite limited bandwidth which meant that the more computers were online simultaneously the poorer the rendering of the graphics. In the computer lab of St. Marc Street School only 10 computers met the technical requirements for running Active Worlds. Obviously, neither of the 4th grade classes enrolled were established for the sake of the Femtedit project. As a consequence of many other networks, in which the classes were enrolled, there were 24 children in the 4th grade class at St. Marc Street School and 20 in the Pine Valley School 4th grade class.

The bandwidth and the quality of the computers didn’t fit with the combination of the online 3D virtual environment and the number of children in the classes. A trial of strength was opened. The combination of bandwidth and number of children was an opponent to the Femtedit design. If we didn’t do something to fight this opponent, Femtedit would never be able to run. It would be undermined by children struggling to get to a computer of an acceptable quality and by computers obstructing the building activities due to their inability to render the graphics of the online 3D virtual environment. We needed to associate more and different forces with the Femtedit design in order to disassociate those opponents.

The force added to the design was an organization of the children. We divided children in two groups working one after the other. Half of the classes would be in the computer lab from 9:45 to 10:30, and the other half from 10:30 to 11:15. We called the early Femtedit group Agents945 and the late one Detectives1030. While one group was working with Femtedit the other half of the class was in the classroom with one of the teachers. This time schedule, however, was insensitive to the differences in number of children of the two classes. The 4th grade of Pine Valley School only had 20 children, which meant that when dividing the Danish class in 12+12, there would be two left over in each group when forming couples with the 10+10 Swedish children. Some of the Danish children had to pair up. Each individual or pair of Danish child(ren) was coupled with a Swedish partner. Together they were in charge of reanimating one appointed Femteditian.
The organisation of children in groups and the time schedule dividing them were added to the design in the trial of strength with the limited bandwidth and the poor quality computers. The Femtedit design won the trial in the sense that the project was able to carry through to the end. But the organization was no sovereign opponent to the poor quality computers and the bandwidth. It happened several times that computers froze due to overworked graphics cards and that children at Pine Valley School could not use the ‘god’s eye’ point of view function (see figure 4), because it required the rendering of more graphics than the bandwidth allowed. This limited their overview of Femtedit. In these cases researchers had to spend extra time solving these ‘technical’ problems and helping children to communicate with their online partners that they temporarily were unable to proceed or only had limited functionality.

Figure 4  A screen shot taken of FEMTEDIM in ‘God’s eye view’.

**Face-to-face localism vs. online technology**

In the FEMTEDIM project collaboration between the Danish and Swedish children had been scarce. For a Danish child other Danish children had been easier to collaborate with than Swedish children were. They could communicate with Danish children in their own language and they could mix online chat with face-to-face talk in the computer lab, which made commu-
Method of contrasting communication much easier than pure online communication. Furthermore, the children at St. Marc Street School had considered collaboration with their school mates more interesting because they had many more resources for expanding and exploring these relationships outside FEMTEDIM. Developing the relations to the children at Blekinge Institute of Technology could only happen online, which excluded the whole range of face-to-face communication repertoire. This made a crucial difference, for instance, for the friendships and love relations that were built up or attempted through FEMTEDIM.

I call the tendency to prioritize communication with school mates a face-to-face localism. This face-to-face localism was an opponent to the Femtedit project. As I described in the previous chapter, we were to make an appropriate school practice available for the online software to participate in practice. One of the critical qualities to make available for the computer program was its online quality. If collaboration took place only among the children in the computer lab of St. Marc Street School, the online aspect of the application would not be fully explored but only its LAN28 qualities. A trial of strength was opened between the children’s tendency to collaborate locally and the demand for making available the online quality for the virtual environment.

Some components are more malleable than others. We couldn’t make the children speak the same language in order to make online communication easier. And we couldn’t contend with the trial of the local practices which had many more resources for expanding relationships than distant relations. But we could make distant collaboration easier and better organized. In FEMTEDIM we had tried to create ‘cyber friendships’ between Danish and Swedish children, but the Danish children had found these friendships quite ‘empty’. They had not known what to do and what to say to their Swedish friends. One girl told me she wouldn’t know what to do with such a friend.

In the Femtedit project we approached the trial of strength with face-to-face localism by giving each of the Danish-Swedish couples the common task of reanimating one Femteditian and rebuilding its home. Their avatars were identified with the name of ‘their’ Femteditian supplied with a country code. The name of the avatar belonging to the Danish children working with the Femteditian Duni was Dunidk, while their Swedish avatar partner was Dunise. Thereby, an answer was given to the children’s question of what to do with an online partner.

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28 LAN is a Local Area Network, a closed circuit network between digital devices.
They had a joint mission to fulfil. This was the first force added to the Femtedit design in order to stand the trial of strength of face-to-face localism.

Furthermore, we graphically designed a few ruins of each Femteditian’s destroyed home at ten places in the Femtedit online 3D virtual environment. The ruins marked where the children could find ‘their’ Femteditian’s home to rebuild, and – more important – where to find their online collaborators. One of the difficulties with online collaboration, which we had experienced with FEMTEDIM, had to do with navigation. Even though it is possible to chat with users whose avatars are not in the visual field of your own avatar, children generally followed the face-to-face genre of communicating, requiring that their communication partner’s avatar was in visual contact with their own. Look at this chat log\textsuperscript{29} from Femtedit:

\begin{quote}
Katose: Annika it is Kajsa who is katose
Katose: write back annika, kajsa
Katodk: (to Katose)\textsuperscript{30} Hi Kajsa, where ere you.
Katose: I am at our house, come here, ON 6E
\end{quote}

\textsuperscript{29} This chat is ‘cleaned’ in the way that all other communication that does not involve Katose and Katodk is left out. A chat room works like a cocktail party where a lot of people all speak at once. Only, in the chat room you cannot distinguish the voices by being closer or farther away from you. All written ‘voices’ have the same ‘volume’, the same appearance. This means that various discussions are going on at the same time, and each message is showed in the display in the temporal order they are posted, not distinguished by which discussion they are part of. An example:

\begin{quote}
Katose: Annika it is Kajsa who is katose
Pirfdk: hi pirfse I am Tasleema is it going ok with femtedit
Jagadk:
Dunise: Hi
Ludose: HI LUDODK
Jagadk: what shall we build
Katose: write back annika, kajsa
Nagidk: hi Nagise
Zubadk: hi Zubase
Pirfse:
Xingse: Xing where are you
Qeqese: do you have any suggestion
Katodk: (to Katose) Hi Kajsa, where ere you.
\end{quote}

In order to focus on the discussion that goes on between Katose and Katodk, I have cleaned the chat for other messages than those between Katose and Katodk. It is, however, worthwhile to bear in mind, that this simplified version is much more accessible than how it appeared to the participants in Femtedit.

\textsuperscript{30} The brackets and blue colour indicate an exception to the principle that all ‘voices’ in a chat room have the same ‘volume’. Katodk is using the ‘whispering’ function of the chat, which makes the messages appear in only Katose’s display. To make it clear to Katose that this is a message particularly addressed to her the system adds “(to Katose)” in brackets as well as colouring the message blue. Whispering is a way in chat rooms to make it easier for your addressee to notice your message, just like it is a way of creating private conversations that other chat room participants cannot access.

\textsuperscript{31} The chat logs and later web logs translated from Danish and Swedish into English, through which the differences in the languages are lost. However, I have translated spelling errors into similar spelling errors in English, just as I have translated the punctuation and structure of sentences into similar formal, informal, right or mistaken punctuations and sentence structures in order to keep the writing style actually constituted by the children.
Katose: write back then
Katose: what shall we build
Katodk: (to Katose) Hi you are standing just opposite annika.
Katose: we have to build write back
Katodk: (to Katose) We have to make the gate light red.
Katose: where did you go
Katodk: (to Katose) Back to our gates.
Katodk: Hi katose. I have coloured the gate pink.
Katose: good, now I have to write in the blog, see you

Chat log 011113

In this sequence we see how the children found it mandatory to locate each others’ avatars in order to collaborate and communicate. The ruins of the Femteditians’ homes were a second component added in the trial of strength between children’s localism and the online quality of the online 3D virtual environment. The little graphic ruins of the Femteditians’ former homes worked as geographic markers that localized the communication virtually, and thereby created a new virtual localism which rendered face-to-face localism less imperative. As the chat excerpt shows, it didn't prevent problems in finding each other, but it constituted fixed geographical places that could be referred to when communicating their locations: “at our house”, at “our gate”. This way, common tasks and graphic ruins were added to the Femtedit design in the trial of strength with face-to-face localism.

Children’s request for sustenance vs. continuity of Femtedit

A third trial of strength involved in the design of Femtedit had to do with the persistence of the activities. The researchers’ field notes concerning FEMTEDIM reveal much concern about children showing signs of boredom, and that the online 3D virtual environment for many did not give rise to much activity. In FEMTEDIM the children had had the tasks of building up villages. There had been a creation myth of the avatar Avafar, who had been living in FEMTEDIM all his life. He was now getting old and mysteriously the virtual environment was disappearing at the same pace as the old man was loosing his vision. Avafar was unable to maintain the virtual environment and asked the children to take over. This creation myth had provided a history, a background for the FEMTEDIM activities. It had been told in order to set the activity in motion, and in order to assign an identity to the FEMTEDIM online 3D virtual environment. But like Avafar’s vision his importance for the activities had quickly vanished.

During the first FEMTEDIM session children had been very engaged and thrilled about taking the responsibility of a virtual world from Avafar. They had been eager to solve the location finding tasks Avafar had set. Like ferocious dogs in search of sustenance they had stormed
the computer lab and the virtual environment. Not in need of a bone but in the need of anything that could fuel activity. During this first session the creation myth had succeeded in allying itself with the children as sustenance for activity. But it had not lasted. After a few sessions the creation myth had been more or less forgotten, and thereby had been unable to sustain children’s activity any further.

The creation myth had been presented to the children only once and only orally. This had been too little substance to keep it allied with the children. Oral communication is flighty, and without any continuous oral repetition or translation of the creation myth into writing, it couldn’t keep sustaining children’s activities in FEMTEDIM. Due to this experience we strengthened the frame story of Femtedit to be more persistent in the trial of strength with children’s request for sustenance for activity. The Femtedit frame story was written on the Femtedit web page. By presenting the frame story not only orally, but also in writing, it could all the time feed into the building activities. It was all the time available as an ally of the children’s need for sustenance for activity. Each Femteditian had its own web page with pictures and a few sentences about its former life (see figure 5), which represented a pool of material for

![Figure 5](image_url)
reanimating the Femteditian and rebuilding its home. Not only at the outset of the project but persistently. This was the first way in which the Femtedit design entered the trial of strength with the children’s request for sustenance for activity.

Another more dynamic aspect than the written web page was taken into the Femtedit design’s trial of strength vis-à-vis this strong opponent. Many children had got bored with the FEMTEDIM project. They had left the online 3D virtual environment to play computer games, enter other chat rooms, surf the Internet, or they had left the FEMTEDIM activity altogether. Since the creation myth had not provided material to sustain the activities, we had introduced activities that carried the characteristics of the tasks Avafar had set at the first session. Activities that had been well defined, goal-oriented and of a shorter duration than the long-term activity of building villages: A party, a relay race, a sign-creating session, a sightseeing tour. Some of these had been successful, creating liveliness all around. But they had induced activity only temporarily. They had had a strong character of being ‘ad hoc’. As an appendix they had not led anywhere, and had not had any connection to the other activities of FEMTEDIM. They had been quick fixes stimulating activity briefly, but when the stimulation had ended there had been nothing left to build on. Again and again new ad hoc activities had had to be presented in order to re-establish the level of activity. This had given the researchers a hard test of having to come up with a new, interesting activity every week.

The children’s request for sustenance of activity was a tough opponent, and we had no expectation that the written web page in the Femtedit design would be enough to do stand the trial. Additionally to making the frame story persistently accessible on a web page, we wrote a frame story which was more persistent than the FEMTEDIM creation myth had been. While the FEMTEDIM creation myth had been a history, a background that let Avafar withdraw from the centre of the virtual environment, the Femtedit frame story accompanied the project to the end and let the Femteditians keep a central role. Buildings and links disappeared when a virus attacked the Femtedit virtual environment and the Femteditians became empty like zombies. But unlike Avafar who withdrew from FEMTEDIM the Femteditians were to be reanimated and would potentially come to interact with the children in the Femtedit world. Being in the state of becomings, they had to be taken into account by anyone who expected to take part in a common future within Femtedit.

The Femteditians, however, were not only becomings. They were also beings. As zombies they were too weak to interact and communicate synchronously with the children in the Femtedit virtual environment. They could only communicate asynchronously, through blog-
Blogger is a so-called web-log. It is an online application, in which users write messages that can all the time be read online by anyone with a web browser. A time and an author name-tag are attached to all messages. They are ordered chronologically, always showing the latest posted message at the top of the page, while older ones are moved down (see figure 6). Each Femteditian had its own blogger through which it could communicate with the children. Every week the children got a message from their Femteditian in blogger with comments on what they had been doing and questions about the chosen links. Questions that challenged and encouraged the children to continue constructing links and buildings. Blogger was also used by the children to write to their Femteditian and to communicate asynchronously with each other, especially for the communication between the Agents945 and the Detectives1030, who collaborated to reanimate the same Femteditians.

Blogger and the element of the frame story allowing Femteditians to communicate with the children were additional components in the trial of strength with the children’s request for sustenance. Blogger and the frame story elements did not try to disassociate their opponent, but

Figure 6 The Femteditian Qeque’s weblog.

32 http://www.blogger.com
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turned the children’s need for sustenance into an ally. Not by making the researchers create new virtual activities every week, but by providing minimal feedback from the Femteditians relating to what the children had already been building and linking to, and thereby turning the children’s own efforts into material for their ongoing sustenance. The frame story as a written source and the frame story as recurrent feedback were the forces associated with the Femtedit design to make it strong enough to turn the children’s request for sustenance into an ally, which would persistently stay associated with Femtedit.

Adaptive involvement vs. desire for variation

In the FEMTEDIM project we had not only experienced the children’s request for persistent sustenance. We had also experienced their desire for variation. Some children had continuously created new activities in the online 3D virtual environment, building warehouses and advertising the sales, making images of their favourite football clubs, adjusting and comparing each other’s designs, competing about how to build most and biggest, making a deep dense forest, building Harry Potter’s boarding school, laying out a maze for avatars to play in, making a secret TV lounge, etc. This list may appear contradictory to the dullness I described above of children being bored and leaving the FEMTEDIM. But it wasn’t. Some children had of course been bored with FEMTEDIM more often and more easily than others be. But even children engaged in these activities had had periods when they couldn’t be bothered to enter the online 3D virtual environment, where they had preferred to work with other programs or play computer games. And periods where they had stayed away from FEMTEDIM sessions. The strong desire for variation which the children had revealed within – and sometimes without – the FEMTEDIM project had opened a trial of strength with the FEMTEDIM design. Variation was not necessarily going to take place within FEMTEDIM and had thus been threatening to move the activities out of the FEMTEDIM project. The desire for variation had mainly been handled by the researchers with ad hoc activities. This had on the one hand not been satisfactory for the researchers overburdening them with work, and on the other hand, it had been unsatisfactory for some children, who had kept complaining of boredom and dullness. The Femtedit project had to strengthen the design in order to stand this trial of strength with the children’s desire for variation.

We decided to include variations in the Femteditians’ weekly feedback to the children through blogger. The Femteditian gave the children feedback on what they had been doing and
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asked questions about the chosen links. Questions that encouraged them to continue constructing links and buildings. The feedback followed a plan evolving through seven steps (see table 3).

<table>
<thead>
<tr>
<th>Session</th>
<th>Femeditian's comment (examples to guide the formation of comments)</th>
<th>Femeditian's inquiry (examples to guide the formation of inquiries)</th>
<th>Children's activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 1</td>
<td>I cannot get into Femedit. Please, open my gate!</td>
<td>I am homeless, please build me a home.</td>
<td>Opening gate.</td>
</tr>
<tr>
<td>Session 2</td>
<td>Thanks for opening my gate, I'm back in Femedit.</td>
<td>I feel so empty, please give me links</td>
<td>Start building.</td>
</tr>
<tr>
<td>Session 3</td>
<td>Oh, I am getting a home, what a wonderful feeling.</td>
<td>I wonder if having an x identity is good for my life, is all I need, etc.</td>
<td>Continue building, start linking.</td>
</tr>
<tr>
<td>Session 4</td>
<td>Being filled up is nice. I feel I am becoming an x (depending on content of web-pages) person.</td>
<td>I am confused. I am both x and y (depending on content of web pages). Does that make me a split identity?</td>
<td>Links and buildings are added and adjusted.</td>
</tr>
<tr>
<td>Session 5</td>
<td>My identity is evolving. Thanks!</td>
<td>I realize my neighbour has a z identity. Does that fit to me being an x? How will our co-existence be?</td>
<td>Links and buildings are added and adjusted.</td>
</tr>
<tr>
<td>Session 6</td>
<td>Thanks to you, it becomes clearer for me, who I am, and I am gaining strength to look around.</td>
<td>Interacting with the Femeditians.</td>
<td></td>
</tr>
<tr>
<td>Session 7</td>
<td>Hurray, you have filled me up, I can move, I'm alive!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3 Plan for the sequence of for Femeditians’ feedback to children.

The feedback plan increased the level of complexity in activities over the seven sessions. First by commenting on an unambiguous task. Then giving feedback in the form of inquiries into individual links of any kind, and thirdly reacting on how the given links related to each other – for instance a link a to mobile phone ring tones and one to a cartoon network page. To giving feedback on relations between different Femeditian’s links – e.g. “how does it work to be a mobile phone fanatic, when I live next to a Femeditian with links to American web pages of satiric political content?” This way, the feedback on the one hand continuously supported activities in the Femedit world. But it also created dynamics between the Femeditians through inquiries that involved the activities of more Femeditians. Thereby the children's own building and linking as well as the relations between what different children were doing were turned back on them as fuel for further building and linking, but always in slight variation from the previous one.

In order for the Femeditian to be able to write to the children about what they had built, a system had to be established which would provide the teacher or researcher who typed the Femeditians’ comments with knowledge about what the children had been building. We allocated two Femeditians to each researcher, who would be in charge of noticing during the
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Femtedit sessions what the children in charge of that Femteditian were doing. Consequently, there was always a Danish and a Swedish researcher or teacher responsible for formulating each Femteditian’s feedback. Every week researchers wrote field notes and posted them on an online researcher-teacher discussion forum set up for the project (see figure 7). After sharing the field notes these were discussed among researchers in the forum and finally a feedback comment from each Femteditian was decided upon and posted in Blogger for the children in question to read Tuesday morning.

By adding the seven step feedback plan and the system for researcher communication and negotiation to the Femtedit design, it was made to ally itself with the children’s desire for variation in much the same way as the Femteditians’ feedback had been turned into an ally of the children’s request for activity sustenance. The opponent was kept intact in the trial of strength, and the design was changed in order to become an ally of the children’s request for activity sustenance and the children’s desire for variation, respectively. Thereby the children’s request and desire was converted into building and linking energy making the Femtedit project progress.

Figure 7  Screenshot of a segment of the online researcher-teacher discussion forum.
**Versions of trial of strength**

There were other trials of strengths besides the four described above. There was a trial of strength for instance with the teachers, who wanted the Femtedit project to be about building a Viking village. We shall hear about that in part two. Here I have limited the discussion of the trials of strength that it was necessary to describe in order to present the Femtedit design. Table 4 summarizes the three different strategies of the four trials of strength Femtedit design folded into the design.

<table>
<thead>
<tr>
<th>Opponent of opponent</th>
<th>Character of opponent</th>
<th>Challenged part of Femtedit</th>
<th>Components added to challenge opponent</th>
<th>Trial of strength strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical limitations</td>
<td>Nonhuman</td>
<td>Smooth running of Femtedit</td>
<td>Organization of children, time schedule</td>
<td>Opponent was kept intact but neutralized by adding components that transformed technical limitations into technical adequacy</td>
</tr>
<tr>
<td>Face-to-face localism</td>
<td>Mix of human and nonhuman</td>
<td>Online character of virtual environment</td>
<td>Graphic ruins and common tasks</td>
<td>Opponent kept intact but neutralized by created a virtual localism that replaced opponent</td>
</tr>
<tr>
<td>Request for sustenance</td>
<td>Human</td>
<td>Continuity of Femtedit</td>
<td>Extended frame story, Femteditians returning</td>
<td>Opponents turned into allies by making the design fit to the requests and desires that constituted opponents</td>
</tr>
<tr>
<td>Desire for variation</td>
<td>Human</td>
<td>Sequential feedback from Femteditians</td>
<td>Researcher forum, blogger</td>
<td></td>
</tr>
</tbody>
</table>

*Table 4* The different versions of the Femtedit trials of strength.

No matter in which version the trial of strength comes, what is important is that it shows that the design is not constructed only out of the components that are ‘in’ the design, but also very much through the opponents that fight the design from ‘outside’. Which means that these ‘outside’ elements are part of the ‘inside’ of the design. Or it means that talking about inside and outside does not make much sense. The important point is to understand that a design is a result of a network coming together through relations between heterogeneous and distributed elements. In Law’s words we can say that designing is about:

*...how to juxtapose and relate heterogeneous elements together such that they stay in place and are not dissociated by other actors in the environment in the course of the inevitable struggles – whether these are social or physical or mix of the two.*

*Law 1989 p.117*

In the first trials of strength I presented the opponent was nonhuman, in the second it was a mix of human and nonhuman qualities and in the two last the opponents were human. But in each case the trial of strength was about adding and reorganizing components to a network.
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already in shape. Accordingly, it is more adequate to understand the trials of strength as rear-
maments and reorganizing that change the balance of power, rather than as a matter of actually
letting the opponents fight the battle.

Finally, I want to mention an observation of time that I find really interesting about describ-
ing design as trials of strength. When I first started writing about the design, my intention was
to focus the thesis on Femtedit, excluding the FEMTEDIM design altogether. It however ap-
peared impossible. So many solutions, experiences, consequences, etc. of FEMTEDIM were
folded into Femtedit that I finally had to give up writing about Femtedit alone without refer-
rering to FEMTEDIM. This taught me that the history in terms of its earlier versions is crucial
for the understanding of the design. We cannot understand the present design without taking
what precedes it into account. This led me to describe first FEMTEDIM in one chapter and the
Femtedit in another chapter, creating a narrative of the design development as following a lin-
ear time line. This solution, however, still was not satisfactory. It was boring and seemed irrele-
vant to read through a long description of a design only because of its promised relevance for
what was coming after. If the description of FEMTEDIM really was imperative for Femtedit
then it should be possible somehow to include it in the description of Femtedit. I searched for
a method that could do this trick and I found Law’s heterogeneous engineering approach. I
find it fascinating the way it enables me to describe opponents to FEMTEDIM as present in
trials of strength of Femtedit. The description captures the way in which the FEMTEDIM de-
sign was folded into the Femtedit design. Note, that this also implies a quite different conceptu-
alising – or performance – of time to the notion of time implied in the description of FEMTE-
DIM as the preceding history of Femtedit which was necessary to take into account. In the
heterogeneous engineering descriptions history is folded into the present. History is not some-
thing belonging to the past, gone and only existing in memory. No, history is folded into the
present materiality.

I give Law the last words about understanding designing as a trial of strength, which is the
third and last point about heterogeneous engineering:
[Designers] seek to create a network of heterogeneous but mutually sustaining elements. They seek to dissociate hostile forces and to associate them with their enterprise by transforming them. The crucial point, however, is that the structure of the network reflects the power and the nature of both the forces available and the forces with which the network collides. To say, then, that an artifact is well adapted to its environment is to say that it forms a part of a system or network that is able to assimilate (or turn away) potentially hostile external forces. It is, consequently, to note that the network in question is relatively stable.

Law 1989 p.121

Network

Understanding designing as heterogeneous engineering implies understanding design as a network. I have already mentioned the notion of network a few times. It is obviously one of the central terms in Actor-Network Theory (Latour 1987; Latour 1999d). In classic-ANT to be precise. The network metaphor describes an assemblage of heterogeneous elements (Callon 1986; Latour 1999a). Heterogeneous in the sense that they may be of different kinds, humans, nonhumans, technical, social, etc. Just as I described the online 3D virtual environment as being connected to the children via building blocks. The position of an element in a network is not due to its ‘ontological kind’. No, it is the other way around: The ontology of an element is given by its relations in the network.

From this it follows that spatial terms like proximity and distance get a new meaning. Through the frame story the URL on the back of the bus, which Hajjah took home from school, came to be next to the digital building blocks of the Femtedit online 3D virtual environment. In a network imaginary what is written on the back of a bus can be the neighbour of what is built in a virtual environment, even though they are distant in geographical terms. The network space – or the network pattern of relations – is defined by the interrelations between the elements, nothing else.

Thirdly, all elements in the network contribute to making up the network. The building blocks, the chat function, the children’s desire for variation, etc. These all do their work to constitute the network.

Fourthly, as soon as relations change, and elements stop providing their part of the work to keep the network together, the network starts dissolving. I described how the freezing of the computers and the bored children were threads to the projects. Children as well as computers each did their job in the overall network, and as soon as any of them started doing something else or nothing at all, the network was in danger of dissolving.
As long as objects in a network stay in place and do their jobs, the network stays intact. The fifth point is that when this is the case, the network can move without changing shape. Law (1989) describes how the Portuguese vessels could travel from Lisbon to Calicut and back again because each plank, each sail, each sailor, each translator and all the other little elements each did their piece of work and stayed in place. Latour and Woolgar (1986) describe how facts are made hard and capable of travelling beyond the laboratory. The Femtedit design needed to move from the design practice to the computer lab of St. Marc Street School and Pine Valley School. If the Internet, the number of children in the class, the blogger, the ruins in the Femtedit world, the researchers’ discussion forum, etc. each stayed in place and did their work, then the Femtedit could without loss move to the schools and through the seven sessions. Latour calls a network that stays intact, that doesn’t change when moving across space an immutable mobile (op cit).

Sixth, it is no magic that makes the network stay immutable when moving. The entities in the network keep each other in place. For example the graphic ruins gathered children in a local place in the Femtedit online 3D virtual environment that thanks to the Internet connection and sufficient bandwidth supported the communication and collaboration between children at St. Marc Street School and at Pine Valley School. The sufficient bandwidth was granted by the organisation of children in time and space and the communication and collaboration made it available for the children to reanimate the Femteditians and rebuild their homes. Thereby and by support from the Femtedit website the frame story was re-enacted. Because the frame story was re-enacted during the Femtedit sessions the researchers could write their field notes, which they could share and discuss thanks to the online researcher forum. Only due to these entities staying in place researchers could write comments to the children from the Femteditians. The children could connect the comments to their work, which would thereby be converted into fuel for further building and linking, etc. In this way, each entity of the network was tightly connected with the others and it was through this bundling that they could keep each other in place and keep the network intact.

The table below summarizes some of the central points about the network pattern of relations. This table will throughout the thesis be extended with notes about other patterns of relations as they are introduced.
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<table>
<thead>
<tr>
<th>Networks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General description</strong></td>
</tr>
<tr>
<td><strong>Defining pattern of relation</strong></td>
</tr>
<tr>
<td><strong>Elements within the pattern of relations</strong></td>
</tr>
<tr>
<td><strong>Relations between elements in the pattern of relations</strong></td>
</tr>
<tr>
<td><strong>Stability of the pattern of relations</strong></td>
</tr>
<tr>
<td><strong>Dissolution of pattern of relations</strong></td>
</tr>
<tr>
<td><strong>Displacement of pattern of relations</strong></td>
</tr>
<tr>
<td><strong>Transformation of pattern of relations</strong></td>
</tr>
<tr>
<td><strong>Differences</strong></td>
</tr>
<tr>
<td><strong>Similarities</strong></td>
</tr>
<tr>
<td><strong>Norms</strong></td>
</tr>
<tr>
<td><strong>Form and displacement</strong></td>
</tr>
</tbody>
</table>

Table 5  The network pattern of relations

Conclusion: the construction of a stable technology

I concluded chapter 2 by emphasizing construction. How the focus on construction makes matter matter in empirical research. How it makes matter matter in the study of how an online 3D virtual environment takes part in practice and with what effects. In this chapter I have shown one spatial imaginary based on the notion of construction: the network imaginary of how the online 3D virtual environment participated in practice. I have described how the Femtedit design was constructed, how it came to be the way it did. The focus on construction has shown us the Femtedit design not as a lifeless well-defined uniform thing, but as achieved, as including close and distant elements and as socio-material. Four points are important to note:

Asking the question of how an online 3D virtual environment participates in practice and with what effects the description of the online 3D virtual environment might seem as beside the point of the thesis since it may be claimed that the technology is a thing, it is not practice. However, describing the design as a result of heterogeneous engineering shows that design is not just a well-defined thing to be identified by its function or by its component parts in general or in abstract. Lots of trials of strength were folded into it. You cannot understand design
properly, is the argument, without taking the practices and conflicts involved in constructing it into account. We have to stop thinking of technology as being ‘an sich’. Technologies are not, things are achieved. They come to be. The stability we imply when we talk about what a technology or a design is is an achieved stability. I have shown some of the trials of strength that made Femtedit the way it was. They teach us that a technology is not just a neutral thing, a passive means in the hands of active and willing humans, but a construction that already on its way to stability has been involved in world-making, subjecting itself to some entities, changing some and building alliances with yet others. The Femtedit design reached the school only due to a lot of objects that had in one way or the other been aligned with the network.

If I have convinced you that describing practice is an inevitable part of describing technology, you may have a second objection. The thesis, you may note, is not about online 3D virtual environments in practice in general, but in a very specific practice, in school practice. Wasn’t it more appropriate to describe how pupils and teachers interact with the online 3D virtual environment? That is indeed appropriate, and I shall do this in part two and three of this thesis. But it is not more appropriate. The spatial approach changes the research site. It is not necessarily, or exclusively, the situation in which technology and users meet that tells us most about how the online 3D virtual environment takes part in practice. The trial of strength involved school practices and school children opposite to, right next to, related to and in the technology. Indeed, school practice was folded into the design of the online 3D virtual environment. Akrich (1992) describes this as worlds of practice being inscribed in the design. What I call the materiality of a technology, it’s achieved abilities to relate to other objects, is characterized by describing the design of the online 3D virtual environment and the entities that as parts of school practice are integrated into the design. Describing the Femtedit design as a network implies that things that we usually understand as distant and outside of the design appear as components of the design, each doing their job of making and keeping the design the way it is. Similarly, I have discussed the way in which the network metaphor folds past and present into the same materiality.

Third, and connected to the point about integrating components into the design, the description of the online 3D virtual environment is hence a story of how the design is made stronger by adding components. It is about extending the network by enrolling allies.

Design is an interesting object because it lives on the boundary between the technological and the social. It involves what we may understand as technology and what we may understand as social practice. This lead us to the final point, namely that one of the advantages of the net-
work imaginary of design is that it allows us to put the technological or material on a par with
the social and thereby to describe how technological and social elements interrelate in design. This is known as the principle of symmetry in ANT (e.g. Callon & Law 1997; Johnson (a.k.a. Latour) 1995; Latour 1999a). I have shown that Femtedit design was not a matter of social interests inscribed into the design, as social constructivists tend to argue, giving the social a special explanatory status, from which the technological is omitted. There were many material elements responsible for the Femtedit ending up as it did. Material elements that mattered. The design could not just as well have been made on paper, as shadow play or other. The online character, the linking options, the frame story that came to be the way it did by combining as many of the program functions as possible, etc. were all material elements that were crucial for the Femtedit design ending up as it did. When in part two and three I start comparing the Femtedit project with classroom practices, we shall see many more details in the differences the different materials made.

This is the first spatial imaginary of the thesis: the imaginary of the online 3D virtual environment as a network. It shows us the online 3D virtual environment as socio-material trials of strength through which the Femtedit design constituted a network of digital building blocks, graphic ruins, children’s desires for variations, URLs on plastic bags, a feedback plan, a frame story, Pine Valley School, poor quality computers, etc. that was able to convert the energy of 44 children into collaboratively building, linking and communicating in the Femtedit online 3D virtual environment and engaging with a variety of experiences from remote places and diverse materials from inside and outside of school. It shows the online 3D virtual environment participating in practice as a network, which integrates a number of elements in a pattern of relations in which each has its place, and each does its jobs.

This is the design we shall discuss throughout the chapters of this thesis. The online 3D virtual environment is interesting because it involves the creative process of building up something that is not defined for the children in advance. It uses a large but limited number of elements because it involves linking, which extends relations beyond the walls of the school, and because it includes online communication and collaboration which is going to happen online. These are qualities that are alien to most of the learning materials traditionally encountered in school.
Chapter 4

Things that don’t quite fit: Fluid Femtedit

There were descriptions and formulations in the previous chapter that at a second glance didn’t quite fit33 into the network pattern of relations. There were elements that did not stay in place. There was transformation instead of stability. And there was interplay in the place of trials of strength. This is the focus of this chapter. I discuss these failing, transforming and interplaying elements and the pattern of relations they contributed to performing. I state that describing the Femtedit design as a network pattern of relations only presents one version of the design and that there were more versions. The network metaphor is not sufficient. It is even partly misleading. I present the critique several authors have posed to the network metaphor.

Crisis: The spatial imaginary provided by the network metaphor is not sufficient to describe how the online 3D virtual environment participated in practice. Law & Mol (Law 2002b; Law & Mol 2001; Mol & Law 1994) suggest three additional spatial metaphors. One of them is that of fluid space. I present this metaphor and show that elements of Femtedit that did not fit the network metaphor performed a fluid pattern of relations. This chapter is about a different, alternative way of describing technology. Concluding the chapter I shall argue for the importance of being able to treat technology as also transforming and temporary, and I shall discuss what it means to understand fluid and network patterns of relations as multiple versions of the Femtedit design.

A second glance at Femtedit

In this section I return to some of the descriptions from the previous chapter of the Femtedit design. I look at arrangements that failed, constructions that did not settle and external elements that were friends and not opponents. Things that did not fit the network metaphor.

33 I have borrowed this inspiring wording from the title “Things that don’t quite fit” of the first of a series of just as inspiring workshops arranged by John Law at the Centre for Science Studies, Lancaster University.
**Optional components**

In the network pattern of relations each component does its job and stays in place. In the Femtedit network children were kept connected to the *online* characteristic of the online 3D virtual environment by common tasks given to mixed groups of children from both schools and through graphic ruins of the Femteditians’ homes built in the online 3D virtual environment indicating where to collaborate online (see p.48ff). These components were ammunition in the trial of strength with face-to-face localism. What I did not write in chapter 3 was that the graphic ruins and common tasks lost the trial of strength against face-to-face localism. There was not much online collaboration between the children at St. Marc Street School and those at Pine Valley School.

This, however, did not make the Femtedit project dissolve altogether as I described a network does if its elements do not stay in place and do their jobs. The Femtedit activity continued with the Danish and Swedish children building and linking next to each other, but without much collaboration. The Femteditians became composite but uncoordinated products of the building blocks and links which each side of the team added to the Femtedit world. Femtedit did not dissolve, it only varied.

The Portuguese vessels Law (1989) describes would not have stayed together had the association of planks, mast, sails, oarsmen, storage capacity and supply of fresh water, etc. not won the trial of strength against the strong current from the Canaries, persistent mists and the depths of the sea bed. This was the tragic fate of the Vivaldi brothers’ trip to the Indies in 1291. “[T]hey sailed their galleys past the pillars of Hercules and out of recorded history” (op cit p.117). The assemblage of human and nonhuman objects making up this trip was dissolved into its component parts. The fate of Femtedit was not tragic. Even though the common tasks and graphic ruins lost the trial of strength against face-to-face localism Femtedit did not dissociate into its component parts.

The trials of strength Law presents are dramatic. They are about life and death. My descriptions are not. Irregularities did not evoke disruptions. Instead of breaking apart, Femtedit varied. It became a technology which two classes on each side of Oresund were connected to, but without the planned intimate collaboration. Component parts slipped out of the pattern of relations without it dissociating. The components did not act in the pattern that network components do.
A raft might be an appropriate allegory to think of when characterizing this different pattern of relations\textsuperscript{34}. You can only re-built a floating raft without falling into the water if you do the reconstruction bit by bit. If everything is taken apart at the same time, the result is dissolution. The raft is no network. Its component parts are not obligatory. They can be left out without the assemblage dissolving. You can pull out a plank without the raft sinking. You could exclude online collaboration from the Femtedit design but the project would still continue. This, however, did not mean that the common tasks, the graphic ruins or the online collaboration were redundant. Many of the component parts of Femtedit could be left out. The building function could stop working and the Femteditians would be reanimated only through hyperlinks. Blogger could fail to work and Femteditians’ feedback could have been distributed via email. You would never know in advance which component would fail or be excluded. Therefore, each component part was necessary in case any of the others failed. Whenever one component failed, the rest could continue without it. Compare this to Law’s description of heterogeneous engineering on page 60, where he notes that “to say that an artifact is well adapted to its environment is… to note that the network in question is relatively stable” (emphasis added). This was not the case of Femtedit. At least not network stability in terms of components staying in place. The components slipping out of Femtedit did not make it less well adopted. The network imaginary does not fit.

Obviously, if all component parts were excluded at the same time, Femtedit would dissolve just as the raft would. But a few components at a time could stop doing their work without Femtedit dissolving. This pattern of relations did not make stability available in terms of all elements staying in place. No, it made it available for components to leave and enter the assemblage. While each component in the Femtedit network was obligatory and had to stay in place, the components of this Femtedit pattern of relations were optional and exchanging. This pattern of relations was different from the pattern of relations performed by the network. It was something else. It was fluid. I will return to this below.

\textit{Ongoing trials}

Many of the trials of strength making up Femtedit were won by the Femtedit design. The one described above between on the one hand graphic ruins and common tasks and on the other face-to-face localism was lost. Common for the trial of strengths that were won and the ones

\textsuperscript{34} In an earlier unpublished version of his article on \textit{Objects and Spaces} (Law 2002b) Law suggested the allegory of Duhem’s raft.
Method of contrasting

that were lost was that they concluded. There was an end-result to the trials of strength. Other trials of strength went on and on. In chapter 3 I described how the organisation of children in groups and a time schedule were inserted into the trial of strength with the limited bandwidth and poor quality computers. But I also noted that the organization was no sovereign opponent (p.48), since computers kept freezing and digital functions recurrently stopped working. Researchers engaged in whatever repair work available, re-booting computers and changing program settings, helping to communicate the temporary breakdowns, etc. This allowed Femtedit to continue even though the problem was not solved. The limited bandwidth and poor quality computers would keep challenging Femtedit, and the conflicts would keep reappearing. The trial of strength was not settled. The limited bandwidth and poor quality computers did not win over Femtedit, putting an end to the project. Neither did the organization of children in groups and the time schedule overcome the opposition from the limited bandwidth and poor quality computers. It was not a zero-sum game as the one described by the network metaphor, in which there is always one winner and one looser. It was an ongoing trial.

This is the second point I want to emphasize which is that the Femtedit design did not perform a network pattern of relations. It disagreed with the characteristic of a network as a pattern of relation proceeding towards stability obtained by the end of trials. Instead, stability was obtained by flexible and changing efforts of researchers assisting with whatever was needed whenever the balance between the Femtedit design and the limited bandwidth and poor quality computers tipped in favour of the latter. Settings were changed, children were relocated to other computers, messages were sent. These were short temporary interventions which did not become permanent components of the assemblage. But they were indeed necessary for the proceeding of the project. Indeed, the project proceeded because of the ongoing repair work and recurring struggle with the limited bandwidth and poor quality computers. This was the fluid stability: little recurring interventions, adjustments, and rearrangements. Ongoing or recurring trials rather than the end of trials.

Absorbing elements from outside

The third point I want to emphasize about the patterns performed with Femtedit, which disagreed with the network pattern of relations, has to do with the relation between the inside and the outside of the online 3D virtual environment. The point about the trials of strength discussed in chapter 3 was that elements that are usually taken to be external to a technology are through the trial of strength approach shown to play a key role in the construction of the tech-
nology. The key role such ‘external’ entities play in the network pattern of relations is that of opponents against whom the technology is designed in order to either neutralize or become capable of withstanding the opposition. In Femtedit ‘external’ elements played this role as described in chapter 3. They however also played another role:

Apart from re-establishing the Femteditians’ homes, the tasks in Femtedit involved making links from the homes in Femtedit to web pages on the Internet. It was entirely open which links children would add. The design encouraged children to look for URLs in their environments, not only in Femtedit, but especially in other places (see p.45ff). Also the research forum contributed to a steady flow of alterations and revisions of the already established links in Femtedit and to ongoing additions of new elements. This was a repeated pattern of Femtedit: new elements entered the online 3D virtual environment and altered the character of Femtedit. Some links came to stay, others were exchanged or deleted, but anyway, the links involved contributed to the ongoing creation (and transformation) of Femtedit.

In this way, external elements were absorbed by the Femtedit design. They were not opponents who contributed to the design by challenging it. No, they were friends, who joined the game, so to say, who entered, influenced and formed Femtedit. Not ‘negatively’ as opponents, but ‘positively’ by becoming parts of the assemblage equal to other components. Let me again remind us of Law’s description of the network (p.60 above): “They seek to dissociate hostile forces and to associate them with their enterprise by transforming them”. In our case, however, external ‘forces’ were not hostile, and they were not associated with Femtedit by being transformed. Sometimes, external entities were assimilated to Femtedit. But sometimes, components of Femtedit were changed to fit to external elements – Femteditians’ feedback, for instance. And often ‘internal’ as well a ‘external’ entities were modified as they came together in Femtedit.

External entities were not just ‘visitors’ that the design could do without. On the contrary, they were decisive for Femtedit’s continuity. If the flow of elements from outside would stop, the researchers would not have any source for the feedback from the Femteditians, the Femteditians would not be reanimated, and Femtedit would start dissolving. So, this aspect of ongoing absorption of external element resonates with the network pattern of obligatory components that have to stay in place if the network is not to dissociate.

However, the elements absorbed in this pattern of relations did not have to stay in place in order for the pattern of relations to stay intact. On the contrary, they had to keep transforming. This was what the researchers encouraged, and it was inscribed in the frame story. It was not a
pattern of relations that as the network once constructed in opposition to external elements stayed the same. No, this pattern of relations continued changing through the absorption of external elements.

**Critique of the network metaphor**

The sections above show that Femtedit also performed patterns of relations that did not fit the network metaphor. Or put the other way around: the network metaphor is not appropriate to characterize this pattern of relations performed by and through Femtedit. The network metaphor fails to characterize those performances. Before characterizing these patterns of relations in more detail, I will therefore look at the critiques of the network metaphor that have been posed by many authors. I shall focus especially on three points of critique concerning the managerial tendency of network stories, as well as the stability and singularity produced with the network metaphor. The criticisms are posed by authors sympathetic to ANT. Hence, I take the critiques as attempts to further develop the line of thinking initiated by classic-ANT and not in order to overcome or defeat these attempts.

**Managerial perspective**

Feminist and Social Interactionist Susan Leigh Star (1991) has observed that Callon and Latour’s writings take a point of departure in heroes or near-heroes; people and things of great importance and great power: Pasteur, Diesel, the double Helix, the Eagle computer. “Some of us”, Star modestly writes, “begin not with Pasteur, but with the monster, the outcast” (op cit p.29). Many of these ‘some’ are feminists, who wish to create descriptions that notice the peripheral, the ephemeral, the invisible and the overseen. What fails, what does not fit the standards. The powerless, if you wish. To these authors the network descriptions of classic-ANT are too managerial, too centred, too integral. Sociologist of childhood Nick Lee & social psychologist Steven D. Brown (Lee & Brown 1994) point to the colonial character of the network metaphor. It leaves no room for otherness and allows for nothing to stand outside the network pattern of relations. Everything is integrated.

Metaphors, Star notes, create worlds, emphasize and give voice to some, while silencing and ignoring others. Along with Star, feminist and technoscientist Donna J. Haraway (1997) remarks that the network imaginary creates a ‘god’s eye view’, which looking at the world from above sees everything as fitting together in one system. It is a managerial perspective, a perspective of the one, who creates worlds, who aims for coherence and order. Philosopher and
sociologist of science and technology Sergio Sismondo (2004) observes that the subtitle “how to follow scientists and engineers through society” of Latour’s Science in Action emphasizes the people at the centre of inventions and technologies, the creators, the heroes.

But there are indeed more to the world than coherence, order and central perspectives. And there were indeed more than coherence and order to Femtedit. As I described above, there were elements that did not stay in place and did their work as the network metaphor suggested. There were elements that did not fit in as permanent components of the assemblage but only briefly passed by and left again. These elements, however, did matter, as I have shown. We need a vocabulary that allows us to describe these different patterns. Along with Star, Haraway, Fujimura and other feminist writers, I therefore want to argue the need for metaphors that are capable of describing the failing, the ephemeral, the overseen.

**Aiming for stability**

The network metaphor has furthermore been criticized for its focus on stability. This critique is closely related to the critique of the managerial character of network descriptions, but its focus is on the temporal stability while the latter is on spatial coherence. The process of constructing a network is a process that draws things tightly together, which aims for settling all components in an all-integrating network. As we saw in the descriptions above, Femtedit was not like that. Or it was, at least, not only like that. There were trials that went on. There were the ongoing constructions of the Femteditians, the identity of the Femtedit world. Without this, Femtedit did not make much sense. There are technologies whose aims are not to fix, to settle, to standardize processes. Think of open source software. Or think of a bush pump (de Laet & Mol 2000) that serves different aims, that continuously changes, whose creators and maintainers are the ones temporarily available. The pattern of relations these technologies perform are not appropriately described by the network metaphor.

Through the discussions of the Zimbabwe Bush Pump the network metaphor is criticized for making a world of big, stable and robust systems. For being incapable of describing assemblages that vary, that do not settle. I shall return to this discussion below, and here just state that I go along with the critique of the network metaphor for being too preoccupied with the building of big, robust, stable systems.

35 That the world, facts, and technologies do not perform one central coherent order is partly what classic-ANT aimed at showing as discussed in chapter 2. The metaphor of construction undermines the view of order as given, but as we realize through classic-ANT analyses, it does not prevent an image of constructions concluding in one centred order. It does not prevent total descriptions. See also p.26 n.21
Singularity

The network metaphor was launched to do war on the understanding that technology and facts among other things are given in the order of things and have essential, isolated existences (e.g. Latour 1987; Law 2002b). I would like to question whether war is the right notion to proceed with in the world. Wars unmake worlds and they make worlds. Unmake understandings, and make understandings. In that sense they are singular. They accept only one order; only one pattern of relations. The network metaphor has put itself in the place of the dethroned understanding. Which is a way of keeping an order while at the same time creating a new. Why not celebrate multiple orders next to each other, intertwining and coordinated instead of celebrating only one order, Mol and Law ask (e.g. Law 2002a; Mol 2002; Mol & Law 1994). In their attempt to develop metaphors for a multiple order, Law and Mol have done three moves which I consider decisive for the turn from classic-ANT to after-ANT: First, they have turned the network metaphor into an empirical metaphor that may be used for empirical descriptions contrary to the network imaginary of classic-ANT in which the network is a fundamental all-embracing and all-including metaphor. Secondly, they have emphasized that the network metaphor does not create sensitivity to describing all empirical formations. And thirdly, they have presented three additional spatial metaphors juxtaposed with the network metaphor. These four metaphors makes it available to create empirical descriptions sensitive to the ways in which patterns of relations may be formed in different ways, co-existing rather than replacing each other. One of these metaphors is fluidity, which I turn to in the next section.

Fluid pattern of relations

The metaphor of fluidity is a supplementary spatial metaphor to the network metaphor (Law 2002b; Law & Mol 2001; Mol & Law 1994; see also Elgaard Jensen 2001; de Laet & Mol 2000; Law 2002a). An example of a fluid technology is the Zimbabwe Bush Pump (de Laet & Mol 2000). De Laet and Mol show how the pump continuously changes shape. Of the many pipes and bolts, etc. that make the pump work none is in itself necessary to keep it working. Each part can be replaced with other components. With many of its bolts removed the pump still keeps its capability to pump. Furthermore, the social and village relations that become part of the pump are not always the same. Just as the purposes of the pump sometimes is to provide clean water and health, sometimes to contribute to creating Zimbabwe as a nation. Material bits and pieces as well as social relations, purposes, etc. vary with the different arrangements the
pump gets entangled in. The success of the Bush Pump, it is concluded, is its ability to change shape. Obviously, the pump does not perform a network pattern of relations. De Laet & Mol call it a fluid technology.

Fields of invariant and gradual transformation are fluid (Mol & Law 1994). Components of a fluid pattern of relations are optional and exchangeable whereas objects in the network pattern of relations are durable and held in place. Fluid objects are not well defined, and their mutual relations are unstable. Stability of a fluid pattern of relations is not generated by fixed relations – as in network pattern of relations – but by continuous transformation. A fluid pattern of relations is variable in the sense that it does not collapse if objects are substituted by others, changed or disappear. On the contrary, fluid patterns are dependent on including new elements. They encounter their limits the moment they no longer absorb their surroundings.

The table below compares the fluid pattern of relations with the network pattern of relations. It is an extension of the table on page 62.

<table>
<thead>
<tr>
<th></th>
<th>Networks</th>
<th>Fluids</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General description</strong></td>
<td>Web of elements with well defined relations between them.</td>
<td>Generates possibility of invariant transformation.</td>
</tr>
<tr>
<td><strong>Defining pattern of relation</strong></td>
<td>Stable relations.</td>
<td>Invariant (gradual) transformation.</td>
</tr>
<tr>
<td><strong>Elements within the pattern of relations</strong></td>
<td>Actants, which are heterogeneous objects that receive their identity through their relations in the network.</td>
<td>Objects are not well defined, bonds are not fixed. A world of mixtures; components a) may or may not be separated; b) inform each other, but the way may continuously alter.</td>
</tr>
<tr>
<td><strong>Relations between elements in the pattern of relations</strong></td>
<td>Relations are defined by proximity in relations. Objects that go together depend on each other.</td>
<td>Changing.</td>
</tr>
<tr>
<td><strong>Stability of the pattern of relations</strong></td>
<td>Actants hold each other and the network in place.</td>
<td>Ongoing transformation, continuity.</td>
</tr>
<tr>
<td><strong>Dissolution of pattern of relations</strong></td>
<td>When linkage inside network start to vary the network starts to dissolve.</td>
<td>When the fluid space no longer absorb their surroundings.</td>
</tr>
<tr>
<td><strong>Displacement of pattern of relations</strong></td>
<td>The whole network moves as one.</td>
<td>Fluids continue from one place to another – involving new elements, varying its form.</td>
</tr>
<tr>
<td><strong>Transformation of pattern of relations</strong></td>
<td>Once constructed the network is immutable. It doesn’t transform.</td>
<td>Fluids transform themselves from one arrangement into another without discontinuity.</td>
</tr>
<tr>
<td><strong>Differences</strong></td>
<td>The network’s opponents are dissociated or turned into allies.</td>
<td>Differences and similarities come in varying shades and colours – they go together. It is not possible to determine a) inside from outside; b) identities nice and neatly, once and for all.</td>
</tr>
<tr>
<td><strong>Similarities</strong></td>
<td>Allies are integrated into the network.</td>
<td></td>
</tr>
<tr>
<td><strong>Norms</strong></td>
<td>Different norms may stay within the network as long as the keep each other in place.</td>
<td>Normality is a gradient rather than a cut-off point.</td>
</tr>
<tr>
<td><strong>Form and displacement</strong></td>
<td>Immutable mobile.</td>
<td>Mutable mobile.</td>
</tr>
</tbody>
</table>

Table 6  Network and Fluid patterns of relations.
Femtedit as fluid

The Femtedit pattern of relations that did not fit into the network metaphor. They performed a fluid pattern of relations. I described Femtedit as a pattern of relations in which components could fail without the pattern dissolving (p.66ff). As an ongoing trial, which did not settle, but continued transforming (p.67ff). And finally, as absorbing elements from outside contrary to treating them as opponents (p.68ff). These three aspects are closely related. Since there were no opponents performed, there could be no trial of strengths. Instead, an ongoing trial was performed, not as a fight between opponents, but as continuous exchange between ‘friendly’ elements. An ongoing trial which gradually altered Femtedit. All elements – ‘external’ and ‘internal’ – engaged in this exchange that made up Femtedit. This also implied that ‘failing’ is not the right term for the components that did not stay in place. That was how they acted in network terms. In fluid terms these components contributed to the ongoing transformation of the fluid pattern of relations.

Femtedit was a kind of experiment. In chapter 2 I called the research process an ongoing trial with the online 3D virtual environment. It was not only nonhuman components like graphic ruins, hyperlinks, interrelations between schools, bandwidth, etc. that changed. Researchers changed as well. The fact that the plan for how to give feedback from the Femteditians in a sequence (p.56) turned out not to match the way in which the project was proceeding did not come to constitute a result of the experiment that falsified the hypothesis inscribed in the plan about how the project should proceed. Instead, it became a lesson for the further process and changed the relation between the plan and the Femteditians’ feedback. The sequential aspect of the plan was removed, and the researchers started using the different ‘steps’ of the plan as inspiration for different ways of giving feedback rather than as a guideline for how to proceed sequentially. In this way, Femtedit changed together with us, the researchers, as we learnt a lesson. We changed our way of participating in the project, as Gomart (2004; see p.34 above) suggests that researchers participate as apprentices in a research process.

The identity of the Femteditians and the Femtedit online 3D virtual environment changed in the process as well as the researchers. Similarly, the children involved in the Femtedit project were continuously challenged through the feedback from the Femteditians. They were not

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36 I keep Suchman’s (Suchman 1987) insight in mind that plans are involved as resources for action rather than prescriptions. However, I want to emphasize that there are gradients of how decisive a role plans play in practice. Differentiating between ‘inspiration’ and ‘guideline’ is an attempt to formulate such a gradient.
given more or less isolated pieces of factual knowledge as final results, which they could take as robust achievements, but encouraged to keep revising, amplifying and extending their work (see part two).

These patterns of ongoing transformation, which Femtedit contributed to performing, implied and required continuous involvement of elements from outside, especially through hyperlinks, as well as the experiences and exchanges involved in bringing these hyperlinks into Femtedit. Together with the ongoing transformation the involvement of new elements from ‘outside’ is a key characteristic of the fluid pattern of relations. These new elements – as well as the elements already entangled in the pattern of relations – may stay within the fluid assemblage for a longer or shorter time. They are optional and gradually exchangeable.

**To be or not to be fluid – a few examples**

Before ending this section about the fluid characteristics of the Femtedit online 3D virtual environment design I shall compare the Femtedit fluid design to a few classic educational computer programs. The comparison partly serves the purpose of clarifying some of the characteristics of Femtedit, and partly it may concretise some of the characteristics of fluid patterns of relations.

Mathematician and learning theorist Seymour Papert’s *Logo* (Papert 1980; 1993) allows children to program ‘turtles’ on the screen to act according to the geometric rules children set. A rule could be that the turtle keep moving one step forward until it bumps into a barrier or another turtle, then it turns 135° to the left. The turtle can also be programmed to draw on the screen while moving, which will create a graphic expression of the rule – as well as nice drawings of flowers, houses, etc. *Logo* is explorative, and open-ended with no predefined result. These aspects contribute to performing a fluid pattern of relations. However, the geometric operations *Logo* is programmed to execute on specific commands are entirely fixed. They define the limits of the fluid pattern of relations. In comparison, most components involved in Femtedit were malleable. Femtedit defined the activities to involve building blocks and hyperlinks which implied a large source of elements from ‘outside’ that could become part of Femtedit. The user of *Logo* has to stay within the discipline of geometry. Without that, the program dissolves.

Involving themes from children’s everyday life has been an element of other educational software before Femtedit. Robert B. Davis’ *Plato* computer system teaches children mathematics, as *Logo* does. Central for *Plato* is that it builds on what children already know (Druin & Solomon 1996). For example, it may introduce fractions by asking the child to share jumping
beans with two friends. This is supposed to make the child involve experiences with sharing jumping beans, which he is already familiar with, and reassemble these experiences into a new frame as he acquires new knowledge. Entities from outside are involved as they are in a fluid pattern of relations. But they are not absorbed by the program in a way that changes its formation, as is characteristic for fluidity. While Plato defines a very specific practice from the child’s life to be of relevance and has a quite limited way of using this experience in the computer program, the Femtedit fluid pattern of relations invites the children to define which practices are relevant to include into the online 3D virtual environment and how.

Finally, by keeping the frame story relatively undefined Femtedit contributed to performing children as those who define which elements to include and how to do so. By keeping the frame story relatively blank. Sociologist John Hetherington & Lee (2000; see also Brown & Capdevilla 1999) have proposed the notion of ‘blankness’ in order to draw attention to how empty spaces like the hole in the board of a Solitaire game can be a pivotal contributor to action. It is not the sticks that drive the game ahead, it is the hole. Don’t look only for the sticks, they note. Don’t go after objects that are ‘full’ and in motion. Social scientists, they continue, usually search among full objects and filled spaces in order to find sources for action. But sometimes it is not an interaction itself or a known interactor, but a break in the interaction or an undefined identity that evokes further occurrences. Hetherington & Lee call such holes, breaks and unidentified identities blank objects. The undefined character of the Femtedit frame story made it a blank object. This blankness, this empty space, was a crucial contributor to the fluid pattern of relations, creating a constant need for filling the blankness of the frame story. The children were in charge of filling this blankness, which put them in an active position, as I discuss further in part three. You may compare this blankness to a textbook which does not involve blankness but conveys a full body of information for the reader to store, engrave, copy. Indeed, a textbook is a full object performing the reader as blank. It is up to the textbook to fill the reader with information. The textbook has no aim if the reader is already familiar with the information it contains, and the textbook thus implies a blank reader. In Femtedit it was the other way around: Femtedit was blank, which required of the user to be ‘full’, to be active. The blankness made it available for the children to be active, and hence through the building process perform a fluid pattern of relations.

Many educational interactive digital designs involve blank lines. Drill-and-practice programs, for instance (also known as interactive textbooks). Based on Suppe’s special version of behaviourism for computer curriculum (see Druin & Solomon 1996) many programs present an arith-
metic exercise followed by a blank line. $3 \times 9 = \_\_\_$, for example. This ‘blankness’ does not contribute to performing a fluid pattern of relations. It is not blank in terms of its answer being blank. 27 is the product. That is set. There is no discussion. If you type in another number – 83 – the computer reacts with TRY AGAIN. The right result – 27 – may not be presented for the user, but in the way the exercise is presented and the repeated assessment of the result typed in makes it clear that a single right answer to the task exists. It is like a disequilibrium that just waits for the 27 to be filled in. And the balance to be re-established.

With these kinds of so-called pseudo-questions, indicating that they are not questions that look for an answer, but questions to which the answers are already known (Lindblad & Sahlström 1998) the children are performed as a kind of trivial machines, to use a term from systems theorist Niklas Luhmann (2002 p.77). These are pupils that given a specific input run a certain function, which results in a specific output. The Femtedit frame story did not have such a predefined result. The blank space established by the frame story contributed to performing the clued characteristics of gradual transformation through involvement of external exchange and optional elements.

Multiplicity

So, did Femtedit perform a fluid pattern of relation or a network pattern of relations? No, it performed both a fluid patterns of relation and a network patterns of relations. In order for the Femtedit design to be able to move from the designer’s desk, so to say, and enter the school context without dissolving into its component parts, it had to be designed as a network that was immutable and mobile. Femtedit could not be designed without taking into account the children, the school schedules, the sizes of the classes, the quality of the computer, etc. Had these elements been neglected in the design process then the Femtedit project would have come to an end before starting. Femtedit had to be designed as an immutable network in order to enter school at all. Furthermore, it was pivotal that the Femtedit design would stay put in the school context once entered without the children, the online 3D virtual environment and other components leaving it. The network pattern of relations should ensure the unbroken condition of the design.

However, in designing the virtual environment not only integrating and stabilising network effects were established. The Femtedit online 3D virtual environment had to be designed in a way that avoided rigidity. It was an explorative project, after all. It needed clearance in the ways in which components were related. Slack that made it available for the online 3D virtual envi-
ronment to participate in different, surprising ways. If no slack was provided, the after-school activity would rather be a test of whether the design made the activity unfold in the predicted way or not. And not of how the technology could participate in practice.

A technology can very well perform a network pattern of relations and a fluid pattern of relations at the same time. A technology can very well be multiple. Postmodernist approaches suggest pluralism to emphasize that there is not only one right description of the world. Giving one description higher status than another is a political, not an objective move. Using Wittgenstein’s notion of language games, Lyotard (ref. Law 2002a) emphasizes that these come in the plural. Language games are the pattern of activities and practices associated with particular families of linguistic expressions. The way an object like a 3D virtual environment may be described depends on the language game used to describe it. A scientific language game, a pedagogic language game, a peer language game all would provide different descriptions, and hence different ideas or representations of what the online 3D virtual environment is. In other words, what an online 3D virtual environment is depends on the perspective of the description. The network pattern of relations and the fluid pattern of relations could be seen as two such perspectives.

While sharing the intentions with postmodernists of theorizing beyond singularity, Law and Mol (e.g. Law 2002a; Mol 1999; Mol 2002) suggest the notion of multiplicity, which differs from that of pluralism on two points. First, Law (2002b) notes that plurality may lead to a fragmented collection of descriptions. Nothing is gained by just having many instead of one. By simply listing a number of descriptions of Femtedit. Different patterns of relations intertwine and interrelate. Multiplicity and coordination go together, Law underlines. Mol suggests the notion of multiple versions of an object. “They are different and yet related objects. They are multiple forms of reality. Itself”, she almost poetically adds (Mol 1999 p.77). Despret (2004) has independently of Mol also fallen for the notion of version. She observes that in Medieval Latin version (versio) meant change. A version overturns and changes what it prolongs and it is able to integrate other versions or be joined with them because it keeps connections to what it turns around. With Law, Mol and Despret we may understand the network pattern of relations and the fluid pattern of relations not as two independent perspectives, which have nothing to do with each other, and which would each happily exist without the other. No, the two patterns of relations coexist and depend on each other. The fluid pattern of relations could not exist without the network ensuring the movement from the designer’s desk to the school and the enrolment of children, online 3D virtual environment and other components. On the other
hand, the network pattern of relations would not be capable of keeping the elements together
should the researchers not provide their flexible and changing repair work, had the children not
continuously brought in new elements from outside, had the components not been optional
allowing the graphic ruins to change their participation, etc.

Secondly, the notion of multiplicity implies criticism of postmodern *perspectivalism*. Mol
notes that perspectivalism ends up dealing with perspectives, language games and interpreta-
tions, leaving the subject matter behind. In her book on atherosclerosis Mol writes with refer-
ence to perspectivalism:

> In a world of meaning, nobody is in touch with the reality of diseases, everybody
> "merely" interprets them. There are different interpretations around, and "the
disease" – forever unknown – is nowhere to be found. The disease recedes behind
the interpretations. In a world of meaning alone, words are related to the places
from where they are spoken. Whatever it is they are spoken about fades away.
Mol 2002 p.11-12

Postmodern approaches find the plurality in perspectives, in interpretations, in language games,
not in materialities. Plurality does not apply to the objects interpreted, but only to the interpre-
tations of them. Despret notes that when understanding visions (perspectives) as determining
the relation to the object of study, sciences have no function other than to:

> ...discover that which predated their questions, to continue and explain the vision
they gave of their object...When we speak of vision... we affirm at the same time
that this vision is what prevents authentic access to what should be known.
Despret 2004 p.29

Latour (1993 p.61) takes the argument one step further noting that postmodern perspectival-
ism creates a hyper-incommensurability between subject and object. Instead of the plurality of
interpretations, Mol suggests we describe the multiple versions of objects, just as Despret notes
that versions of objects are versions of the world. This relates to the discussion on performativ-
ity and reality I initiated on page 31. Here it suffices to say that following Despret, Law and
Mol the network pattern of relations and the fluid pattern of relations are two *versions* of the
Femtedit online 3D virtual environment. Two coexisting versions that partly involve different
elements and whose relations between components form different patterns. They are different
ways of making the online 3D virtual environment technology – to which my vocabulary and
metaphors contribute.

In her study of atherosclerosis Mol (2002) visited two hospitals and went to different de-
partments within the hospitals: the outpatient clinic, the operating theatre, the department of
pathology. In each place she found another version of atherosclerosis. This may mislead us to
think that versions is only about how objects appear differently in different places. It may mis-
lead us into a Euclidian way of thinking space. In my study I stayed in one place and I discuss one technology. But I still find different versions. This is important. A technology is not multiple simply due to its participation in different practices. It is not multiple due to its displacement. It is multiple in itself.

**Conclusion: flexible and multiple technology**

What have we learnt in this chapter about how technology may participate in practice? Two things, at least: That technology may be other than a stable, fixed product. And that it may be so whilst at the same time being a stable fixed product; that technology participates in practice as a multiple object. Concluding the chapter I shall elaborate further on these two points.

The metaphor of fluidity allows us to think about technologies as assemblages that are not held in place by immutability and control, which is the case with the network. It allows us to think about technology as something changing and varying. And to understand that changing and varying processes can also be stable. But that stability lies somewhere else other than in immutability and control. That it may lie in the process of change. Hence, we don’t have to think about technologies and other assemblages that change, and whose boundaries are vague due to its dependency upon elements from outside as failing or dissolving. On the contrary, these aspects can even be what *keeps* the stability, and what keeps the assemblage in place\(^\text{37}\). The network metaphor limits our understanding of stability and change, and of success and failure. The fluid metaphor offers itself as an alternative, for which the variable and failing is no residual category, but a pattern of relations with its own logic as to what counts as elements, relations, stability, dissolution, etc., as shown in table 7 on page 100.

Law, Mol and others discuss fluidity in the frame of after-ANT with the purpose of developing some of the theoretical investments of classic-ANT to embrace the temporary and varying. I find it important to emphasize that this is not just a matter of a new aim. It is also a matter of different kinds of empirical material. The strong currents from the Canaries and the northeast trade winds, etc. from Law’s discussion of the Portuguese vessels are quite different materialities from children, research practice and online conversations. They are lethal. If the heterogeneous components of the Portuguese galleys were not tied properly together the wind and the currents would indeed make them sink with all hands. The distance between integrity and dissolution was short. One moment they might have been floating proudly along the west coast of

\(\text{37 See also Law’s (Law 2000a) very nice analysis of failing systems.}\)
Africa, and the next they might have been hit by a storm, split into thousand pieces and sent to
the hereafter. The conditions of the Portuguese vessels were quite different from the conditions
of Femtedit. They were much more dramatic, as stated above. The components of Femtedit
were weaker and many of them could disagree without anyone suffering any major pain. Fluid
patterns of relations were much more pronounced in Femtedit whilst network patterns of rela-
tions were dominating the Portuguese vessels. Fluidity is an empirical discovery. It is not sim-
ply a result of researchers’ wish to describe the ephemeral, the varying, the invisible and over-
seen. It is very much due to the different empirical fields in focus of after-ANT studies: medical
practice, staff developing workshops, a local community pump. These fields are different from
classic-ANT preferences for facts and large technological systems. Facts and large technological
systems may indeed also involve fluid patterns of relations but the do perform another level of
network stability than for instance a technology like the Femtedit online 3D virtual environ-
ment. Indeed, the ways in which patterns of relations are combined and intertwine are what
characterize different ways technologies participate in practice.

This leads to the second point about Femtedit as a multiple object. Technology use is often
described in plural terms while the technology is kept in singular. I have involved human users,
designers and other components in my descriptions of Femtedit, but my descriptions of the
fluid Femtedit do not involve more use practice than those of the Femtedit network. Both dis-
cuss design components and the ways in which they were related to make up the Femtedit de-
sign. But they made up Femtedit as two different patterns of relations. Patterns of relations that
shared components, that were intertwined and depended on each other. That made up Femte-
dit as a multiple object.

Technologies are often defined in terms of stability and in singular terms. The notion of
fluidity undermines the common understanding of technology as a system with a singular func-
tion of solving problems or fulfilling goals (Hughes 1989), and allows us to take versions of
technology seriously, which are otherwise considered residual. Taking the alternative, fluid,
version of Femtedit seriously, which is my aim in this thesis, the focus of this chapter has
turned away from how to design a technology that can work stably and predictably fulfilling a
specific goal, to focus on the varying and on what in other (network) terms would be ‘failing’.

In this first part of the thesis I have discussed the Femtedit design. First, I described how
Femtedit became a research question, emphasizing that an object is not given once and for all,
but becomes the way it does through construction processes. Following classic-ANT I contin-
ued describing the process of constructing the Femtedit design as the construction of a net-
work. This led to the conclusion in chapter 3, that heterogeneous elements are involved in constructing a design, and that ‘external’ elements are not that external since they contribute to creating the design through trials of strength. Chapter 4 turned to the components that did not quite fit into the network metaphor, and stated that Femtedit performed not just a network pattern of relations, but also a fluid pattern of relations. The fluid metaphor keeps the understanding of construction, but without however an endpoint. Furthermore, the observation that external elements are involved in making up the design is kept in the fluid metaphor, but here the external elements contribute differently, as friends, not as opponents. Taking the fluid pattern of relations of Femtedit seriously, I shall in the rest of the thesis explore the performative effects of especially the fluid characteristics of Femtedim participating in practice.
Chapter 5

Ephemeral events through method of contrasting

While part one of this thesis dealt with designing the online 3D virtual environment to take part in school practice, part two and three turn to some of the effects of the online 3D virtual environment taking part in a six weeks project in St. Marc Street School. They do this by contrasting the Femtedit practice with classroom practice. Chapter 2 presented the research design for the Femtedit study and chapter 3 and 4 presented the online 3D virtual environment design. In this chapter I present some additional aspects of the methods applied that are especially relevant for the analyses in part two and three. These concern my research position and data selection in the Femtedit project and how these affected the descriptions to be presented in part two and three. I discuss the classroom study in more detail, with which the Femtedit study will be contrasted in part two and three. Furthermore, I present the analytical strategy of contrasting the online 3D virtual environment with classroom learning materials. I argue that this method is a way of performing ephemeral events, and hence a movement from classic-ANT to after-ANT.

Research design of the in-school online 3D virtual environment study

Research position

The teachers of the 4th grade class had wished to have a position during the Femtedit project with an overview of the whole class even though we had suggested that they participated in the same way as we did, engaging with what was going on in the online 3D virtual environment. However, we accepted their wish which they argued was mainly motivated by a feeling of technical insufficiency. We had had one ‘training session’ with them in the online 3D virtual environment, which had taught them the basic functions but apparently had not given them a sense of proficiency.

The researcher’s tasks were to support and encourage the children to move on with whatever they were doing during the Femtedit sessions. This was not the typical relation children had to their teachers, as I discuss in part three, but because our stay in the class was relatively brief, I have no reason to expect that the children developed a specific relation to us, but rather
took us as teachers. Our positions in the Femtedit project were the ones teachers would neces-
sarily have taken had there been no researchers.

During the Femtedit sessions I was positioned in the computer lab of St. Marc Street
School. I had very little impression of what was going on in Pine Valley School in Sweden with
whom we were collaborating. I read my Swedish colleagues’ accounts and discussed with them
every week, but these data were terribly scarce compared to the richness of my experiences
from taking part in the Femtedit project in St. Marc Street School. Therefore, I decided to fo-
cus only on the online 3D virtual environment’s participation in St. Marc Street School. We
may see this as a methodological weakness of the research design. However, we may also see it
as data already informing us about how the online 3D virtual environment took part in school
practice, about the circumstance that the virtual environment, although on the Internet and
accessible from any online computer, did not give all users the same access. I discuss this fur-
ther in part two and three.

Data selection
As described in chapter 2 (p.39) the data generated during the Femtedit sessions were of vari-
sous kinds: field notes, discussions in the research forum, the Femtedit online 3D virtual envi-
ronment, screen shots, chat files, blogger, and video recordings. I used data from all types of
sources for the descriptions in part two and three, but my own field notes were guiding the
descriptions and the most frequented source just as it was the case in part one.

While all sources of data were used, I only used a minimum of the total amount of data. I
was familiar with most of the data having read all field notes, all researcher discussions and all
bloggers, seen all the Femtedit online 3D virtual environment, read many of the chat logs and
watched several of the video recordings. The data that entered my analyses were selected due to
what was relevant in the course of pursuing the issues of knowledge and presence.

Part two and three both take as a point of departure a more or less explicit problem the
teachers had with Femtedit. These concern forms of knowledge and forms of human presence,
respectively. Because the teachers were the persons who had granted us access to the class, we
were accountable to them and therefore especially sensitive to their reactions to the project. But
their reactions were also particularly relevant because if an online 3D virtual environment was
to be used in school practice apart from our project, the ways in which teachers would deal
with it was of key importance. This is one of the reasons why I decided to follow the issues that
were problematic for the teachers. Another reason is that my participation in the Femtedit pro-
ject as a teacher made me experience and get engaged in the problems and issues of teachers. Thereby, my field notes to some extent perform a teacher’s perspective. Finally, the problems of the teachers are very often also the problems of the school, which is another reason why it makes sense to take these problems seriously.

Because of this mix of the researchers’ and the teachers’ positions during the Femtedit Sessions, I discuss the teachers’ as well as the researchers’ presence in terms of teachers in part three. This is mainly because it makes the analysis more focused. But there are also other reasons: In front of the children the researchers’ positions were similar to at least some of the teachers’ positions during Femtedit sessions.

In selecting the data I read through the field notes several times looking for material that would tell me anything about the knowledge and presence performed with the Femtedit online 3D virtual environment. This always led me to look into other data sources: chat files, other researcher’s field notes, the online 3D virtual environment itself, blogger, etc. New perspectives thereby arose, which took me back to reading through parts of the field notes again, etc. The data analyses proceeded as a journey between different data sources, following the questions and perspectives that the reading of each one gave rise to the other data types. Hence, the data analyses also followed a spatial pattern, taking a point of departure in the online 3D virtual environment, step for step carefully following the relations and objects it was entangled in, and noting which pattern of relations were formed, which could in any way describe knowledge and presence respectively. The use of several sources of data was not a triangulation (or ‘pentagulation’) since such an approach implies the imaginary of one reality behind the data produced. This view is inconsistent with my spatial imaginaries. The different sources of data were taken as different versions (Despret 2004a; Mol 1999; Mol 2002) of the online 3D virtual environment, of knowledge and of presence.

**Classroom research design**

Apart from reporting the Femtedit project part two and three concern classroom practices of the same 4th grade class and their two teachers. Furthermore, a teacher assistant attended the class during two lessons of my stay. What is a classroom observation doing in a thesis about an online 3D virtual environment? Why would I want to study the classroom, where the object of study was not present? It was motivated through repeatedly experiencing that the after-school FEMTEDIM project was constantly compared to school, to classroom practices, to educational methods, to peer relation in the class, to the relations between pupils and teachers, etc. These
comparisons were made by colleagues and teachers with whom we discussed the project but also by the children who took part in Femtedim and by ourselves. Even though none of the researchers focused on the educational implications of the online 3D virtual environment, educational agendas were all the time stealing upon us. There may have been many reasons for this, among these the predominant understanding of children as incomplete adults and of childhood as a phase of becoming (e.g. Christensen & James 2000; Lee 2001). But more than that, we should not forget that Femtedit was taking place in a school building, that children were recruited for this research project in school through their teachers, and that the relations between the children were rooted in the school. This ‘school’ that was repeatedly implied, questioned and compared to made me curious. I was curious to know in what ways other learning materials took part in classroom practices. Without any detailed research agenda and without expecting the classroom research to become any major part of my thesis, I made an appointment with the 4th grade class teachers to visit the classroom for one week with the aim of getting an impression of the ways in which learning materials participated there.

To my surprise the classroom observation turned out to be given a central place in this thesis. What I didn’t realize then, was that studying the classroom was in accordance with the spatial imaginary discussed in chapter 2 (page 23). Following the online 3D virtual environment and relations in which it is entangled step-by-step, relation for relation did not only mean staying in close contact with the online 3D virtual environment. On the contrary. It was an empirical fact that school practice repeatedly got woven into the discussions and interactions with the online 3D virtual environment. Following the relations in which the online 3D virtual environment was entangled implied following the relations into classroom practices. It was not until I started making the descriptions of the online 3D virtual environment presented in part two and three that I realized how informing the comparison of the virtual software with the classroom materials was for the understanding of the online 3D virtual environment. I return to this below. First, I present the classroom observation with a little background.

Classroom ethnography background

The term classroom ethnography covers a broad body of research, among which are:

- the role of the teacher, and the organizing of teaching
- subject matter didactics (often mathematics and science studies)
- the characteristics of the interaction and talk within classroom settings
• construction and implication of ethnicity, gender and social groups, etc. (e.g. Klette, Kirsti 1998).

Just as the topics are varied, so are the methods applied in classroom ethnography involving:

• linguistic or rhetoric analysis of video or audio-recordings
• participant observations and conversations often assisted by video or audio-recordings and field notes
• action research, where the teacher is involved in the research process as a means towards evaluation and development of her work practice (op cit).

Classroom ethnography sees the classroom as a social reality constructed through ongoing negotiations among participants. According to classroom researchers Lindblad & Sahlström (1998) classroom ethnography is the most common present-day method in classroom studies.

As I wrote in chapter 2 (page 32), my presence in the classroom was so brief that it probably doesn’t deserve to be called ethnography. However, being only one part of a larger multi-sited ethnography I will keep this label, and carefully draw the conclusions the limited data allows.

Research position and data collection

I accessed the classroom through the teachers with whom we already had contact due to the planning of the Femtedit project. I told them that my interest was to study the ways in which learning and other materials were involved in classroom practice, and they accepted my wish to sit quietly at the back of the classroom with a notebook and to let a video camera run in the corner of the classroom recording a wide angle of the classroom. The first morning, I presented myself to the class. I told them what I would be doing, registering and recording in the class, and for how long.

From my position at the back of the classroom I had a good view of the class. I was committed to a ‘nomadic’ form of observation. I wanted to study the variety of what went on with and around learning and other materials in the classroom. This was why I decided upon an attitude of not dwelling too long with any material or interaction. I needed to observe a material long enough to get a sense of what it was involved in, but I wanted to be careful not to give any materials priority over others. I expected that some materials would be more conspicuous than others. I expected that I myself, like the other humans in the classroom, would be absorbed by the unfolding of the practice which would put some materials in focus and make others disappear. And I expected furthermore, that the materials in the focus of the classroom practice also would be the ones I would have a tendency to focus on, even though they
might not be more important for the performance of the classroom activities than inconspicuous ones. Therefore, I was committed to a nomadic gaze, to force myself not to focus too much and too long on the same materials, but let my gaze travel the classroom from material to material to experience conspicuous as well as inconspicuous materials.

My blue notebook, my pen, my position at the back of the classroom and my nomadic attitude towards learning and other materials were my devices for producing field notes during my classroom study. My position in the classroom practice was that of a participant observer (Hastrup & Ovesen 1985). I was more of an observer than of a participant, but compared to other studies of public behaviour in the street using covert observation from a window or observation of nursery school children through a one-way mirror (Hammersley & Atkinson 1995 p.107), I was indeed a participant. I took part in neither the learning nor the teaching. I was so busy with noting what I saw and heard that I often was quite incapable of taking part in the learning activities. My way of participating was different from any other participant in the room. But it was nonetheless participation. By my sheer presence I was drawn into the practice as a participant. Pupils, for instance, were interested in what I did, asked what I was writing, and sometimes acted in front of me in order to enter my notes. Similarly, one teacher often made a kind of stage direction in which she was commenting to me on what was going on while teaching. During one lesson for instance she looked at me and said, “this is when it can be a bit difficult to proceed as planned”. A comment she obviously would not have given had I not been present. Furthermore, I wrote in my field notes by the end of the week:

I’m happy my fieldwork is soon over. The teacher more and more often reprimands or corrects the children that I am or just have been observing, even though they sometimes just play a bit with legitimate materials. I feel like a radar that directs her attention to where something is happening.

Field note 2909_93

102 pages of handwritten notes and 16 hours of video recordings were the data resulting from my classroom observation. Furthermore, I made a group interview with the teachers of the class about their use of learning materials. This interview was recorded. I read through the 102 pages of field notes several times, I listened to the recorded interview and I watched video recordings of sequences described in the field notes when I felt the written notes gave a too poor description or when I felt the need for help to remember what had happened in specific situations. Just as it was the case with the data selection from the Femtedit project, the selection of data from the classroom observation was selected because of its relevance to the course of pur-
The method of contrasting

I had not expected the classroom study to play any major role in this thesis. What happened was that I identified an issue of knowledge and one of human presence with the online 3D virtual environment. Looking through my field notes from the Femtedit project to find data about knowledge, I was all the time reminded of what I had seen in the classroom. I understood the data from Femtedit through the data of the classroom. I turned to the field notes from the classroom and started describing how knowledge was performed there. This made me associate back to the online 3D virtual environment. I understood the classroom through the Femtedit data. The descriptions of the classroom raised new questions about knowledge with the online 3D virtual environment, and I turned to the Femtedit data and continued the descriptions about knowledge there. The same happened when describing human presence. Through these pendulum movements between classroom and Femtedit data new aspects appeared relevant in each place over and over again, which repeatedly swung the pendulum back and forth to compare or contrast the two sets of data.

Analysing the data by contrasting sets of data was fruitful, as I hope it becomes clear in part two and three. It incited a richness of subtleties and details to be described about how the online 3D virtual environment participated in school practice. Since the online software is the focus of the thesis, I could have left out the descriptions of the learning materials in the classroom. However, firstly you need to read the descriptions of how the learning materials participated in the classroom practice in order to understand the contrast. Secondly, what went on in the classroom must be taken as the ‘business-as-usual’ in school, and when introducing a new technology, you will always be confronted with this ‘business-as-usual’ as the point of departure for your intervention. It may even be the resistance to your intervention, as was partly the case with the Femtedit project. In the enormous amount of literature existing on technology in education, technology is usually taken to be computers or other high technology, and the ways in which the already existing and functioning technologies or materials take part in the concerned practices are hardly ever discussed. As if it didn’t matter. As if the new technologies would just
slip into practice without any resistance or without any efforts. In chapter 2 I argued that this is not the case. The ways in which low technology learning materials participate in practice is indeed crucial for understanding how digital technologies participate.

Because a description written in an oscillating manner jumping back and fourth between classroom and online 3D virtual environment would complicate the presentation, I present the descriptions of classroom and online 3D virtual environment separately giving each a chapter of part two and three. Apart from producing clarity this has the advantage of creating a more cohesive picture of what went on in each of the two places.

The contrasting descriptions of classroom and online 3D virtual environment in part two and three are not one-to-one comparisons. I did not look for the same variables in the classroom and online 3D virtual environment to study how their values varied. I did not check for instance how much was learnt in the classroom and how much was learnt with the online 3D virtual environment. I did not run similar tests in the two places to see how they scored differently. No, if we stay within this vocabulary, I rather asked what the variables were in the two places. How did the materials participate differently here and there? I call the different ways of participating and the different patterns of relations I identify different forms of knowledge and different forms of human presence. By talking about forms I want to emphasize that I am not looking for more or less knowledge/presence or better or worse knowledge/presence, as if these were singular objects with a more or less complete appearance. Instead, I am looking at how knowledge and human presence were performed as different patterns of relations, which however in one way or the other share the identity of being knowledge and presence, respectively. Secondly, the notion of forms emphasizes the plural reality of these objects. There is not one knowledge and one presence; there are multiple forms of knowledge and multiple forms of presence. Finally, with form I hope to emphasize the spatial materiality of the objects – it is about how they are formed through patterns of relations as discussed in chapter 1. How they are performed.

Because the differences between the different forms of knowledge and human presence were substantial, it was necessary to study and describe the two (and often more) ways of participating differently. For instance, in the description of the online 3D virtual environment I describe the relationship between only one teacher and one child, in contrast to my description of the

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38 Discussing new media Drotner (Drotner 2001) has emphasized a similar point, namely that ‘old’ media influence and are intertwined in the ways in which ‘new’ media are used, which is why it is essential to involve ‘old’ media in the study of the ‘new’.
Method of contrasting classroom, which involves a teacher and many pupils, in fact the whole class. The difference in descriptions appears not because of different researcher perspectives. It appears because of differences in the pattern of relations performed in the classroom and in the online 3D virtual environment. As I describe in chapter 9, the virtual world did not allow teachers to relate to much more than one child or at the most a few at a time, as we shall see. Contrasting the one-to-many relationship in the classroom with the one-to-one relationship with the online 3D virtual environment is not like comparing apples and pears. It is comparing the ‘business-as-usual’ here with the ‘business-as-usual’ there. And what is interesting is precisely to describe the patterns of relations that constitute these different ‘businesses-as-usual’, and not to define variables to compare the ‘same’ across the two places.

**Conclusion: Describing ephemeral events**

...there is a sense in which actor-network theory is much more able to describe steely accumulation than lightning strikes, sustained longings and strategies rather than the sharp movements that may also pierce our dreams. Actor-network theory is good at describing certain intermediated kinds of effectivity, but, even though fleet Hermes is one of its avatars, dies a little when confronted with the flash of the unexpected and the unrequited.

*Thrift 2000 p.214*

This quote mainly addresses classic-ANT, which is about construction stories, about networks, about drawing things together. This is the kind of story that has dominated part one of this thesis, even though I have mixed in multiplicity and fluidity. In 1999 the book *Actor Network Theory and after* was published. It marks a shift in Actor-Network Theory between what I call classic-ANT and after-ANT. Even though it is far from its aim, even though fleet Hermes is one of its avatars, classic-ANT tends to produce descriptions in which everything adds up. Descriptions that end up with a complex but coherent and singular network, machine or world. The problem is the focus on construction. The focus which I celebrated so much in chapter 2 and 3 because of its capacity to make matter matter in empirical studies. For making us understand how materialities come together. I do not withdraw these points. And I believe construction stories are useful for understanding and emphasizing that materials are indeed prepared for practice. Materials are in particular ways such that allow them to connect to some materials and not to others. I think this is important armour against social constructionism. But in Latour’s descriptions as well as in Foucault’s all the materials, all the contingencies and particularities tend to adds up and tensions, conflicts, irritations, etc. tend to disappear. We can breathe a sigh
of relief and say: oh, those microbes finally got tamed; ok, those facts were finally settled; ah, that’s how the Diesel engine came to work. There is always a conclusion that ends the war, that settles the negotiations, that quietens the noise. As Geographer Nigel Thrift points out this also has the consequence that everything fits so nicely in the network analyses. You hardly encounter any surprises. Which is a problem because this may not be the only way that things are. There may be noise that continues, negotiations that never settle, changes that never come to an end. Even technologies that keep producing new effects. That keep surprising.

One of the endeavours of after-ANT is to understand the flow of things, to allow surprises, to think in terms of performance rather than in terms of construction. Performance tends to go on. Construction tends to come to an end. In my construction story in part one I showed how designing and construction went on even after entering into use practice. The contrasting method I use for describing participation of online 3D virtual environment and other learning materials in part two and three does something different. It does not produce a construction story. It tells about ephemeral events, about short moments, about how events are shaped as they happen. Here and there. But now, at present. In the classroom and with the online 3D virtual environment.
Part Two

Forms of knowledge

The second and third part of the thesis concern the performative effects of the fluid way in which the online 3D virtual environment participated in school practice. Especially the effects of fluid patterns of relations are in focus. I compare the patterns of relations performed with the online application with the patterns of relations performed by and through learning materials in the classroom. This second part of the thesis is about the ways in which learning materials and their patterns of relations contributed to performing forms of knowledge in St. Marc Street School. Especially, it is about three different forms of knowledge – representational, communal and liquid – performed with different learning materials.

I was inspired to study the forms of knowledge performed in St. Marc Street School by one of the teachers' comments on Femtedit: “It doesn't resemble reality”, she said. She was commenting on the activities with the online 3D virtual environment and especially on what she saw on the computer screens as the children were engaged with saving the Femteditians in the virtual world. My colleague Nina Armand’s field note describes the situation like this:

*I went up to Grethe and said that I appreciated her helping Ronny to find codes for the objects he wanted to build. She answered by saying that she couldn’t see the children were learning anything, that it was frustrating for them not to all learn the same and that many of them did not know what it was all about. She and the children had expected to link to web pages and discuss with the Swedes about what to build. She couldn’t see any collaboration, and they built all kinds of mixed up jumble. It didn't resemble reality. She would have preferred, she said, if they had sketched out a Viking village and learnt to plan how such a village could look like. She didn’t understand, she said, why we didn’t initiate each lesson by telling the children collectively what they had to do.*

*Nina’s field note 1511_1*

The teacher’s critique forms a puzzle to be solved in part two of the thesis. Especially Grethe’s complaint about the lack of resemblance will be in focus. I describe the patterns of relations performed with the online 3D virtual environment and look at how it was possible that a mixed up jumble was performed which had no resemblance to reality and displayed no collaboration. This will be described in chapter 7. Chapter 6 describes the patterns of relations performed in the classroom and looks at how a less mixed up knowledge was performed which had resemblance to reality and was common to the whole class.
In the STS literature you find descriptions of scientific knowledge that have some of the same characteristics as those of the forms of knowledge performed in school. I therefore let discussions of scientific knowledge alternate with those of school knowledge in the next two chapters. Especially, I refer to a classic in the history of science literature, historians of science Steven Shapin & Simon Shaffer’s book *Leviathan and the air-pump* (Shapin & Schaffer 1985).

Sociologist of science Andrew Pickering (1995) describes how the study of scientific knowledge until the late 50s mainly was about different sciences as bodies of knowledge; collections of empirical and theoretical propositions about the world. The questions asked by for instance the philosophy of science regarded the formal relations between these propositions, their logic and integrity. Among others Kuhn’s (1970) work on the periodization of the history of science undermined the understanding of science as self-contained bodies of knowledge. Kuhn depicted periods of ‘normal science’ succeeded by ‘revolutionary’ periods, which again would be followed by ‘normal science’, etc. Thereby, a procedural element was introduced in the understanding of knowledge contrary to the timeless bodies of scientific knowledge depicted by philosophy of science. According to Pickering, sociology of scientific knowledge (SSK) has since the 70s increasingly documented the importance of the human and the social contributions in the production and use of scientific knowledge. Social structure, social interests, and human skills came to be seen as constitutive of science and scientific knowledge. Additionally to the procedural and social elements of knowledge SSK highlighted the material elements of science and its extensive use of machines, instruments, apparatus and experimental set-ups. From the late 70s this led to studies of the procedural, social and material arrangements of science, through ethnographic and other studies of performance of science, and construction of scientific knowledge (eg. Latour & Woolgar 1986; Traweek 1988).

Such studies of everyday conduct and construction of knowledge are not just realized in laboratories and universities. Anthropologist and learning theorist Jean Lave (1988) has studied the use of mathematic knowledge in everyday practices in supermarkets. Lave & Wenger (1991) have followed the use and negotiation of knowledge in diverse communities of practice such as Yucatec midwives, Vai and Gola tailors, meat cutters and non-drinking alcoholics. Cultural Anthropology and cognitive scientist Edwin Hutchins (1995) has observed how naval quartermasters use knowledge in their daily practice on the US marine transporter U.U.S Pa-

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39 See also my study of how children in supermarket situation apply knowledge achieved from playing health education computer games (Sørensen 1998).
lau. And linguist Charles Goodwin (1994) has explored the construction of ‘professional vision’ in archaeologists’ practice and in court room practice. These studies approach knowledge in *practice* emphasizing in varying degrees the procedural, social and material elements of the construction of knowledge.

Even though the approaches applied in these studies vary, they are all more or less ethnographical, all studying knowledge ‘in the wild’ (Hutchins 1995). They all look at knowledge as part of practice and provide thereby a quite different image of knowledge from that of knowledge as mental, abstract, or formal. Approaching knowledge as practice also implies that knowledge is not singular. Wittgenstein states that “if a concept depends on a pattern of life, then there must be some indefiniteness to it” (ref. Thrift 1996, p.32). If we state the same about knowledge, then not just some indefiniteness appears to be an aspect of knowledge but also variation. Because obviously patterns of life vary and if depending on life, knowledge must vary as well. It is this variation I am after. I am interested in different *forms of knowledge*, as I shall call them, emphasizing that what I want to produce is not a definition but descriptions of the different ways in which forms of knowledge are performed in practice. Hence, I shall over the next two chapters approach knowledge in a similar way as the authors mentioned above.

The descriptions of forms of knowledge in the classroom and with the online 3D virtual environment are results of oscillations between materials from the two places, as described in chapter 5. I set off by looking at the classroom and describe a few learning materials, the patterns of relations they contributed to perform and the forms of knowledge that emerged as an effect of these patterns of relations. After first describing the forms of knowledge of the classroom (chapter 6) I return to the online 3D virtual environment and from the point of departure of what I saw in the classroom I look at what took place with the online 3D virtual environment; which patterns of relations were performed and through this which forms of knowledge (chapter 7).
Chapter 6

Representational knowledge in the Classroom

The teacher had complained that the online 3D virtual environment lacked resemblance to reality. I turned to the classroom to see if I could find things that ‘resembled’. And I found resemblance. In this chapter I describe some of the learning materials of the classroom and the patterns of relations they contributed to performing. Furthermore I characterize different patterns of relations as different forms of knowledge. One of the learning materials is the one-meter ruler. It contributed to performing a regional pattern of relations, I argue, and I present the third of Mol & Law’s spatial metaphors: the region. I jump 350 years back in time to Boyle’s air-pump experiments and describe the three technologies involved in producing ‘proper knowledge’ (Schaffer & Shapin 1985). This form of knowledge is representational. Like the resemblance I found in the classroom\(^40\). This form of knowledge is the dominating form of knowledge in school. However, there were other patterns of relations performed in the classroom. There were other alternative forms of knowledge performed. I present another field note and discuss other products created in the classroom. Products that did not involve resemblance. They performed a communal form of knowledge that circulated in a network of relevant partners from outside the classroom. Both representational knowledge and communal knowledge were dependent upon elements beyond the walls of the school, I argue. In different ways they both made the class and its knowledge ‘bigger than itself’.

Classroom demonstration

Let me report from my field notes. We are in the classroom. It is a maths lesson:

*The teacher is standing next to her desk with the textbook in her hand, reading out loud*

\(^40\) I use ‘resemblance’ as synonymous with ‘representation’. The Danish word Grethe used was ‘ligner’. As the English ‘resemblance’, ‘ligner’ may signify ‘correspond to’ as in ‘represent’, but it may also signify ‘similar to’ as in Wittgenstein’s ‘family resemblance’. Grethe’s said that it did not resemble reality which I indicates that she used ‘ligner’ in the meaning of ‘represent’ rather than ‘similar to’. This reading is supported by her additional comment of preferring that the children had built a Viking village, implying that in that case, what was built in the online 3D virtual environment would have been a representation of something ‘real’ – a Viking village.
T: “4th B are doing physical education. Today they are on the athletics pitch. They do long jumping. First, it is Jens’ turn. He runs as fast as he can and jumps. Mette is the linesman. She takes out the tape measure and measures his jump: Two meters”.

The teacher looks up from the book.

T: Two meters – is that a long or a short jump?

Three children raise their hands. Kim doesn’t.

T: Kim – two meters, is that a long or a short jump?

Kim looks bewildered at the pupils around him, but no one comes to his rescue.

K: Short... [low voice]

The teacher walks towards the blackboard

T: Well, Kim... let’s see...

She takes a piece of chalk and a big one-meter ruler down from a hook on the wall. She turns around and walks towards the middle of the classroom.

T: Come here, Kim.

Kim walks over to her.

T: Ok, stand here...

The teacher draws a chalk line on the floor. Kim looks at it and shuffles his feet.

The teacher walks backwards towards the blackboard.

T: So... just stay there.... Kim, now jump from that line ahead as far as you can.

Kim looks at her, looks back at the chalk line, takes a step back and jumps ahead with great effort.

T: Stay there, stay there...

The teacher grabs Kim’s shoulder. She bends down and draws a chalk line on the floor where he stands.

T: Ok, Kim. Let’s see how long you jumped. This ruler is one meter long.

The teacher puts the ruler on the floor and measures the length between the two chalk lines.

T: Ninety... three centimetres... Almost one meter... You jumped 93 centimetres. Not too bad. So... what do you think? Jens jumped two meters. Was that a long or a short jump?

K: Long.

T: That’s right, Kim. Two meters is quite a long jump... Now, please sit down.

Field note 2609_82

Knowledge is performed in this sequence. Knowledge about the length of Jens’ jump. This was done through the use of a standard measurement instrument, the one-meter ruler. This standard allowed the teacher to compare two entirely different activities. If he had been able to refer to the standard, Kim could have known the answer in advance as to whether Jens’ jump was long or short, without jumping and measuring. But Kim wasn’t familiar with the metric standard, and so he couldn’t make much sense of the length of Jens’ jump from the teacher’s reading of the maths textbook. Through the teacher’s nice little demonstration Kim gained bodily experience about the length of a jump. But this still wouldn’t allow him to compare his own jump with Jens’ from the maths book because Jens’ jump was only presented as a measurement. If Jens had been jumping next to Kim in the classroom, they could have gained knowledge about their jumps through direct comparison without needing to involve any measurement. But since Jens was absent from the classroom and only present in the book, knowledge about Jens’ jump could only be gained by involving the standard measurement.
This is the amazing work of the standard. It can link two distant and entirely different situations. And it can do this only because it is isolated from each of the two. By each of the jumps being known through their reference to the standard measurement, they could be compared to each other. But remember, the standard did not do this on its own. Kim jumped. The ruler was placed and read. And the teacher drew chalk lines on the floor. These things and these efforts were not unimportant. Without them, the knowledge about the length of the jumps could not have been performed.

However, the result of the demonstration did not involve all these heterogeneous elements. The result was that Jens’ jump was long. This result was the knowledge Kim in principle could have held prior to the demonstration which would have rendered the demonstration redundant. In the knowledge resulting from the demonstration the efforts of the ruler, the chalk lines, Kim’s bodily efforts and the witnessing were all discounted. The resulting knowledge was pure and simple. Kim’s jump was 93 cm., which rendered Jens’ jump long. The knowledge about the length of the jump was performed not as residing in the material activities of the classroom but in the reference to the standard metric measurement.

The standard was beyond the jumping demonstration in the classroom. It was somewhere else. The knowledge performed was referring to something located elsewhere. Here was the resemblance. The measurement of the length in the classroom, the measurement of the length in the book and the standard metric measurement. They resembled each other. They were all metric measurements. Kim’s jump resembled reality – as long as we can render the standard measurement reality. This resemblance involved a boundary between the activities in the classroom and the standard measurement. The activities in the classroom simply contributed to revealing knowledge about the length, while the standard was beyond the classroom and referred to from the classroom. There is a spatial metaphor that fits well to characterize this form of knowledge performed in the classroom: the region. Let me turn to that.

**Regional pattern of relations**

I will briefly leave the classroom and introduce the regional imaginary. The region is the third and last of the spatial metaphor presented by Mol & Law (1994) that I discuss in this thesis. Something performed as a region takes the shape of a container or field in which objects are located, where people act or where entities belong. Think of a map. You can point at a map and say: “look, there are the mountains, there is a forest, there is the city”. Maps perform regions because they are each defined by their content: rocks, trees, houses. It is a forest because
it consists of trees. The region is defined by what is in it: a school is a region for teaching, a club is a region of members (Elgaard Jensen 2001), Dutch anaemia-diagnostics is a region for measuring haemoglobin levels (Mol 1999), etc. The regional pattern of relations is performed in a way that makes what is inside it homogeneous in the sense that all inhabitants of the region have the same regional identity or are all of the same kind.

The relationship between content and field is not simple in the regional imaginary. It is not necessarily the case that the content defines the region, i.e. that you see a clump of trees and know it’s a forest. It may also be the case that you define a region to be ‘Denmark’ of which follows that inhabitants, traditions and things within this region are Danish. It goes both ways. Content and field mutually define each other in the way regions are performed: trees define the field to be a forest, while the forest defines the content to be trees. Denmark defines the content to be Danish, just like the Danish content defines the field to be Denmark. Or you identify a group of people to be women and consequently, what they do is female.

Furthermore, regions have boundaries. The forest, mountains and cities are performed with certain, limited extensions. Just as regional genders are. It may be difficult to define the boundary of the city, but in principle a specific point can only be either inside the city or outside of it. A road sign tells you when you leave the city and documents at the City Planning Division displays its boundaries for you. Because of difficulties in defining the boundaries, you may define sub-regions of suburbs and settlements, but that doesn't change the circumstance that the region is always performed with a clear inside and outside – of regions or of sub regions. In the regional imaginary you are either in the school and involved in teaching/learning practices, or you do not belong to the school. Either you are a member of the club, or you are not. Either you measure the haemoglobin level, or you don’t belong to the Dutch anaemia-diagnostics. Regions have boundaries; they have inside and outside.

You may object, noting that there are cleaning staff in the school, that there is a hierarchy of members in the club, that it does happen that a nurse in the Dutch anaemia-diagnostics system looks into her patient’s pale eyes and without measuring the haemoglobin level concludes he suffers from anaemia. That there are “queer” genders (Butler 1993). You may claim therefore that the content of the school, the club or the diagnostic system is not that homogeneous. Indeed, you may be right if you are arguing in terms of network or fluid imaginaries. But not in regional terms. The ‘different’ is not what defines the inside of a region. In the regional imaginary differences inside the region are suppressed. If you are inside a region and don’t fit the definition of the regional identity, then you are performed as an exception.
While similarity is to be found inside regions, differences in a regional pattern of relations are performed between regions, across boundaries. There are the different ways of diagnosing anaemia in the Netherlands and in Africa, city and countryside are different in population density, Sweden and Denmark are different nations. Men and women. Compare a region with another, and you will find differences.

Finally, regions are stable, immutable. The descriptions of the region as fields with boundaries, with homogeneity within and differences between is not a very dynamic description. The region is rather a firm structure. It is a pattern of relations that stays as it is, where it is. Table 7 compares the regional pattern of relations with network and fluid.

<table>
<thead>
<tr>
<th></th>
<th>Networks</th>
<th>Fluids</th>
<th>Regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>General description</td>
<td>Web of elements with well defined relations between them.</td>
<td>Generates possibility of invariant transformation.</td>
<td>Homogenous fields divided by boundaries.</td>
</tr>
<tr>
<td>Elements within the pattern of relations</td>
<td>Actants, which are heterogeneous objects that receive their identity through their relations in the network.</td>
<td>Objects are not well defined, bonds are not fixed. A world of mixtures; components a) may or may not be separated; b) inform each other, but the way may continuously alter.</td>
<td>Homogeneous objects clustered together with boundaries around. Defined by closure.</td>
</tr>
<tr>
<td>Relations between elements in the pattern of relations</td>
<td>Relations are defined by proximity in relations. Objects that go together depend on each other.</td>
<td>Changing.</td>
<td>Relations are defined by their position within the same region.</td>
</tr>
<tr>
<td>Stability of the pattern of relations</td>
<td>Actants hold each other and the network in place.</td>
<td>Ongoing transformation, continuity.</td>
<td>Boundaries keep differences inside suppressed.</td>
</tr>
<tr>
<td>Dissolution of pattern of relations</td>
<td>When linkage inside network start to vary the network starts to dissolve.</td>
<td>When the fluid space no longer absorb their surroundings.</td>
<td>When differences within region start to emerge.</td>
</tr>
<tr>
<td>Displacement of pattern of relations</td>
<td>The whole network moves as one.</td>
<td>Fluids continue from one place to another – involving new elements, varying its form.</td>
<td>Immobile.</td>
</tr>
<tr>
<td>Transformation of pattern of relations</td>
<td>Once constructed the network is immutable. It doesn’t transform.</td>
<td>Fluids transform themselves from one arrangement into another without discontinuity.</td>
<td>Immutable. Doesn’t transform.</td>
</tr>
<tr>
<td>Differences</td>
<td>The network’s opponents are dissociated or turned into allies.</td>
<td>Differences and similarities come in varying shades and colours – they go together. It is not possible to determine a) inside from outside; b) identities nice and neatly, once and for all.</td>
<td>Differences exist between spaces.</td>
</tr>
<tr>
<td>Similarities</td>
<td>Allies are integrated into the network.</td>
<td>Similarities lie within space. Variables inside regions are averaged and fixed.</td>
<td></td>
</tr>
<tr>
<td>Norms</td>
<td>Different norms may stay within the network as long as the keep each other in place.</td>
<td>Normality is a gradient rather than a cut-off point.</td>
<td>Each region has its norm. Different norms exist across regions.</td>
</tr>
<tr>
<td>Form and displacement</td>
<td>Immutable mobile</td>
<td>Mutable mobile</td>
<td>Immutable immobile.</td>
</tr>
</tbody>
</table>

Table 7  Network, Fluid and regional patterns of relations.
Regional knowledge in the classroom

We return to the classroom. In the description of the field note excerpt above, I showed how knowledge by use of the standard measurement was performed as referring to something somewhere else. Two regions were performed. Before the jumping demonstration knowledge was performed as residing in a region of thoughts, ideas and knowledge inside Kim (probably in his head) from which it could be derived and spoken out. This mental knowledge was performed as referring to another region, the one-meter standard measurement which was delimited and separate from the first. The one-meter measurement belonged to a region of exact measurements and facts about distances – a region of different kinds of entities than the knowledge inside Kim. The knowledge would not necessarily be inside Kim. It could be in a textbook as a written representation, in images, on the blackboard, etc. No matter where this form of knowledge is located it is performed as separate from and referring to another region, to that which it is about. And it is performed as different from what it is about – it is a representation while what it refers to is reality.

Because Kim could not deliver the knowledge about Jens’ jump, the knowledge had to be constructed in the classroom. If Kim and Jens had both been present in the classroom jumping next to each other and comparing the lengths of their jumps there would not have been any regions performed. The form of knowledge hence performed would be in the activity, in the bodies, the jumps. Or more precisely, it would not be in the activity, it would be the activity. It would be the bodies, the jumps. There would be no reference to anything anywhere else. This form of knowledge would be performed as local, as embedded in the assemblage making it up.

But Jens wasn’t there. The meter measurement enrolled to bridge Jens’ absence with Kim’s presence. By making both of them refer to the same standard, which was separate from them, their jumps could be compared. This way, the length of Kim’s jump was performed as mirroring the length given by the standard measurement.

In order for this regional pattern to be performed, the two regions had to be stable. If the standard would change and be sometimes longer, sometimes shorter, it would not work to bridge the jumps. The jumps could only be compared because the measurement Jens had used to measure his jump was exactly the same as the measurement the teacher used to measure Kim’s jump and that it had not changed in the meanwhile. The stability of the standard measurement was crucial.
The other region, the one performed with the jumping demonstration in the classroom, also had to be made constant. If it would vary, the comparison would not be possible. The length of Jens’ jump was noted in the textbook, and due to the materiality of the printing ink, it would not change. It was immutably two meters long. The length of Kim’s jump was made constant by the chalk lines on the classroom floor drawn by the teacher. These lines performed a constant distance, without which the distance could not be measured. Even though the teacher held Kim with a hand on his shoulder his shuffling feet might not have ensured the necessary constancy for making the measurement. Finally, the other pupils contributed to the constancy of the knowledge. Witnessing the measurement of the 93 cm, they as a collective contributed to performing it as a stable and immutable figure. If one pupil would later say it was only 78 cm or it was 124 cm, he would have to convince all other pupils. This would probably be hard considering he was one against more than 20. By their bare perception of the jump as a group the pupils contributed to making the knowledge constant. What happened next was important, as I have already discussed on page 98. The result of the demonstration that was simply ‘long’. It was purified from all the heterogeneity of bodily efforts, chalk lines, witnessing, etc. Those were not the entities the teacher would want to hear about if she would rehearse measurements with the class the following day. She would want the facts; the measurements and nothing else. Thereby the knowledge resulting from the demonstration was performed as identical with the knowledge Kim was supposed to have held prior to the demonstration. Performed as residing inside Kim, the socio-material processes involved in the demonstration were black boxed.

This way, two immutable regions were performed. The form of knowledge performed in the occurrence discussed in the classroom was regional. It performed two stable regions, one referring to the other. I return to this shortly. First, I turn to a classic in Science Studies. It will teach us more about this form of knowledge.

Boyle’s experiment: the material technology

Let me turn to something completely different, which later turns out not to be that different. It is about mid-17th century debates over what counts as knowledge. Robert Boyle (1627-1691)

41 In my description of the demonstration in the classroom I make use of the network imaginary to describe the performance of the region. I show how heterogeneous elements are connected. A central endeavour in classic-ANT has been to demonstrate that regions are performed through network. That regions depend on networks. Network patterns of relations are involved in performing the representational knowledge discussed.
is a protagonist in this story. He argued for an experimental basis of the specific form of knowledge called ‘matters of facts’. He did it through pneumatic experiments. These experiments and Boyles discussions with his opponent Hobbes are thoroughly described and discussed by Shapin & Shaffer (1985). Operated by his assistants Boyle’s air-pump could evacuate the air from a transparent glass container. Or so, at least, was what he with great effort sought to demonstrate. Shapin & Shaffer describe how three technologies were involved in the production and validation of matters of fact: a material, a literary and a social technology. These three technologies were not distinct and their workings depended on each other. However, I shall deal with them separately, as Shapin & Shaffer do. Indeed, I will separate them more than Shapin & Shaffer do. In this section, I present the material technology and return to the literary and social technologies in relation to a second field note excerpt I shall discuss later (p.106ff).

We set out by taking a look at Boyle’s air-pump apparatus. As a committed contributor to the mid 17th century discussions on vacuum Boyle made dozens of experiments in pneumatics. His air-pump consisted of two main parts: a glass globe (or ‘receiver’) and a pumping apparatus. The air was to be removed from the glass globe. At the narrowing base of the glass globe it was connected to a hollow brass cylinder. To fit into the brass cylinder the glass globe was equipped with a brass device containing a stopcock. By way of this the glass globe was attached to a small hole at the top of the brass cylinder into which a brass valve was inserted. Within the brass valve was a wooden piston topped with “a good thick piece of tanned show leather” (op cit p.28) inside of the cylinder. The piston was worked up and down by means of an iron rack and pinion device, and the whole thing was resting upon a wooden frame. Boyle argued that air was pumped out of the glass globe by activating this assemblage.

Let me not dwell on this device. I am not particularly interested in the pumping of air. What is relevant here is that this material technology was carefully set up in a way that allowed Boyle to detach his findings – the matters of fact – from himself as a person. “The matters of fact in Boyle’s new pneumatics were machine-made” (op cit p.26), Shapin & Shaffer note. This is crucial. The products of the experiment, the knowledge, was observed and recorded by Boyle, but it was not he who invented it. The power of the air-pump like that of other new scientific instruments at the time – the microscope and telescope – resided in their capacity to enhance perception and to constitute new perceptual objects. Information obtained through senses assisted by instruments was preferable to those of senses alone, Boyle stated (op cit p.36). This implied a new understanding of the senses, namely that senses alone were inade-
quate to constitute knowledge. Only senses assisted by instruments and disciplined to follow the workings of the instruments could produce ‘proper knowledge’.

The machine not only degraded the senses it also factored out human agency in the knowledge it produced. Shapin & Shaffer depict how Boyle struggled with this material technology to produce ‘proper knowledge’. They present several designs of the air-pump and describe Boyle’s efforts to prevent the glass globe from imploding when air was evacuated, to avoid leakages, etc. The machine had to be carefully calibrated in order to produce factual knowledge. Its capacity to produce matters of fact crucially depended upon the physical integrity of the air-pump. The machine had to perform in a way that convinced the human witnesses that it was airtight for all practical purposes. When this was the case Boyle could lean back and state “It is not I who says this; it is the machine” (op cit p.77). The knowledge produced by the machine was superior to that produced by the human senses alone, and it was detached from human agency. The knowledge was ‘over there’ by the machine, Boyle was standing here, modestly watching, recording.

We need some context. It was the 1660s, post-civil war Restoration England. Fights over beliefs were lethal. Boyle’s construction of knowledge as separate from the domain of humans was a remarkable contribution in the battle. This form of knowledge was set apart from beliefs and opinions. It only required the humans to discover, pick up and register what nature showed. Thus, it would make no sense to fight over believes or opinions anymore. The construction of knowledge was out of the hands of humans. Knowledge simply mirrored nature. This form of knowledge created a firm boundary between the human and the natural. Furthermore, it performed a direct correspondence between knowledge produced in the laboratory and what is ‘out there’ to be known. Knowledge as a representation of what is ‘out there’. An empirical style that we still use today, Latour (1993, p.18) notes. And a form of knowledge which is even to be found in school.

**Representational knowledge**

The material technology making up the knowledge in Boyle’s laboratory created two regions: Nature acting through the air-pump, and the experimenter, who perceived and registered the knowledge, which the pump brought about. Analogous the length of Kim’s jump was given by the standard in the classroom, and the pupils only perceived and registered the knowledge, which the one-meter ruler brought about. The carefully calibrated set-up of Boyle’s experiment performed a boundary between the knowledge it produced and the human being. The knowl-
edge was simply an expression of the ‘nature’ it represented. Let me call this form of knowledge *representational knowledge*. The form of knowledge performed in the experiment and in the classroom.

Both were hardly more than demonstrations – one of the length of a jump, the other of the facts of nature. Of course, the experiment was supposed to reveal ‘new’ knowledge. But the ‘news’ of the experimental knowledge did not refer to the object of study. It referred to the knowledge – apart from the object – which was new to *us* (humans). The object was not new; it already existed – apart from us (humans). The knowledge in the classroom was performed as new to the pupils, but the reality or the standard the knowledge referred to – was performed as existing prior to and independent of the classroom activities. The experiment and the classroom shared the characteristic of performing a representational form of knowledge.

By looking at Boyle’s experimental practices Shapin & Shaffer describe that it was never entirely possible to set up a machine that unambiguously performed the boundary between man and nature. One thing was that human investments were involved in setting up the machine that factored out human agency. Just as humans were disciplined by these machines to perceive matters of fact in certain ways. Another thing is that the calibration of the machine never resulted in producing unequivocal facts. This however does not change the fact that the efforts involved in this assemblage contributed to performing a regional pattern of relations, and so is representational knowledge. The form of knowledge performed in the classroom was *purified* from the ruler, the chalk lines, the jumping body, etc., as I described42. Just like the experimental set-up in Boyle’s experiments was discounted after the experiment and only the black boxed ‘finding’ or fact of the experiment was taken into account as knowledge. The representational form of knowledge performed two stable regions with a boundary between them. The pattern of relations this *representational form of knowledge* contributed to performing was *regional*43.

42 There were of other occurrences with other materials in the classroom at which representational knowledge was performed. Textbooks are good examples. They are representational in character. They talk about something that exists somewhere else. Law (Law 2002a) describes a textbook on lower-limb arteriosclerosis: “It [the textbook] assumes that there is an object – lower-limb arteriosclerosis – out there that manifests itself in various ways” (p.17). This is what textbooks do.

43 Latour discusses ‘facts’ as immutable mobiles that circulate within networks. As I discussed above (note 41) classic-ANT is especially fond of describing networks. As discussed in chapter 4, however, the network metaphor in classic-ANT differs from the network metaphor in after-ANT, which I apply. The from I describe the representational knowledge as regional because
Inaugural ceremony

The story of representational knowledge is not the whole story – or the only story – about forms of knowledge in the classroom. There were occurrences in the classroom in which representational knowledge was either not performed or was less prominent. The inventory of the classroom told stories of former projects:

- On the wall were two posters. They displayed paintings of how to sort garbage and keep the environment clean. The class had made them the previous school year for a school contest about environmental issues. They had won a first prize and a considerable sum of money.

- Next to the posters hang some pictures from Hans Christian Andersen’s fairy-tale the Snow Queen. They were to inspire a current project. The class was preparing a theatre play about the Snow Queen to be shown to the parents at Christmas time.

- There was a miniature cardboard model of a school in the corner. It was three storeys tall, about a metre. On each storey were two or three rooms in which miniature furniture, animals, wooden bricks, cooking utensils, a water basin, etc. were organized. The class had made the model in an earlier project about the ideal future school.

- I spent most of my classroom observation time seated under a big bed-loft. St. Marc Street School was built in 1882 and lives up to the ideal of the day that schools should be stout and tall, looking down on the surrounding tenement houses. Consequently, the classrooms are high-ceilinged. In collaboration with a school of carpentry the 4th grade class had built a large wooden bed-loft, about six meters square and two meters tall, in the corner of the classroom as a refuge for pupils during breaks, for group work, etc.

At least two of these products involve some aspects of representational knowledge. But a regional pattern of relations is far from an obvious element of the practices performed with these materials. Therefore, I shall in this section turn to one of these materials, the bed-loft and discuss the form of knowledge performed with that. The bed-loft was central on the class agenda during my visit. Consider this field note excerpt:

*Wednesday morning. For an hour the class is busy preparing the bed-loft inaugural ceremony. They bring up soft-drinks and sandwiches made by Suzan’s mum. They arrange the food and drinks nicely as a buffet on a few desks put together. Some pupils sweep the floor and decorate the windows, windowsills and the blackboard. They put all school bags to the wall. A song for the occasion written by the teacher is distributed on printed sheets. The classroom door is open. Children pass in and out from and to the neighbouring class, who is*
preparing as well. The other class was part of the carpentry project as well and has also built a bed-loft in their classroom. Around 11 o’clock parents start turning up. They chat with the teachers and with children. Some sit down at the pupils’ desks, some stand. The principal arrives. At 11.15 the bell rings. One of the teachers comes into the classroom and says: “It’s time, come over”? We all pass to the neighbouring class where we are told to gather by the walls. We are almost 70 people packed by the four walls of the classroom. One of the teachers initiates the song, and we all read from the printed sheet in our hands, singing about the fabrication and erection of the bed-lofts. After the song, the principal makes a speech celebrating the project and the pupils’ hard work. Then follows three speeches held by pupils, who are all a bit tense and clearly excited by their performances. The speeches are each followed by long applause. One of the teachers invites everyone for drinks and sandwiches and the crowd moves to the other classroom.

Field note 2609_56

The bed-loft was a successful project and the teachers talked about it with satisfaction and pride. Even though it wasn’t a representation of an external reality. This was what I found exciting about this material and this project. Unlike the occurrence with Kim jumping, the bed-loft did not contribute to producing representational knowledge. The teacher was however happy about it. This indicated to me that resemblance or representation was either not enough or not the only criteria for a form of knowledge to be adequate for school practice.

Figure 8  The bed-loft photographed during the inaugural ceremony.
Being new and original the bed-loft constituted a legitimate reason for making a celebration at which the different groups of people with interest in the work of the class could come together. Being visible it allowed the partners to witness the product, which was a reason for people to attend the celebration. By enrolling the parents and the principal the bed-loft contributed to performing a network of not only the teacher, the pupils and their work, but also of external parties. The bed-loft did as well as the three other projects I mentioned above made gatherings available of groups of people who in one way or the other had interests in the progress of the class. Groups that were otherwise beyond the class were drawn into the work of the class, making it ‘bigger than itself’. I do not suggest that the parents and principal were part of the class. But by their presence at the inaugural ceremony they implicitly (and the principal explicitly in his speech) showed recognition of the class work, assigning importance and value to it. Because they were coming and because they could be invited an song for the occasion and several speeches could be written and performed. They contributed to extending the class by adding an account about the bed-loft to the class.

What is interesting is not in itself the network pattern of relations, which the bed-loft contributed to performing. It is that as an effect of this network accounts were created. The network of the event and the people coming together made it available for these accounts to circulate far beyond the classroom as knowledge about the class work. I will call these accounts a communal form of knowledge. These accounts were added to the bed-loft as an effect of the coming together of various parties from inside and outside the class (and in similar ways communal knowledge had been or would be added to the products of the other class projects mentioned above). Because it was communal this form of knowledge could start circulating as a shared memory or experience.

**Boyle’s experiment: literary and social technologies**

I wrote above that Shapin & Shaffer (1985) present Boyle’s experiment as performed through three technologies. I discussed the material technology and how it contributed to performing a representational form of knowledge that was detached from man. In this section I discuss his social and literary technologies. Crucial for the two latter is their contribution to performing knowledge as communal.

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44 We can legitimately equate ‘man’ with ‘human’, since there hardly were any women in Boyle’s experimental world (see Haraway 1997 p. 26ff.)
In order to produce ‘proper knowledge’ – matters of fact – it wasn’t enough for an experiment to apply the material technology. No matter how perfectly calibrated an experimental set-up would be, it could not claim to have produced any knowledge, if it was accomplished by a lonely individual in a remote laboratory. One of the crucial elements of the material technology, the glass globe, was also one of the pivotal elements for the social and literary technologies. Made out of transparent glass it allowed people to witness how small animals were suffocated, candles put out, etc. as a consequence of emptying the container of air. Witnessing was the crucial point in the experiment. The experimenter had the modest task of perceiving and registering the facts ‘spoken’ by nature through the machine. But the experimenter shouldn’t be the only witness. The capacity of the experiment to yield matters of fact depended essentially upon the assurance of the relevant community. Witnessing had to be a collective act and the laboratory had to be a public space. One witness could be mistaken in his observations but two or even ten or a hundred confirming the perception were likely to be right. So, Boyle engaged witnesses in his experiments.

The laboratory, however, had only a limited capacity and limited access. Written reports could guarantee the multiplication of witnesses of an experiment. This literary technology, completed in an unadorned, factual, compelling style, could make the experiments known to those who were not direct witnesses of the experiment. To ‘virtual witnesses’ as Shapin & Shaffer call them. Knowledge wouldn’t count as such just by being conducted in a laboratory and witnessed by gentlemen. It had to travel beyond the walls of the laboratory to be acknowledged and accepted. It had to be made communal:

**Radical individualism** – the state in which each individual set himself up as an ultimate judge of knowledge – would destruct the conventional basis of proper knowledge, while the disciplined collective social structure of the experimental form of life would create and sustain that factual basis... No one man was to have the right to lay down what was to count as knowledge

Schaffer & Shapin 1985 p.78, emphasis added

To the literary technology the social technology was added. Shapin & Shaffer describe in detail the conventions Boyle set up for experimenters to use in dealing with each other and in consid-

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45 Modesty is a central term in Shapin & Shaffer’s description of the experimental way of life, which is however beyond this thesis to discuss. See also Haraway (Haraway 1997).

46 The way in which witnesses were selectively picked for the experiment is a central part of Shapin & Shaffer’s argument. I return to this point in the next chapter where the comparison between the classroom and the online 3D virtual environment makes it apparent that it did indeed matter who the witnesses of the knowledge were, also in a school context.
ering knowledge claims. Disputes should for instance be strictly about knowledge – about matters of fact – and not about persons. By separating knowledge from humans the social technology contributed to the regional pattern of relations (to objectifying as Shapin & Shaffer call it).

Communal knowledge

It is amazing to read Shapin & Shaffer’s description of how philosophy in the mid-17th century was concerned with the threat of ‘radical individualism’. In spite of the frequency of contemporary accounts lamenting over the fragmentation of knowledge, culture and value – often claimed to be due to the Internet – it is instructive to gather that similar voices could be heard 350 years ago. The separation of expert knowledge from mere opinion as the legitimating knowledge for ways of life without appeal to transcendent authority or to abstract certainty of any kind is a founding gesture of what we call modernity, Haraway writes (1997 p.24). The alleged problem of opinion or individual ‘non-knowledge’ and the request for acknowledged communal knowledge is not new. The literary and social technologies let Boyle’s experimental knowledge circulate and enrol a vast number of virtual witnesses, through whom it became communal and gained degrees of recognition and authority that by far exceeded what a knowledge claim given by any individual could ever obtain. A similar mechanism seemed to be at stake in the classroom. No report was written about neither the bed-loft, the school model, the environment posters nor the Snow Queen. But as remarkable objects they were magnets for people to come to the classroom and witness these objects directly. Like the transparent materiality of the glass globe in Boyle’s experiment the visual appearance of these objects made them available to witnessing. And as witnesses the gathered pupils, teacher, parents and principal started interacting and created communal knowledge about the class work similar to the circulating knowledge Boyle’s material and literary technologies contributed to.

Conclusion: making the classroom ‘bigger than itself’

I have in this chapter discussed two forms of knowledge – representational and communal. In concluding the chapter I shall look at one crucial difference between Boyle’s experimental set-up and the forms of knowledge performed in the classroom. While the representational knowledge performed in the classroom depended on a large network already in place beyond the school, the aim of Boyle’s experiment was very much to establish such a network.

The metric standard worked, I explained, because Jens’ jump in the maths textbook referred to the same immutable measurement as the ruler in the classroom. Jens’ as well as Kim’s jump
Representational knowledge in the classroom

was local and separate from one another but the standard bound them together across the boundaries of the school, across the distant places in which the jumps took place. The assemblages that made it possible to perform the metric standard in the textbook and in the situation the textbook referred to as well as in the classroom were in place. There was already an infrastructure of maths textbooks with references to metric measurements, of one-meter rulers distributed to all classrooms, etc. Similarly, the children’s parents could probably refer in metric terms to their own abilities in long jump, to measurements from sports events, or to the length in meters of the dining table, which they remember from the trade description note stuck on the table when they bought it in IKEA. This ubiquitous presence – this infrastructure – of the metric standard made it possible for the pupils to discuss what they learnt in the class with their parents. The infrastructure of references was already in place, and thereby the representational knowledge was ‘bigger than itself’.

It has been shown in detail by Lave that representational knowledge cannot be performed anywhere (Lave 1988; Lave & Wenger 1991). It is dependent on an assemblage that makes it possible to refer to it from different particular places. To be precise, representational knowledge does not circulate. It is rather persons who circulate between assemblages, which perform references to representational knowledge. The metric standard could be performed in the classroom because a one-meter ruler was already available. Even though the metric standard contributed to constituting a regional pattern of relations in which it was positioned in a region beyond the classroom, it was also materially present in the classroom as the ruler, without which the metric standard could not be performed. Similarly, the metric standard could only be ‘re’-performed at other places where the standard in one way or the other was made present by rulers, tape measures, information about sizes, etc. In this way, regional patterns of relations are dependent on socio-material networks, as Latour (1993) has demonstrated widely in terms of purification and hybridisation.

The network of references that was in place across the boundaries of the school allowed the representational knowledge to be performed and it granted it universality and validity. It was indeed no ‘radical individual’ knowledge. No, it was widely distributed. This was not the case with Boyle’s new experiments in the mid-17th century. There were not references to vacuum on

As I discussed in chapter 4 patterns of relations are never singular existing on their own, but co-performed with other patterns of relations like the regional pattern of relations through which representational knowledge was performed was dependent on and constituted through a network pattern of relations.

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47 As I discussed in chapter 4 patterns of relations are never singular existing on their own, but co-performed with other patterns of relations like the regional pattern of relations through which representational knowledge was performed was dependent on and constituted through a network pattern of relations.
the coffee packages on the shelves at the grocer’s, nor did the people of 1660 have vacuum cleaners or vacuum flasks that as a matter of course would make them associate vacuum with air tight containers or the suction of air. These references to vacuum did not exist, and convincing people that a glass globe could be emptied of air was not supported by much beyond the experimental setting. The knowledge Boyle’s experiments produced did not have allies all around which would grant it validity, which the universal metric standard had. Because of the lack of such an infrastructure of references, Boyle’s experimental knowledge was local and vacuous until allied with references beyond the laboratory. It was ‘radical individual’. Since he could not rely on an already existing infrastructure as the representational knowledge in the classroom could, Boyle had to contribute to building up such an extended network of references himself. This is what he did by engaging direct witnesses and virtual witnesses through literary technology. Thereby, the representational and communal aspects were inseparable and interdependent in Boyle’s experimental knowledge. His matters of fact could only be representational if they were also communal.

While the representational knowledge in the classroom was associated with an already established infrastructure, the knowledge performed with the bed-loft was not. It was quite local and without much reference beyond parents’, pupils’ and teachers’ particular, local efforts. Like the knowledge in Boyle’s experiments it lacked an infrastructure to grant it universality and validity. This infrastructure had first to be established.

In a group interview with the 4th grade teachers they reported that they much preferred making projects like the ones with the bed-loft, the Show Queen and the future school project mentioned on page 106 to doing the teaching of representational knowledge required by the curriculum. However, they also agreed that those projects were much more time consuming than traditional teaching. Through the discussions in this chapter, we understand at least some aspects of what makes them so time consuming. Teachers did not only have to carry through the projects but also to draw together parents and principal to witness them. They had to put together the assemblage or infrastructure for making the communal knowledge of the bed-loft and to make it circulate. An infrastructure, which when doing traditional teaching was already available and in place. In the case of the bed-loft project teachers had to initiate and ‘calibrate’ an extended socio-material assemblage of bed-loft, invitations, occasional songs, speeches, etc. in order to grant the knowledge of the bed-loft if not universality then at least common legitimacy in the network of parents and principal. Without this, it was at risk of being ‘radical individual’. Danish schoolteachers often appeal to parents for more involvement in their children’s
school activities. If parents did show more commitment to their children’s schoolwork, it would indeed be easier for teachers to make projects that did not involve representational knowledge. If parents constituted an already established infrastructure, which would mobilise itself ‘automatically’ (without the teachers’ efforts to draw them together) to witness the class projects and establish communal knowledge, then such projects would be more manageable for teachers.

Like Boyle the teachers at St. Marc Street School had to invest efforts into establishing communal knowledge. Indeed, these activities were not unlike those of scientists. Latour (1999b) describes the work of scientists as that of making references circulate. “For the world to become knowable, it must become a laboratory”, Latour writes, indicating that ‘the world’ must be prepared to be rendered as a diagram, a text, etc. that can start circulating. As mentioned above, scientists need to establish an infrastructure of references and they do so by letting references circulate. There are however other ways of knowing the world as the ways of scientists and the ways of teachers appreciating ‘alternative’ learning. Other people, including pupils in school get to know the world not by making it into a laboratory or making references start circulating. They get to know the world by learning to manage the instruments (e.g. a ruler) that enable them to perform representational knowledge by referring to an already established infrastructure of references.

The network in which the communal knowledge circulates will never be as extensive as the infrastructure allowing representational knowledge to be referred to. The communal knowledge performed with the bed-loft could hardly be included in any examination. It would not appear in the national standard examination sheets distributed from the Ministry of Education to all schools. Communal knowledge can never be the only form of knowledge performed in school, no matter how committed and engaged the parents’ network may become. It is therefore considered ‘alternative’ to representational knowledge, whilst representational knowledge dominates the school practices.

Common for the representational form of knowledge and the communal form of knowledge described in this chapter is that the materials involved in performing them need to be of a materiality that makes connections available between inside and outside of the school. Either between the classroom practices and external references or between classroom products and a connected network in which knowledge about the products can circulate. The connections between materials inside and outside of the school are crucial for the forms of school knowledge to be performed.
Chapter 7

Liquid Knowledge
With Online 3D Virtual Environment

I now turn to the online 3D virtual environment. From the classroom and into the assemblage that was the occasion of the teacher’s complaint about the lack of resemblance and lack of collaboration. I look at the online application, at the pattern of relations it contributed to performing and at the form of knowledge generated. I compare occurrences with the computer program with those described from the classroom and I show how the materiality of the virtual environment and the pattern of relations it was entangled in did not contribute to performing either representational or communal knowledge. It was not that the computer program did not contribute to connections between the inside and the outside of school. And there were indeed external people associated with the project. But the temporality, the transforming quality, the character of the people involved, the materiality which was difficult to witness, etc. rendered representation and communal knowledge impossible. I call the form of knowledge performed with the online 3D virtual environment liquid knowledge. And I end the chapter by clarifying the difference between liquid knowledge and the two forms of knowledge discussed in chapter 6, as well as by discussing why this form of knowledge does not fit into school practice.

Tvía’s Twin Towers

The children’s task in the Femedit project was to build up homes for the Femeditians as well as creating their identities by making hyperlinks to Internet web pages. The following story is created out of a combination of field notes, of what children and researchers wrote in blogger and of the visual appearance of the online 3D virtual environment. The compression of materials from over almost the whole project period makes it appear as one unbroken sequence, but please keep in mind that the sequence covers a period of several weeks.

Five boys were busy building a house for the Femeditian Tvía. Michael, Tim and Pete from the Danish group had chosen dunbrown granite wall plates and were arranging them in two big squares slightly staggered. They wanted to build something ‘big and pretty’. It was not easy to get the wall plates to fit. While struggling with the plates they explained the following week that it had to be as tall as possible. But they had not even managed to complete the first floor yet. More granite wall plates were attached. Ola and David, their Swedish team mates, put a TV in front of the ‘empty’ Tvía, to make sure she wasn’t bored while waiting
for them to reanimate her. And they put in floors and walls of water inside the house and added the sound of water to these elements.

Tvia responded in blogger: "Great building!!! Please, link to some good pages... weak...help...oh...need more memory..." Tvia required more hyperlinks for its reanimation.

Michael, Tim and Pete started surfing. Tim found an animation on the Internet and linked it to the TV their Swedish partners had built in the house. "I have made a film", he wrote in blogger. Michael linked to some satiric anti-terrorist web pages. There was an animation about Osama Bin Laden. "Look at this, look at this", Pete said excitedly, handing out the headphones to Tine Jensen, my colleague. Tine watched and listened to the animation about how to ‘bash’ Mr. Laden. She didn’t know how to react. She found it repellent and felt the urge to forbid the link immediately. On the other hand, she wanted to be in accordance with the frame story which implied that feedback was motivated by the relations and happenings inside the online 3D virtual environment and not by external criteria for what was good or bad. She told Pete that she personally found the joke distasteful because of its glorification of violence, its dumb US centrism and its ignorance of the complexities of the conflicts between the US government and its Muslim enemies. Pete shrugged his shoulders and turned to the online 3D virtual environment. The teacher passed by and started reprimanding Pete for the worthlessness of what he was doing; for the lack of any quality in the web pages he was visiting. Turning to Tine she stated that “that’s the problem with the Internet; you never know what sort of rubbish the children get in touch with”.

Tvia didn’t comment on the satiric web pages but on the divergence in what the children built: "Thanks for all you have built. It is so nice. It gives me strength, but my mind is divided. I am CONFUSED. It is as if I were two persons. It is because you do not collaborate. The Swedish children try to rebuild my old house. The Danish children try to build as big as possible – you need to start agreeing..........”

Pete changed the surface of the ‘water’ walls and floor to granite and industrial metal respectively. Ola put a skating image on the TV and two armchairs in front of it. Michael changed the skating image to a Digimon figure, which David overwrote by an image of a speedboat. Tim found a web page with pictures of bombs that he put right in front of their house and next to a few animations of fireworks, which he called ‘explosions’: "It’s the Twin Towers", he said smiling proudly to Tine.

What kind of knowledge is performed in this sequence? That is what I discuss in the first half of this chapter. Prior to that, however, I look at the pattern of relations which unfolded. The sequence describes a vast number of objects that were built and several links added to the building blocks. It reveals a zigzag course from the wish to build something big and pretty to naming the building Twin Towers. Around and in between other wishes, objects and links. It wasn’t until quite late that the Twin Towers were associated with the granite buildings. The idea of the Twin Towers was not there from the beginning. But it fitted well to the combination of wanting to build something big and the links to anti-terrorist web pages. It was late 2001, only a few months after two planes crashed into buildings on lower Manhattan. The

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48 ‘Digimon’ is an abbreviation of Digital Monsters, an animated TV series to which a lot of franchise is available; collectible card games, digital games, comics, and movies. Digimon is one of the most popular global figures in contemporary child culture.
children were asked to attach whatever links they wanted to the buildings in Femtedit, and being the most exposed issue in the media that autumn, it was no surprise that ‘911’ found its way to Femtedit.

The pattern of relations performed in the sequence is one of *single elements coming together one after the other*, neither following any set plan nor directed towards a goal. First there was a wish to build something big, then the granite plates, then the anti-terrorist web pages, then the idea of the Twin Towers. We need not to understand ‘Twin Towers’ as the conclusion to the story, as summing up or embracing all other elements. Maybe it was just added to the elements already connected. An addition, however, that influenced the character of the flow of the elements. Just as the antiterrorist web pages altered the tall granite building and the putting together of granite wall plates shaped the idea of building something big. The point is not that one object influenced the other in a stable structure. The point is that each new element influenced the flow of the procedure constituted by the assemblage of elements. Step-by-step elements were put together, each contributing to the direction of the journey.

The *fluid* metaphor describes a pattern of entities coming together one after the other, not a pattern of summing up to form a more and more robust entity but a pattern of the latest elements attached influencing the direction of the process. It was always what was on the top of the blogger that was read and that counted. I never saw anybody scrolling down in blogger to be reminded of what had been written earlier. The past discussions were indeed over. Hence, the story of the Twin Towers is a product of talking about the process from a specific point in time of the project. Had the project continued, the story might have turned away from the Twin Towers.

This also implies that during the course of events some links and building blocks were replaced, while others changed or lost effect. The elements were *optional and exchangeable* which is characteristic of fluid patterns of relations. Some elements were in focus at one point but then they faded into the background. Sometimes they were exchanged and replaced. Just as some reappeared and regained importance. The relations between elements in fluid patterns of relations are *unstable*.

The story of the Twin Towers emerged as a zigzag course around and between interactions, wishes, graphic objects and links, etc. There was much more than the story of the Twin Towers in the sequence above. There was a TV and a sofa, a film, a picture, a Digimon, Tvia’s feedback, blogger, a researcher’s personal comment and a teacher’s reprimands. To which degree these elements mattered in what was going on is difficult to say. But they were *there*, and they
contributed to the impression of Femtedit as a process of continual transformation of what was in focus and important. Continual transformation is a consequence of the pattern of elements coming together one after the other, just as it is another characteristic of the fluid pattern of relation. Building blocks erected, statements written in blogger, links added to the online 3D virtual environment. Now it was a film, then it was a granite wall, then it was the Femteditian’s feedback. Then it was something else. Indeed, what the online 3D virtual environment was was continually changing.

This sequence shows some of what happened with the online 3D virtual environment as a fluid pattern of relations. Of elements coming together one after the other, of the characteristics of elements being optional and exchangeable, and of ongoing transformation. It is time to look at the form of knowledge performed with this pattern of relations. I return to the field note sequence later. First, however, I will approach the discussion of what form of knowledge was performed with the fluid online 3D virtual environment by looking at the fluid pattern of relations in relation to the representational knowledge performed in the classroom.

No representation in fluidity

In chapter 6 I showed how a representational form of knowledge was performed as an effect of a regional pattern of relations. A pattern of relation which the ruler among other things contributed to performing. Was there anything like that in the online 3D virtual environment?

Femtedit consisted of among other things the Femtedit website which included a web page for each Femteditian. There were a few pictures and a few sentences about each Femteditian, as shown in figure 5 on page 52. But there was no total account or map, which would allow the children to re-build what they saw on the pictures and read in accounts. The Femtedit website presented a partial story of life and concerns of Femtedit rather than a model of it. The phrases on each Femteditian’s web page were even rather cryptic. Look for example at the ones on Tvia’s web page:

I was here first.
I give good advice if you ask.
My colour is green.

The frame story provided more context to the phrases. You would meet Tvia as one of the protagonists in the frame story. She was the oldest and wisest Femteditian, the one who arrived first in Femtedit.
Tvia wrote in blogger that her Swedish helpers were trying to rebuild her old house, while the Danish were focused on building something big. The Swedish part of the team, David and Ola, indeed attempted to create a representation of what was on the pictures on Tvia’s web page\(^{49}\). However, they received little support from the design of the online 3D virtual environment. With the design providing only a few more or less blank sentences on a web page and a bit more information for those carefully reading the frame story the children were ‘thrown’ into the Femtedit world in an almost Heideggerian way, without any definite model of what to do. There simply was neither any standard available that could show the children how the Femteditians’ homes had to be built nor any unambiguous story telling how their identities had to be formed through hyperlinks. The design of the online 3D virtual environment did not offer any standard or other clear-cut representational object like the one-meter ruler in the classroom which made available a regional reference in the performance of a representational form of knowledge.

But what about the Twin Towers? They were not depicted on the Femtedit website but they were (or at least had been) ‘out there’ somewhere other than the online 3D virtual environment which could be referred to from here. Did that not count as representational? We need to look carefully at the relations between the Twin Towers in the online 3D virtual environment and the late World Trade Centre on lower Manhattan in order to establish whether the relation is representational. Satiric anti-terrorist websites were linked to the Twin Towers in Femtedit as well as an image of a bomb and ‘explosions’. Thus, they rather built on the legendary New Yorker buildings than mirrored the ‘real’ Twin Towers. They involved historic material in their activities but mixed it with fictional and other materials which would probably be counted as incorrect from a representational point of view. The pattern of relations performed with the Twin Towers in Femtedit was not regionally representing something ‘out there’ but fluidly connecting elements – real and fictional on the same footing – in an ongoing transformative process. It didn’t constitute the spatial arrangement characterized by boundaries and separate regions necessary to perform the representational form of knowledge.

\(^{49}\) This was partly due to a divergence between the Danish and the Swedish researchers. The Danish believed the children should build the Femteditians’ homes by involving hyperlinks and inspiration from external sources while the Swedish researchers supported their children in recreating what was shown on the pictures. As we shall see in part three of this thesis, the degree to which the researchers’ and teachers’ advices were included in the online 3D virtual environment varied. The design did not allow teachers to control what children were doing in the online 3D virtual environment. Their presence and advice were involved in the children’s activities as elements on par with web pages, images, sentences and other elements available for solving their tasks.
Not only the spatial, but also the temporal arrangement of the online 3D virtual environment stood in the way of performing representational knowledge. The activity with the online 3D virtual environment changed gradually, as I noted above. The buildings were not the Twin Towers from the beginning nor all the time. I described on page 114 how both the metric standard and the knowledge about Kim’s and Jens’ jumps had to be stable in order to be create a regional pattern of relations. Continuously transforming and with its unstable relations the online 3D virtual environment did not contribute to performing such stability. Due to its continuous transformation a construction like Tvia’s home in Femtedit cannot be a mirror image of something ‘out there’ that stays the same – or changes differently. The fluid pattern of relations performed by and through the online 3D virtual environment performed neither the spatial arrangement of elements nor the temporal stability required to constitute a regional pattern of relations and representational form of knowledge.

The teacher complained about this. She reprimanded Pete for the worthlessness of what he was doing. Indeed, in the imaginary of representational knowledge an arrangement that does not perform representation is worthless. The teacher’s complaints opening this second part of the thesis criticized that the buildings in the online 3D virtual environment did not resemble reality. Like this complaint the teacher’s reprimand of Pete concerned lack of representation. After describing the online 3D virtual environment as contributing to performing a fluid pattern of relations we understand why resemblance was lacking in the online 3D virtual environment. Fluid patterns of relations do not produce resemblance.

That resemblance and representational knowledge was not performed with the online 3D virtual environment provides a better understanding of what was taking place with the online 3D virtual environment but it does not indicate which form of knowledge was performed. I return to this shortly but first I present another field note excerpt to compare with the other form of knowledge discussed that was performed in the classroom: the communal form of knowledge.

The Pakistani song

We shall take a look at another occurrence with the online 3D virtual environment. This time with an account put together of a few excerpts from my field notes:

*Hajjah told me she would like to have some Pakistani music in the house of her Femtedittian. I said that was indeed possible; we could search for a song by typing in the title in Google. This, however, turned out to be difficult because she didn’t...*
know how to spell the title in Latin letters. Her cousin in 6th grade would probably know, she said, so she could go and ask her. Ok, I answered, and off she went. Only a few minutes later she returned but unfortunately without any song title.

During the next week I spent an evening digging out a Pakistani song from the Internet. Not knowing anything about Pakistani music I was searching in the dark but with help of hit lists I finally had one downloaded. I was excited to get my efforts evaluated but before I could play the song for Hajjah she came running up to me at the next Femtedit session telling that she had found a music website. She hitched up her sleeve and revealed a URL written with Indian ink on her forearm: xxx.com. Some of the older boys had written it, she said. I don't know how it could happen that I naïvely sat down with her at the computer and typed in the URL. A porn site, of course, appeared on the screen. A responsible one, though, with a non-explicit first page and warnings about the explicit material to be shown by clicking on any of the links on the page. We concluded that the boys had played a trick on her, and indeed on me as well.

Therefore, we were both quite satisfied when it turned out that the Pakistani song I had brought was one Hajjah already knew and liked. She linked it to her Femteditian’s home. Soon other Pakistani children from the class crowded up behind her to listen to the music. More and more children gathered and a queue formed of children waiting for their turn to try on the headphones. An ethnic Danish boy exclaimed: “Oh it’s real Uzma music”. Uzma was a very traditional Pakistani girl of the class. This could easily have been meant as derogatory, but it wasn’t. Another boy smiled, looked a little puzzled, and said with surprise in his voice: “It is actually good”.

Field note 1115_2-7

I shall discuss communal knowledge in relation to this field note in the two sections below. The first section discusses the difference between the circulation of communal knowledge about the bed-loft and the circulation of knowledge of the Pakistani song between the children in the field note. The second discusses the possibility of witnessing the online 3D virtual environment.

**Lack of network stability**

The odyssey about how Pakistani music eventually ended up in the online 3D virtual environment is interesting because it shows how various people were mobilised. First Hajjah and I, then Hajjah’s cousin, then a few older boys, and finally several class mates. We do not know who else might have been involved. Hajjah might have involved other people in the problem who however did not provide any solution that had the necessary characteristics (a written or memorized URL or the spelling in Latin letters of a song title) to be transferred to the online 3D virtual environment and hence to me (and my field notes). This involvement of actors and elements, which were else not associated with the Femtedit project, was made available through the task of linking involved in the online 3D virtual environment design. It was possible to draw in web pages directly by way of Internet search machines without having to consult any external (human or nonhuman) actors. But like Hajjah other children frequently drew in actors
and elements from elsewhere in order to find web pages to link to from the online 3D virtual environment.

With various external people involved, we might want to conclude that the online 3D virtual environment contributed to performing a communal form of knowledge just as the bedloft did in the classroom. However, we need to examine these people’s involvement closer before coming to such a conclusion. The persons involved with the online 3D virtual environment were others than those involved with the communal knowledge in the classroom. It was not parents or the school principal. It was children. This is important and I take an excursion back to Boyle’s experiment to demonstrate it.

Shapin & Shaffer (1985) describe how the witnesses of Boyle’s experiment were carefully selected following the taken-for-granted conventions that Oxford professors were accounted more reliable witnesses than Oxfordshire peasants. Just as important as making the experiment a public space by engaging witnesses, was only letting ‘reliable’ and ‘credible’ persons witness the experiment (p.336). Haraway (1997 p.31) notes that Boyle even sometimes conducted experiments late at night in order to exclude women from witnessing. Women might interrupt the experiment as it did happen once when a small bird was suffocating in the glass globe and the attending women demanded air to be let in to rescue the bird.

While appreciating Shapin & Shaffer’s descriptions of how ‘proper knowledge’ could only be produced by excluding a vast majority of the population as potential witnesses as potential witnesses, Haraway criticizes their account for overseeing that this procedure produced an experimental way of life and a ‘proper knowledge’ that was a European and white and male way of life and a European and white and male form of knowledge. A knowledge that gives all attention to the observed object ‘out there’, to the ‘nature’ distant from the body of the observer, to which critical attention was minimized. By excluding women, people of non-white colour and of non-European nationality it became invisible that gender, colour and nationality was present in the laboratory and active in producing knowledge.

Haraway’s commentary is sharp and important. But doesn’t its emphasis on nationality, colour and gender forget a just as important category? Doesn’t it overlook age? Weren’t children just as excluded as witnesses, and by their exclusion just as much involved in performing ‘proper knowledge’ as a European white male adult form of knowledge? A knowledge, which rendered age invisible; which concealed the fact that the perceiving eye must be of a certain age in order to view in a disciplined manner which renders it reliable and credible. I am sure that the presence of children as witnesses in Boyle’s new experiments could have contributed to
forming knowledge and the experimental way of life in a quite different direction than how it came to be. Just as the excluded women mentioned above would probably have influenced the experiment to become something different than it did, had they not been banned. The form of knowledge and the way of life performed through Boyle’s experiments were detached from the marks of nation, colour, gender, and age that bodies have. Marks that are not essential categories, Haraway (op cit) reminds us, but relational formations, which is why they stay invisible until confronted with bodies of other nations, colours, genders and ages. The experimental form of knowledge was detached from the observing body and its marks of nation, colour, gender and age, performed as a product of the mind (see also Shapin 1990).

The excursion is over, and we can return to the online 3D virtual environment. I was concerned with the question of whether the involvement of a number of people in placing Pakistani music in the online 3D virtual environment resulted in a communal form of knowledge. It was children who were involved in the procedure, not parents, not the school principal. What difference did that make? It made the difference that Hajjah’s cousin, her older friends and her classmates did not constitute any stable network. Neither Hajjah’s cousin nor her friends or classmates held stable positions and their relations to each other varied. This lack of an immutable network meant that they did not account for each other, which made available undisciplined perception and accounts. The example of Hajjah’s friends teasing her by writing a porn URL on her forearm shows their unreliability. She – and I – thought they would give her a link to a Pakistani song and then it was a porn site. Incredible! Parents and the school principal would not be likely to do things like that. They formed a formal network with stable positions and stable relations to each other with unambiguous mutual accountabilities. A stability that disciplined their perceptions and accounts. They were reliable and they were credible. They formed good witnesses to the class work. They would credibly and reliably circulate the knowledge about the loft-bed after witnessing it at the inaugural ceremony. You couldn’t expect the same from children.

While Latour (1993) celebrates Shapin & Shaffer’s book for taking the socio-material practice of knowledge production into account, I think they at this point relapse to a social, humanist thinking, referring to the conventions that rendered some social groups more reliable and credible than others. If we stick to a spatial description, we can describe the difference between the ‘reliable and credible’ on the one hand and the ‘others’ on the other, as well as between parents and principal on the one hand and children on the other, as a difference between stable and formal network patterns and loose and an unstable fluid pattern of relations. Oxford pro-
Professors were reliable and credible because their positions – in terms of places and interests – and their relations to each other were stable. The Oxfordshire peasants could not perform the same societal stability, and hence not the same immutable reliability and credibility\(^50\). The school children shared the fate of the Oxfordshire peasants of the mid-17\(^{th}\) century. Knowledge did not simply become communal because it was circulating among many people. It had to be circulating among people who formed a stable network which allowed the knowledge to circulate in a way that made it stay the same; which made it robust. The fluid mobility of the way in which children were involved in the online 3D virtual environment did not perform the stability needed to establish (reliable and credible) communal knowledge.

\textbf{Making witnessing unavailable}

Communal knowledge was not performed through the children involved. But it could have been performed by involving parents and principal as witnesses to the online 3D virtual environment as they were involved in the classroom. Or could it? Parents were involved as witnesses even before the project began. During the planning of the Femtedit project with the teachers of the 4\(^{th}\) grade class, the teachers asked us to present the project at a parent-teacher meeting prior to starting the project. It seemed natural to me to present to the parents what their children were going to do in school. I didn’t think of it as already part of the product – of the knowledge – of the online 3D virtual environment. But indeed it was. After the parent-teacher meeting the project, which had not even started yet, had enrolled parents who could start talking about Femtedit and circulate knowledge about it. With the parent-teacher meeting communal knowledge about Femtedit was added to the online 3D virtual environment. A knowledge that could circulate, just as communal knowledge was made to circulate as an effect of gathering the parents in the inaugural ceremony for the bed-loft. However, the presentation of Femtedit was prior to the project and thus only a foretaste – or even an appetizer – of what was going to happen and it had to be confirmed by the Femtedit activities. You are not satisfied with a nice weather forecast, you also want sunshine. An expectation was created for further witnessing of the Femtedit activities.

However, as I explained through Boyle’s experiments, a material arrangement had to be carefully set up and calibrated in order for it to be possible to witness. The globe had to be

\(^{50}\) The different abilities to display stability has surely to do with the differences in power and wealth necessary to constitute stability. A further discussion of how this stability was constituted is however beyond the scope of this thesis.
transparent for witnesses to be able to see the suffocating animals, etc. Did the online 3D virtual environment have something analogous to the glass globe? It was possible for parents to enter the online 3D virtual environment from their home computers. We had written down the URL of the web page from which you can download the Eduverse platform for the children to take home. However, probably due to the relative immaturity of digital technology, this was overstretched both parents and children. Downloading and installing Eduverse at home was not an accessible way for parents to witness the online 3D virtual environment. Nor was visiting the school and entering the online 3D virtual environment from there. Several people who have entered the Femtedit online 3D virtual environment complained about its messiness. Just as the teacher complained about the mixed up jumble. As newcomers people usually only move around in the online 3D virtual environment without clicking on or bumping into building blocks to activate animations, sounds, web pages, teleports, etc. They do not hear the Pakistani song. They miss a lot of what is built. Furthermore, the Femtedit online 3D virtual environment was intimately related to frame story, blogger, the Femtedit website as well as the ongoing chats and dialogues, which you missed when focusing on moving around the avatar in the online 3D virtual environment. Apart from this special spatial arrangement, which was difficult to access for newcomers, the temporal ongoing transforming character of the online 3D virtual environment made it difficult during a short visit to get a picture of what was going on. It would be like trying to understand a film from seeing the film poster.

Since direct witnessing was difficult because it involved training of parents in how to work with the online 3D virtual environment, virtual witnessing could be a solution: an account that translated what happened in the online 3D virtual environment to a language understandable for parents. Because of the teachers’ complaint that children didn’t learn anything, we, the researchers, decided to involve in our field notes reports of what the children had learnt during each Femtedit session. We would then have these descriptions ready whenever somebody would ask us to account for Femtedit. Thus, Tine wrote about Tvia’s helpers Michael, Tim and Pete:

**Michael/Tim learnt:**
- Building
- How to use the codebook
- Joining
- Privilege password
- How to log in to the 5D server space

**Pete learnt:**
- How to build and use codebook (found a bed and a toilet a.o)
There was some overlap in what we wrote that children had learnt. But there was also great divergence. Due to the pattern of always reacting to the last prior step children worked in very different directions and their activities differentiated increasingly. Tvia asked the Danish and Swedish children to collaborate (p.114). And the teacher complained that the children did not collaborate (p.93) and that we did not tell the children collectively what to do every session. If we had done this, if we had restrained the building and linking process from following the last prior step and had frequently told them ‘from above’ what to do next there was a much greater chance that the activities on the learning and the knowledge performed would have been the same for all children. As described in chapter 3 (p.76) Femtedit was designed in a way that made children active constructors in the virtual environment in order to make it available for the building function to unfold in surprising ways. Therefore, we did not instruct children in what to do and consequently the building activities developed in diverse directions which made one single account of what was going on with the online 3D virtual environment unavailable.

The spatial and temporal arrangement of the online 3D virtual environment made it difficult to witness it directly and, because of the step-by-step pattern performed with the online 3D virtual environment, diversity proliferated which made it difficult to create one single account for virtual witnesses or even one overall principle for assessing what was learnt.

**Liquid knowledge**

The forms of knowledge performed in the classroom and by and through Boyle’s experiment have helped us to understand some ways in which the form of knowledge performed with the online 3D virtual environment differ from that of the classroom and of Boyle’s experiment. I noted that single elements came together one after the other continually transforming their relations that were accordingly unstable. Indeed, the involved elements were optional and exchangeable. These characteristics match those of the fluid spatial metaphor and I called it a fluid pattern of relations. I showed how this pattern of relations lacked the regional characteristics of representational knowledge; that single elements coming together gradually did not make available a stable reality, standard or model that could be referred to. That no infrastructure of references were in place. What was taking place with the online 3D virtual environment built
on and involved external elements, it didn’t mirror external elements. Secondly, I showed that because the assemblages in which the knowledge of the online 3D virtual environment circulated were that of children (with the ways their lives were formed through socio-material assemblages) these assemblages lacked the stability necessary for performing communal knowledge.

Thrift’s (1996; 2000) nonrepresentational theory is helpful for formulating the characteristics of the form of knowledge performed with the online 3D virtual environment. However, the negation implied in ‘nonrepresentational’ emphasizes an opposition to the representational knowledge described. Because the characteristic of not being representational and being different from representational knowledge is far from the only quality of the form of knowledge I want to discuss I refrain from using Thrift’s term ‘nonrepresentational’ about the form of knowledge even though much of his ‘nonrepresentational style’ is folded into my descriptions. With inspiration from Law and Mol’s metaphor of fluidity I instead call the form of knowledge performed with the online 3D virtual environment a liquid form of knowledge. As Thrift’s nonrepresentationalism liquid knowledge is characterized by “effectivity rather than representation; not the what but the how” (Thrift 2000 p.216). Thrift emphasizes the interest in invention rather than reflection because invention is about adding to the world without adding up. Furthermore, his nonrepresentational style implies a selection principle that is not about if there is a link between account and reality but whether or not ‘one travels’, i.e. whether or not an effort makes a difference. What Thrift says about his nonrepresentational style can be said about the form of knowledge performed with the online 3D virtual environment: It created or invented something, it didn’t refer; its ongoing involvement of new elements did not result in representation but in change, in making a difference. The effectivity of this form of knowledge lay in its characteristics of producing effects. The story of the Twin Towers as well as that of the Pakistani song were both chains of effects in which one link resulted in another, resulting in a third, etc. And indeed, even though the boys were focused on building something big it was very much the ongoing process that was important, a process in which the wish of building something big was a part rather than a guide or a motor. Just as the process of finding the Pakistani song through the enrolment of a number of other human and nonhuman actors was in focus rather than the end-result of having the Pakistani song in the Femeditian’s home. This resonates with the computer game culture, in which the process of playing the game is decisive, not

51 Thrift emphasizes that these elements of nonrepresentationalism are inspired by ANT.
the object or goal of the game. On the contrary, reaching the goal or target is usually experienced as an anticlimax because it indicates that the game is over (e.g. Sorensen 1998). It is the *how* that is vital for the liquid form of knowledge, not the *what*.

This implies that liquid knowledge is *processual*; it is in action. “There is no last word; [only] infinite becoming and constant reactivation” (Thrift 2000 p.217). The mobility of liquid knowledge is not like the circulation of communal knowledge. The mobility of liquid knowledge consists of reactivation or *continuation*; mobility created by drawing in new elements that make the process move and alter. The online 3D virtual environment process did indeed move and alter continuously. We cannot, as with the communal knowledge, distinguish the knowledge or accounts circulating of the bed-loft, and the network in which it circulated. The fluid pattern of relations did not create regional boundaries or a network in which knowledge could circulate and thus liquid knowledge was not performed as separate from the socio-material practice in which it was embedded.

Consider the accounts about what Michael, Tim and Pete learnt through Femtedit presented on page 124. There is something quite odd about the list compared to the story of Tvia’s helpers on page 114. What does the list have in common with the sequence? Where are all the efforts, the conflicts, the interrelations between objects and discourse? They are gone, they are *narrated away*. This is the problem of the virtual witnessing, of trying to translate what happened in the online 3D virtual environment to a form of knowledge that tries to represent it. We need Thrift’s help again in order to understand this.

Thrift opens his article *Afterwords* by contemplating on how to honour his late father:

*I feel a need to write the event and yet... I am not at all sure that this is what I want to do. In a sense, I believe that this writing down is a part of the problem. I do not want to take over my father’s being by making him into fodder for yet more interpretation, by colonising his traces*  
*Thrift 2000 p.213*

While Thrift experienced his father through interactions with him the problem arose when he tried to produce an account for virtual witnesses. The life of Thrift’s father was not representable. A representation would colonise his father, letting him recede into the background of the formal, solemn ritual of an obituary, very unlike the “small sayings and large generosities” of Thrift’s father. Representational knowledge would narrate him away.

Because this description of the problems encountered when translating what happened with the online 3D virtual environment to a representational form of knowledge may mislead us to think we are dealing with a problem of more or less correct representation, I would like once
again to emphasize that we have to conceive of liquid knowledge entirely differently from how we understand the other forms of knowledge I have discussed. Consider this story told by a character in Lewis Carroll’s *Sylvie and Bruno Concluded* from 1894:

‘That’s another thing we’ve learned from your Nation’, said Mein Herr, ‘map-making. But we’ve carried it much further than you. What do you consider the largest map that would be really useful?’ ‘About six inches to a mile’, ‘Only six inches!’ exclaimed Mein Herr. ‘We very soon got to six yards to the mile. And then we came the grandest idea of all! We actually made a map of the country, on the scale of a mile to the mile!’ ‘Have you used it much?’ I enquired. ‘It has never been spread out, yet, said Mein Herr: ‘the farmers objected: They said it would cover the whole country, and shut out the sunlight! So we now use the country itself, as its own map, and I assure you it does nearly as well.

Carroll 1894 p.524, ref. Smith 2003 p.75

What I want to point to with this quote is that we have to abandon the idea altogether that knowledge is like a map. Several authors have stressed that ‘map’ is a widespread but inadequate metaphor for theory or knowledge (eg. Smith 2003; Turnbull 1993). Representational knowledge fits quite well the imaginary of a map. But other forms of knowledge do not. Liquid knowledge of the online 3D virtual environment is not a knowledge which ‘on the scale of a mile to a mile’ maps the practice with the online 3D virtual environment. It is not about making a representation that is not a reduction. Liquid knowledge is not a map.

Linguists and speech-act theorists have since linguistic philosopher J.L. Austin (1962) distinguished between constative and performative talk. Constative talk refers to something outside itself: “The bed-loft is tall”, “I like Shapin & Shaffer’s book”. These sentences talk about or describe a bed-loft and a book. Other sentences are performative:

‘I do (sc. take this woman to be my lawful wedded wife)’ as uttered in the course of the marriage ceremony. ‘I name this ship Queen Elizabeth’ – as uttered when smashing the bottle against the stem.

Austin 1962 p.5

Those two sentences do not talk about or describe anything, they carry out an act. In other words, constative sentences are representational and refer to something outside themselves while performative utterances are embedded in a practice. This is a rough distinction and Austin spends a whole book specifying different variations of performatives and constatives which are essential for a more subtle understanding of them. Here, however, it is mainly important that we become aware of their different relations to ‘the world’. One talks about ‘the world’ while the other performs ‘the world’ through talk. The distinction between representational and
Liquid knowledge is analogous to that between constatives and performatives. Liquid knowledge is an ongoing process producing effects.

Another crucial characteristic of liquid knowledge is that it is not performed as a human possession or ability. Science studies scholar and one of the most important scholars of technology's influence on identity Sherry Turkle (1997) has described a new style of thinking evolving with the proliferation of personal computers. She calls it *tinkering* and by relating it to Lévi-Strauss's notion of bricolage she emphasizes that tinkering problem solvers proceed from bottom-up by trying one thing, then another, making connections and bringing disparate elements together. They learn by playful exploration and manipulation of objects by being ‘immersed in its cadences’ (p.61). And Turkle very defines tinkering very much in contrast to abstract thinking, which she describes as characterized by following rules. There are several aspects of my description of liquid knowledge that resonates Turkle's tinkering. An important difference, however, is that Turkle describes tinkering as a skill, a way of working, thinking and acting with the world, just like abstract thinking is a way of thinking about the world, while one of my points is to characterize how the relation between the human and the world changes, how boundaries and separations, connections and links are transformed.

Developmental psychologist and activity theorist Lev Vygotsky’s (1978) notion of the *zone of proximal development* (zpd) for assessing children’s developmental stage is a useful point of departure for thinking about how liquid knowledge may be immersed in a socio-material practice that contrary to representational knowledge does not make a cut between the human and the world. While psychologists and educators usually look at what a child does independently when determining what he or she knows or can do, Vygotsky recommended we look at children in collaboration with an adult or with more capable peers, because such situations reveal the child's zpd. In a zpd the child becomes “a head taller than himself” in the sense that he is capable of performing what he could not do on his own. Thereby the zpd “contains all developmental tendencies in a condensed form and is itself a major source of development” (op cit p.102). Looking at the child in a zpd does not tell you about his or her current developmental stage but about what the child is *about to* achieve, which Vygotsky considered more relevant for learning how to support the child's development.

Vygotsky gives the example of a child who has only just begun to speak. The mother talks to the child in a language with a large vocabulary which is already grammatically and syntactically formed and the child talks back in one word phrases often with words the mother has just
said. I follow philosopher Fred Newman & developmental psychologist Lois Holzman’s (1997) unconventional reading of Vygotsky emphasizing that the:

...continuous shaping and reshaping of the ‘rudimentary’ and ‘developed’ forms of speech through joint activity simultaneously creates the zpd... In imitating in the linguistic zpd, the child is performing (beyond her/himself) as a speaker.  
Newman & Holzman 1997 p.112

What is interesting for my understanding of liquid knowledge is that the knowledge of language the child performs is not a creation of him or herself as an independent knowledgeable individual, but of practice. In most interpretations of Vygotsky’s works what happens in the zpd is understood as ‘scaffolding’ of the child (e.g. Rogoff & Wertsch 1984). The child has certain abilities independently, but with the support of an adult or more capable peers the child is enabled to achieve better than that. Newman & Holzman disagree with this interpretation of what happens in the zpd. They find it more accurate to see the zpd as “an historical performance space or stage than a societal scaffold. In the zpd, children perform ‘a head taller than they are’”, which means “human beings become who we ‘are’ by continuously ‘being who we are not’” (Newman & Holzman 1997, p.110).

I like Newman & Holzman’s version because it presents the speaker-child (and humans in general) as a result of the practice he or she takes part in. The zpd makes the child perform as a speaker. I will take it one step further and suggest that it is the zpd that performs the child as a speaker (to which the child, the mother and the language contribute, of course). Contrary to this description the idea of a scaffold creates a more clear separation between the knowledgeable child and the scaffold. The zpd as a scaffold suggests the child is capable of presenting some knowledge when supported by the adult, while the performance versions depicts the practice as turning the child into a speaker. The difference is subtle but crucial. While knowledge is attached to the child-in-the-practice in the former, knowledge is the practice in the latter.

The knowledge created with the online 3D virtual environment did not speak about Femtedit or represent it. It lay in the buildings, links, chats and dialogues, etc. created by and through the online 3D virtual environment, or rather, in the continual transformation of buildings, links, chats, and dialogues, etc. This continual transformation was the liquid knowledge. There was no point or place you could isolate and point to saying: “there it is, the knowledge”. Liquid knowledge was all over, embedded in the socio-material practice, present. It could be spo-
ken about but in the act of representing it, it would be made absent and its on-going, dialogic engaging present character would disappear.

**Conclusion: withnessing substituting witnessing**

In this chapter I have discussed the form of knowledge performed with the online 3D virtual environment and I have especially described it in contrast to the representational and communal knowledge performed in the classroom. I concluded chapter 6 by noting that it was crucial for the learning materials of the classroom that their materiality made available connections between the activities in the classroom and the references and networks beyond the classroom. That they could contribute to making the class and its knowledge ‘bigger than itself’. What about the online 3D virtual environment? Did it have a materiality that allowed it to contribute to making the class and its knowledge ‘bigger than itself’?

I described the pattern of relations the online software contributed to performing as *fluid*. It was characterized by entities coming together gradually, continuously transforming due to the optional and exchanging elements making up the fluid pattern of relation whose relations were consequently unstable. After comparing this pattern of relations with the knowledge performed in the classroom and with Boyle’s experimental knowledge I concluded that the knowledge performed with the online 3D virtual environment did not have the materiality needed to perform a regional pattern of relations and hence representational knowledge.

The virtual environment design did not involve any model or standard but only incomplete images and cryptic sentences and neither did it have any object which could help to refer to any model or standard somewhere else, as the one-meter ruler did in the classroom. Due to this assemblage no representational knowledge could be performed. Instead, elements – building blocks, links and chat, feedback from the Femteditians elements from outside involved in finding and selecting URLs, etc. – were added one after the other with ongoing transformation as a consequence, and an instability that contradicted the performance of a regional pattern of relations and representational knowledge. When the teacher complained about the lack of resemblance she also mentioned that she found the building of a Viking village much more reasonable. Now, this makes sense. If we had asked the children to build a Viking village, they could have used pictures from their history textbook, just as they would have visited the open-air museum south of Copenhagen, where a Viking village is reconstructed. This indeed would have made available the constitution of a regional pattern of relations and representational
knowledge. But without these stable materials – the textbook or the open-air museum – no representational knowledge could be performed.

The form of knowledge performed could however neither be characterized as communal. The online 3D virtual environment lacked the materiality which made it available to witnessing either directly or virtually. It was because the bed-loft was big, visible and immutably nailed to the walls of the classroom that it could attract parents and principal and that it could be observed and witnessed. The online 3D virtual environment, on the other hand, was difficult to witness due to the novelty of the technology, because of its ongoing transformation and because of the plurality it contributed to. While it was difficult to witness the online 3D virtual environment, it was indeed possible to be involved temporarily. Other children were involved, contributed to the liquid knowledge and let it continue and transform. Due to the task of linking, children involved web pages which they got to know through their informal relations to other children. Hence, it was because of the digital materiality that other children became involved. This temporary involving, however, performed a different pattern from the circulation of knowledge in a stable network, just as it was unable to contribute to drawing people involved together in a stable network through witnessing, which was required to perform communal knowledge.

The online 3D virtual environment did not have a materiality that made it available to contribute to performing representational or communal knowledge. Did this mean that it did not contribute to making the class and its knowledge ‘bigger than itself’? No, children from outside, web pages and URL material, etc. were involved. Continuously involving new elements from beyond the school was indeed crucial for the Femtedit design to continue. The forms of knowledge performed, we must conclude, is not only due to whether the learning materials are able to connect between the school and beyond, but also how these connections are arranged. With the online 3D virtual environment, the connections between the activities in the computer lab and outside school were indeed established but they were unstable and changing, which is different from the stable networks both representational and communal knowledge, in different ways, were dependent upon. The liquid knowledge differed from the way in which it related between inside and outside of school in two crucial ways: It was effects and as ongoing transformations that connected between the inside and the outside of school.

The virtual environment let elements from beyond the class have effects on the activities with the online 3D virtual environment just as it let the activities with the online 3D virtual environment have effects in the world outside school. Discussions on schooling often concern the
relation between school and the surrounding society, demanding more permeable boundaries of the school. However, this is usually discussed as what I would call semi-permeable boundaries which makes boundary crossing possible only in one direction: from the ‘outside society’ to school. Not the other way around. Among the many reasons for making schooling obligatory in Europe in the mid-19th century was the wish to remove children from the streets because of their threats to the public order and their revolting behaviour (Cunningham 1995). Keeping children in schools was a way of preventing them from having effects on the public order. Because schooling is now obligatory it is less obvious that the absence of children’s effects on society is still crucial. However, Lee (2001) draws our attention to the British government’s 1998 strategy, which allowed local authorities to impose a curfew on children under 10 who are on the streets between 9 p.m. and 6 a.m. without adult supervision. The curfew does the job at night of keeping children away from having effects on the surrounding society which schools do during daytime. Representational knowledge which refers to but does not intervene with elements beyond schools’ boundaries and communal knowledge which circulates in stable networks outside schools are safe from the point of view of the public order.

Secondly, because the liquid knowledge which the online 3D virtual environment contributed to performing, was effective the connections between school and the outside of school were continuously transforming. The Pakistani song was performed in the computer lab as a song title, as teasing, and as recognition of a foreign culture but between and after these performances it travelled beyond the computer lab to places where I could not trace it. In that respect my position in the pattern of relations was not different from that of the teachers and, like myself, they were not able to trace the liquid knowledge which can indeed be seen as one of the reasons why the teacher complained. Because it is untraceable and because it is impossible to create an account of without compromising the liquid character of the knowledge, liquid knowledge cannot be directed in a controlled way to travel to the examination rooms in a controlled way nor to networks of people who could recognize it and grant it, if not universality, then at least publicly valid.

The consequences of the three forms of knowledge described are indeed different. One of the points at which they differ is on evaluation. In his discussions of constatives and performatives Austin (1962) notes that constatives, like representational knowledge, can be true or false, and they can be verified. Performatives, on the other hand, cannot be true or false. They can be ‘felicitous’ or not. Whether they succeed depends not on the performative itself, but on the circumstances. Saying “I do” before the alter does not perform the marriage, if it is the wed-
ding rehearsal and not the date fixed for the wedding at which all your friends and relatives watch you with tears in their eyes and where the minister subsequently notes your names in the parish register. The context is decisive for whether performatives succeed or not. But they can never be verified. They can not be true or false. Similarly, you cannot tell whether what was created with the online 3D virtual environment was true or not. ‘Truth’ is a concept that belongs to representational knowledge and the logic of regional patterns of relations. One of the consequences of representational knowledge is that it makes it easy to test children’s knowledge, and it makes it relatively easy for future employers and further educational institutions to differentiate between proficient and incompetent candidates. At the same time, however, it excludes a major part of children’s lives as sources for knowledge, skill and development. This exclusion is a necessary in order to establish the stability and well-delimited character of the regional pattern of relations of representational knowledge, as discussed on page 102. The purification of representational knowledge means that large parts of the socio-material activities that are involved in performing the knowledge are disregarded. Just as Boyle’s experimental arrangement excluded all kind of legends and lore from the purified space of the laboratory. Liquid knowledge, on the other hand, allows a greater diversity of elements to contribute to performing knowledge. It however cannot be evaluated whether it is true or not. It may be evaluated on whether it is successful or not, as performatives. But while the performatives Austin discusses are embedded in quite formal or well-established interactions and thus have quite clear criteria for success, the criteria for success were not settled for Femtedit. It made children and other entities come together and interact but because the knowledge continued among children in unstable assemblages and because the knowledge transformed as it went along, it was difficult to evaluate.

You might want to develop instruments for monitoring the liquid knowledge performed with the online 3D virtual environment. Indeed, the abstract character of a marking system can always be added to any form of knowledge, also to the performances in Femtedit. Translating the liquid knowledge of Femtedit into marks would be a way of making it available for parents to witness Femtedit. However, this translation would indeed transform the liquid form of knowledge just as our registration did of what the children had got to know through the online 3D virtual environment, described on page 124. Liquid knowledge is probably as it is because it is not monitored. As I described, Thrift wanted to honour his late father, but refused to let an obituary colonize the father. Thrift continues:
We need a form of writing that can disclose and value his legacy – the somatic currency of body stances he passed on, the small sayings and large generosities, and, in general, his stance to the world – in such a way as to make it less important for him to be written.

Thrift 2000, p.213

Thrift's solution is to let the somatic currency of his father circulate. In the article Thrift does not mention his father again after the first one and a half pages. The father stays in the text as a ghost. Because I do not have any representational knowledge of Thrift's father, I cannot tell in which ways his somatic currency circulates in the text. But I believe it does. I believe Thrift has done what he could to continue the “small sayings and large generosities” as well as other experiences of his father in the text. Validating liquid knowledge is less about evaluating it, and more about continuing it. ‘Somatic’ is a good term, because it emphasizes the embedded and material character of knowledge – it is about circulating social and material elements involved in performing the knowledge.

I described how Tine, my colleague, was in doubt about how to react to the satiric animation she disliked. As I have described, liquid knowledge does not create a regional pattern of relations. This is not only the case for the knowledge and the object, but also for the humans involved. As I shall describe in more detail in part three human presence changes with the different patterns of relations. The teacher reprimanded Pete for the worthlessness of what he was doing, for the lack of any quality in the web pages he was visiting. Thereby, the teacher did what she could to establish a regional pattern of relations in which knowledge and thus web pages can be evaluated in definitive and dichotomous terms – as valuable or worthless. The teacher placed her assessment of the web page in general terms. She did not involve herself as a person but formulated her verdict as objective. Just as we saw Boyle doing in the former chapter, the teacher factored out her own agency out of the knowledge claim and created thereby a region, a measurement or standard against which good quality could be judged. Wishing to forbid the link and excluding it as a possible element of knowledge my colleague Tine was also just about to perform such a ‘view from above’, or rather from ‘nowhere’. But Tine hesitated, realizing that this did not agree with the frame story, which carefully only drew on elements available in and through the online 3D virtual environment as resources for knowledge. Banning a satiric web page would not have any grounds in Femtedit and the socio-material activities going on there. It would be grounded on reasons independent of Femtedit. Tine’s alternative was clever. She provided a personal, partial view. A view that allowed the other elements of the fluid pattern of relations to be included as a component of the ongoing process. It did not
stamp the web page as objectively good or bad. It contributed with a perspective on the web page which did not have to be either adopted or rejected but could be taken in and contribute to forming and transforming the process. Unlike the teacher’s ‘view from above’ which could only connect to elements that would either accept it or reject it.

“That’s the problem with the Internet; you never know what sort of rubbish the children get in touch with”, the teacher said. Indeed she was right. The Internet provides a plurality of more or less edited information. In a regional pattern of relation this is problematic because it puts you in the position of finding out whether what you find on the Internet is true – whether it has (performs) a referent ‘out there’ in the world. Or whether it is untrue which implies a representational position as well that just performs the referent as absent. Taken instead as fluid, materials from the Internet could be taken into the knowledge process and situated in the pattern of relations performed. Just as a personal, clearly partial perspective could be integrated as an element in the somatic currency of the liquid knowledge, and contribute to forming the knowledge.

Teachers’ task in cultivating liquid knowledge in school would be to participate carefully in the socio-material knowledge practices, and do what they could to contribute to their continuity or prolongation. To let their somatic currency circulate. With reference to Despret (2004b) I will call this withness as a contrast to witnessing. While witnessing requires a distance to the object that is witnessed, withnessing means staying with the liquid knowledge in a way that let the somatic currency of the practice circulate without making it a distant object, a representation.

Withnessing and contributing personally or partially is one of the consequences of the fluid pattern of relations. Liquid knowledge flows, continues and transforms. It cannot be dealt with in absolute terms – true or false, right and wrong. Therefore, the role of the teacher and the relations between the teacher and children also becomes something other than the one performed by and through the regional pattern of relations. This is what I shall discuss in detail in the part three of this thesis.

The connections between school and outside of school, the way in which learning materials contribute to making those connections and to making the class and its knowledge ‘bigger than itself’ matters. In order for knowledge to be universal or at least public and valid (and to work as an instrument of differentiating between children) these connections must be stable and possible to witness. When this is not the case, the teacher must complain. She must warn that the form of knowledge does not agree with the pattern of relations which schooling is entangled
in. This is what the teacher did when complaining about the lack of resemblance and of collaboration in Femtedit. From the point of view of a representational or communal knowledge what was achieved with the online 3D virtual environment was a mixed up jumble. It was liquid knowledge. Effective and untraceable.
Part Three

Forms of Presence

In this third part of the thesis I continue the descriptions of performative effects of the fluid patterns of relations of the Femedit online 3D virtual environment. I do so by comparing these patterns of relations with classroom practices. More specifically, I study the forms of human presence resulting from the patterns of relations performed in the classroom and with the online 3D virtual environment. Presence became of interest as I observed the teachers being restless in the computer lab. Since they were not restless in the classroom, the question arose about what constituted the restless presence whilst working with the online 3D virtual environment.

I define presence as human participation. Many authors have been absorbed by the discussions of the ways in which computers and Internet may influence our selves and our identities. Turkle (1997) emphasizes that the computer is a new tool for thinking about identity and the Internet and simulation software are especially useful for playing with the plurality of postmodern identities. My approach to human presence is different. I do not ask how the human may come to think about or understand him or herself differently through interaction with computers but how the humans ‘are in the world’ with computers – or more specifically with the virtual environment design in question. I ask in which ways humans may come to connect to other entities – technical, non-technical, human or nonhuman – due to the involvement of this specific software in practice. As I have clarified in part one technology should be studied with its social aspects: likewise humans should be studied with their technological or material aspects, as a result of socio-material practice. Thus, studying human presence is just as much about studying socio-material assemblages as the study of technology and forms of knowledge were. The only difference is that now the human presence is in focus as the performative effect of these assemblages. It is especially my interest to describe how the fluid pattern of relations performed with the virtual environment design contributed to performing different forms of presence. Socio-material practices are multiple, I have argued. Thus, understanding presence as an effect of socio-material practices implies that as practices vary, so does presence. The focus of part three is to describe how different learning materials contributed to performing different forms of presence.
In describing different forms of presence I have been inspired by theorists who in different ways understand the ontology of human as an interactional achievement. I will use the notion of subject, collective and agent. But different from the theorists, from whom I borrow the notions, I use the notions as empirical metaphors. By this I mean that contrary to the fathers of the notions for whom they are central theoretical concepts, I only take them as descriptions that fit particular presences performed by and through particular patterns of relations. I talk about forms of presence that are achieved as an effect of particular socio-material assemblages, and which I do not understand as foundational neither to my descriptions, nor to the persons (as a whole) I describe in these ways. Important for my use of the different notions is indeed that they help depict not only the characteristics of the forms of presence, I discuss, but also the differences between them. I do not consider whether or how the different forms of presence may add up to constituting one whole person. I consider this is an empirical question beyond the scope of this thesis.

As in part two I turned to my data from the classroom to see if contrasting these with what I experienced with the online software would be helpful in understanding the latter. And it did. Over the next two chapters I discuss teachers’ presence. The descriptions are, like those of part two, results of oscillations between materials from the classroom and materials from the online 3D virtual environment. This third part of the thesis is however not only about describing the teachers’ restlessness in the computer lab as an effect of their interaction with the virtual environment. Neither is it only about understanding different forms of presence performed with different learning materials. It is also about understanding separations and connections. Separations in the pattern of relations in the classroom, which I shall characterize as regional. But it is mainly about separations in fluidity. About less agreeable sides of fluidity. Especially, I look at the ways in which separations were performed by and through the fluid pattern of relations with the online 3D virtual environment. Being defined by ongoing transformation, by involvement of elements from outside and by blurring boundaries, it sounds as if fluid patterns of relations do not create any divisions, any separations or any splits. Where are the splits in the river, in the rain, in a cup of coffee? They are hard to see. I was directed to this question when discovering boundaries in the classroom which were not performed with the online 3D virtual environment. Did the fluid pattern of relations of the online 3D virtual environment produce any separations? And if so, how did they look? We set out by looking at the classroom.
In this chapter I visit the classroom and see how the teachers’ presence was performed there. How teachers’ presence came to be as a result of the pattern of relations performed by and through materials and humans in the classroom. Even though it is the teachers’ presence I want to know about I need to decentre from the teachers and look at the patterns in which materials and humans were related in the classroom. Since teachers’ and pupils’ forms of presence were co-constructed as opposed regions, as we will see, I not only discuss teacher’s presence but that of the pupils, too. Several materials were involved: songs, desks, hair clips, chalk pencils, exercise books, papers, etc. Among these was one material especially involved in the patterns of relations in the classroom. This material was the blackboard. It contributed to performing regional pattern of relations with boundaries between pupils and the teacher, which resulted in the teacher’s presence as that of an authority and the pupils as that of subjects.

There are many, especially social psychological, studies on authority. One of the most quoted is Adorno et al.’s *The authoritarian personality* (Adorno et al. 1950), which argues that authority is exercised due to a specific personality developed through early childhood. This hypothesis is still popular and a standard topic of social psychology textbooks. It is however also challenged. Cultural approaches see authority as a product of an authoritarian culture, while cognitive approaches have pointed to the human’s limited information processing abilities as the source for authority (Sabini 1992 p.126 ff.). Even though diverging, these schools of thought share the implicit understanding that authority is located in the individual – either formed in early childhood, influenced by culture or due to cognitive abilities. Discussing the nature of social psychology sociologist Johan Asplund (1985) notes about “The Authoritarian Personality” that rarely has such an untenable work had such an influence. His critique of the book as well as of the approaches critical to it is that none of them understand the historically variable qualities of social spaces, and consequently, their explanations are reduced to an individual level. While appreciating Asplund’s emphasis on the interactional (and hence historically variable) qualities of space, I take in this chapter the understanding of authority one step further, not studying it as a social achievement, but as a socio-material achievement. The chapter shows how materials – especially the blackboard – are involved in performing authority as a...
socio-material achievement. It forms the background for chapter 9 which, looking at the online 3D virtual environment, notes that regional patterns of relations were not performed with and through the online 3D virtual environment. This became a problem of authority in the computer lab, as we shall see. But let’s first turn to the classroom.

**Performing a one-to-many relationship with the blackboard**

We start with a field note excerpt. It is a Danish lesson in the 4th grade at St. Marc Street School. I am seated in the back of the classroom with a notebook on my lap and a pencil in my hand. The teacher arrived a few minutes ago assisted by a teacher from the neighbouring class, each with a pile of dictionaries.

*The dictionaries are distributed while the teacher explains that today they are going to learn how to use a dictionary. A necessary qualification for using a dictionary, she adds, is being familiar with the alphabet. Let’s sing the alphabet song, the teacher says and picks up the chalk pencil from her desk. She turns to the blackboard and raises her hand with the chalk to the blackboard. With her body facing the blackboard she turns her face towards the class and asks “are you ready”? This makes me curious. Ready for what? Everyone apparently knows what is going to happen. Except for me. The teacher takes a deep demonstrative breath and starts the song: “a, b, c, d ...” Already at ‘a’ the children join in and with their eyes fixed on the blackboard they sing the song out loud and clear. On the blackboard the teacher writes the letters one by one at the pace of them being mentioned in the song. It doesn’t look easy to keep up with the pace of the song. By the end of the song 28 letters are on the blackboard. The teacher turns around and facing the pupils she says with a smile: “I made it”.  

*Field note 2509_40*

All pupils were seated at their desks. The teacher was at the blackboard, writing. The pupils were carefully watching the teacher’s writing. Or more precisely: they were watching the letters appearing on the blackboard. The visual materiality of the letters appearing on the blackboard constituted a geographic place to which each child’s gaze was fixed. O’Day et al. (1998) note that the blackboard (or whiteboard in their study) works as a ‘focusing feature’. This was the case in the 4th grade classroom not only due to the letters having a visual materiality, but also because they were emerging in the very situation: They were at risk. The whole assemblage was a game in which the teacher to the amusement of the pupils put her abilities at risk of writing the letters at the pace of them appearing in the song. The possibility of the teacher failing made the children carefully monitor the letters appearing at the blackboard.
Figure 9 is an attempt to sketch the assemblage of children (◯), letters on the blackboard (□) and the teacher (◯). The letters on the blackboard were in the centre of the attention. The teacher and the emerging visual materiality of the letters she was writing on the blackboard co-constituted one single and central geographic place to which the pupils’ attention were drawn.

The pupils were all seated. Due to the layout of the desks in the classroom their gazes were easily directed towards the blackboard. This geographic place positioned the teacher opposite the pupils with the teacher writing letters on the blackboard at one side and the pupils’ gazes on the letters on the other. It was a one-to-many relationship: one teacher opposite many pupils. I return to this assemblage below and discuss the forms of presence performed by and through it.

Performing a collective through singing

To emphasize the point that the visual materiality of the letters emerging on the blackboard were involved in constituting this one-to-many relationship, I contrast the occurrence with other occurrences of singing I witnessed in the classroom, in which the visual blackboard was not involved. Here is a video transcript of one of them:

It is the last lesson on the timetable. The class has been working with the exercise book. All pupils are seated at their desks. Standing at the blackboard the teacher has told the pupils to pack their things and she has said that she wants the class to sing a song when finished packing. Two minutes later all desks are cleared, chairs are pushed under the desks and the pupils are standing behind their chairs with their rucksacks on their backs. The teacher’s voice is heard again:

“You need to put the desks back in place”.

52 I’m aware of the misleading connotations of representing humans with circles and materials with a square reproducing a stereotypical Western symbolism. Just as I am aware of the potential simplification and reduction caused by representing an activity in such a figure. However, I here need to appeal to the goodwill of the reader to read this figure as a partial element for discussing the pattern of relations rather than seeing it as attempting to accurately correspond to the activity discussed.

53 The specificities of the visual character of the materiality of the blackboard is discussed in Sørensen (Sørensen 2003b).
Desks are pushed in place, while the teacher continues: “I badly need to hear some beautiful… some really beautiful song… Quiet!… Pete!… I dream about us being able to remember one of those we learnt down at… eh…”
“Greenland”, a pupil suggests.
“No, not that one, not the one from Greenland, the one down from… eh… Bulgaria”
Several children suggest songs.
“Which one do you say?”
One child repeats the name [inaudible].
“Yes, that one! Should we sing that one?”
Children start chatting. The teacher says in high voice:
“We try… hush-hush… remember [inaudible]… one, two, three”
Teacher and pupils start singing. Pupil’s bodies are swinging from side to side.
Some hold their hands on the back rests of the chairs, some have turned around and are leaning on the backs of the chairs while others have stepped back from the chairs and stand in the open room. Keeping their feet in place most of them swing their upper bodies slightly to the sides. Their faces move slowly to one side and the other. Gazes travel from face to face. Several times a child smiles when his or her eyes meet those of another child.
“Well done!” the teacher says as the song is over. "Get home well, and don’t forget the textbook tomorrow”.
Pupils start chatting while moving towards the door that has already been opened.

It is the singing that interests me. The way pupils’ bodies swung and faces turned in the classroom. Calmly pupils let their gazes travel and got eye contact with one after the other. The relations between them were constituted through the common singing and through letting their eyes and bodies meet. Sometimes, the mutuality was emphasized by a smile. While the video highlights the visible bodies it is important also to note the ubiquitous character of the sounds of the song. It was in the muscles and bodily vibrations involved in producing the song and at the same time it was in the room, everywhere between the four walls of the classroom. Looking at the bodily movements we note the pupils’ visual attentions followed this ubiquity of the sounds, letting the gazes travel around in the classroom. The ubiquitous sounds of the song, the continuously travelling gazes, the eye contacts and the smiles performed connections between pupils. They drew the singing together. By mutually drawing each other together the song, the travelling gazes, eye contacts, swinging bodies and smiles performed the assemblage as a collective.

I use this term ‘collective’ as an empirical metaphor defined with inspiration from Asplund (1985) who associates the collective with medieval peasant society. Collectives and collective beings are characterized by being directed towards the present without any expectation of progress or change. This also means that the collective is directed towards itself, not towards something apart from it in either time or space. As a member of a collective, you share the life and
activities with others. You are not feathering your own nest – as the collective’s counterpart, the individual is – because your nest is the nest of the collective. There is no clear boundary between you and the collective, and hence no individual stands out from the crowd. Not that there are not criminals, witches and other ‘others’. Indeed, there are, but these are parts of the collective (as Foucault (1979) also emphasizes). Criminals are collectively punished because crime is not a personal business nor a business between a person and the authority; it is everybody’s business. Everyone is mutually related in a collective. I won’t discuss whether Asplund’s description of the medieval way of being is correct or not. I do not understand the collective as typical for a specific historical episode but use the collective as an empirical metaphor. As an analogy that makes me depict a specific form of presence that I accept may be more prevalent at specific historical places or times but which I only use empirically to describe a form of presence that displays the characteristics of the collective. I use it to describe empirical moments that may be of longer or shorter duration. In this case, it was indeed of short duration. The mutuality of the gazes and swinging bodies created a form of presence in which humans were directed towards each other and the song. There was no external focal place, no goal or target the activity was heading for. There was only the song and the bodies and gazes continuously performing mutuality between humans. It was here and now, and in this moment all humans were part of the song. The pupils were not acting differently nor was anyone standing out among the rest. They were connected collectively through the song.

The characteristics of this pattern of relations render schematic figures inappropriate. Figures depict elements as clearly separate and relations as located between elements. This fits to the regional pattern of relations, while it does not fit to the collective pattern of relations. Schematic figures are popular visualizing devices, especially in management literature, but also in social science. It is rarely discussed what the figure does, and why some patterns of relations fit to schematic figures while others don’t. Using such figures as ‘neutral’ representations of
patterns of relations easily makes us think of pattern of relations as regional, which they may often not be. Figure 10 depicts how the collective should not be depicted.

We are all familiar with the ability of songs to contribute to performing collectives: from family gatherings, religious ceremonies, from parties, national celebrations, etc. Songs can indeed be crucial glue in sticking humans together in collectives. Returning to the occurrence with the emerging letters on the blackboard we notice that no collective was formed. Then, the letters appearing on the blackboard absorbed the visual attention of the pupils and directed all gazes towards the same geographical place. Hence, children’s gazes were parallel directed towards an external place contrary to the gazes and bodies that during the Bulgarian song mutually confronted pupils. During the alphabet song the bodies and gazes of the pupils did not confront each other. They all confronted a geographical place which positioned the teacher opposite to the pupils. Furthermore, the pupils were not only related to the emerging letters through their gazes but also through their voices and the song whose rhythm matched that of the emerging letters on the blackboard. By the way in which the rhythm of the song and the emerging letters on the blackboard were coordinated a quite strong one-to-many relationship was performed in which several elements were precisely calibrated to contribute to the same pattern of relations. While I have already characterized the form of presence during the Bulgarian song as collective I hesitate with characterizing the presence during the alphabet song. Before I return to this, we need to discuss this more complex pattern of relations in more detail.

Two regions and one collective

Through the two occurrences in the classroom we learn about how a one-to-many relationship and a collective were differently performed in the classroom. With and without the visual materiality of emerging letters on the blackboard different interpersonal relations were performed. From focusing on the relationship between persons – as a one-to-many relationship and a collective – I turn in this section to focus on how separations were performed in the first while not in the latter.

The occurrence with the Bulgarian song performed one gathered pattern without any internal separations. A pattern was formed which was held in shape by the mutuality of all participating elements. The occurrence with the emerging letters on the blackboard performed an assemblage with an internal separation of the writing teacher at the blackboard on the one hand and on the other the singing and reading pupils. At the blackboard the teacher was writing and actively trying to keep up with the pace of the song while apart from her the pupils were read-
Authority and subjects in the classroom

Regional presence in the classroom

A regional pattern of relations was performed with two regions. One with the teacher writing and actively trying to keep up the pace of the song, and one with the pupils reading and reacting on the teacher’s writing. During my classroom observations and especially by trying to describe and characterize the materials in the classroom the blackboard appeared as a pivotal material of the classroom. I realized, as I discuss below, that the blackboard was a regional technology. Or putting it more precisely: A technology that in its specific version in the classroom setting contributed to performing regional patterns of relations.

In the two following sections I go into more detail about the regional characteristics of what happened in the classroom, discussing the boundaries between and homogeneity within each region and the differences across regions. I take quite some pages to discuss the blackboard and what happened around it in the classroom. Not only in the occurrence with the emerging letters on the blackboard but also at several other occasions. This is because we need a thorough description of the pattern of relations in the classroom in order to realize the specificities and differences as well as the similarities and sameness emerging with the online 3D virtual environment. Especially, I focus on separations and boundaries.

Boundaries separating homogeneous regions

The blackboard contributed to creating a place in the classroom to which attention was drawn, as illustrated above in the description of the emerging letters. The blackboard was a pivotal material in the performing of attention in the classroom because it formed a big visual field for all pupils, as of their desks all faced towards it. This was not particular to when the alphabet song was sung. In almost all lessons I attended in St. Marc Street School the blackboard played this role. At times carefully prepared texts and images were put on the blackboard by the teacher. At other times the teacher wrote words and signs on the blackboard to support her explanations of different spellings. One put numbers on the blackboard to make everyone focus
on a specific calculation, and another drew a map to help children formulate sentences in English about directions and locations. At all these occurrences attention from all pupils was directed towards the blackboard.

The pattern of relations depicted in figure 9 was recurrently performed in the classroom with the blackboard as the material involved in gathering attention at one geographic place. It created a place separate from the pupils to which attention could be directed. In the occurrence of the class singing the Bulgarian song, the materiality to which the pupils’ attention was directed – the song – was not clearly delimited from the pupils. It was inside, among, between them. Contrary to this, the blackboard clearly established a place outside the children, whereby a ‘here’ and ‘there’ was established. A geographical ‘here’ and ‘there’. Here the blackboard, there the pupils (or vice versa). Not only at the blackboard was a geographical place performed, but through this a geographical ‘counter’ place was performed opposite to the blackboard from which the children could attend to the blackboard.

There were also words (‘orientational metaphors’ as Lakoff & Johnson (1980) call them) involved in performing these two places. “Laila, please come up to the blackboard”, the teacher could say, and when the pupil had done what she was asked to at the blackboard she would be asked to “go down to your seat”. There were two distinct places – ‘up here’ at the blackboard and ‘down there’ by the pupils. Being clearly delimited places separate from each other they fit the regional metaphor. Two regions were performed by and through the assemblage around the blackboard.

While the blackboard anchored the pupils’ gazes at the visual region on the blackboard, the lines of attention also separated pupils and the blackboard. Pupils were ‘here’ attending to the blackboard ‘there’. The lines of attention created a distance between pupils and blackboard. Pupils were connected to the blackboard which was however distant to them, i.e. separate from them. The Bulgarian song was not distant to the pupils and hence did not have the ability to draw pupil’s attention to one single place. The Bulgarian song was circulating among the children. It didn’t create any ‘here’ and ‘there’, any distances, any separations. The assemblage involving the visual materiality on the blackboard created distance and separations between the region of the blackboard and the region of the pupils. I further characterize this separation to it below.

First, I take a closer look at each region. The blackboard region was the teachers’ home. That this was the case could especially be observed when those not ‘at home’ in this region visited it. Even though the teachers were the most frequent writers on the blackboard, they were
not the only ones. Sometimes, a pupil was called to the blackboard, which however did not necessarily mean he was going to write on the blackboard. “Going up to the blackboard” meant going to the area of the blackboard, not necessarily to write on the blackboard.

*It is the library lesson in which pupils can either go to the school library to take out books, stay reading in the classroom or write book reviews either at their desks or in the computer lab. When a book is finished a review has to be written. After half an hour in which some pupils have been in the library, others in the computer lab and some stayed in the classroom, all pupils and the teacher are again gathered in the classroom. The teacher has corrected a few book reviews, which she holds in her hand. Standing in front of the blackboard she asks: “Who would like to read their review out loud”? Three children raise their hands. Nina is one of them. “Nina, please come up”, the teacher says. Nina goes to the blackboard. Seated the teacher hands out Nina’s review to her saying loudly: “Nina liked this book very much, so pay close attention. Maybe others might want to read it”.

Nina has taken the review out of the plastic folder. She stands next to the seated teacher in front of the blackboard facing the rest of the class. She reads the review. When finished, the teacher says “Very good, Nina” and without a sign the pupils applaud.*

Field note 2910_86

By moving her body from the pupils’ region to the blackboard to read a text out loud Nina’s voice gained attention from all pupils in quite the same way as did writing on the blackboard. It happened often that a pupil’s presentation at the blackboard was followed by applause. This never happened as a reaction to a presentation given from the pupil’s desks. The different reactions to similar presentations at different places contribute to perform a *boundary* between the region of the pupils and the region of the blackboard.

Even though pupils could cross the boundary to the blackboard region they were clearly ‘guests’ here: They only entered this region when being explicitly permitted access. Teachers were mistresses of the blackboard region, they were the ones who regulated who could enter the region and when. Furthermore, applauses frequently followed pupils’ presentations at the blackboard. Teachers were never applauded. They were not guests, they were at home. Consequently, what they did in the blackboard region was ordinary, while what the pupils did there was extraordinary.

As the latter field note indicates the blackboard region was not limited to writing on the blackboard. It was an area around the blackboard that had a particular identity in contrast to the region of the rest of the classroom. But writing was a crucial activity associated with the blackboard, and this writing was indeed much more frequently done by the teacher than by the pupils. Teachers had chalk pencils with their names engraved on them. These pencils would
protect the skin of their fingers from drying out as a consequence of holding the chalk for so many hours every day. And the chalk pencils contributed to performing the difference between teachers and pupils. No pupil had a chalk pencils. As rare writers on the blackboard they had no need for a chalk pencil.

The blackboard region and the region of pupils were separated by a boundary. The boundary separated the teacher from the pupils and set two distinct regions with different rules of conduct. There were, moreover, different norms for how long anyone would stay in the region. The pupils as well as the teacher always only stayed briefly in the ‘other’ region. As if a rubber band was attached to them, always pulling them back to their ‘own’ region. Playing the videotape fast forward from my classroom observations I realized how the teacher always went down to one, two or three pupils to talk to them individually when they were working on their own with the exercise books. Then she walked back to the blackboard, stood there for a while, returned to talk to one or two pupils, went back to the blackboard again, etc. Sometimes she would write notes on the blackboard to remind herself of things to be explained later, but most often she would just stand next to the blackboard for a minute or two before she went ‘down’ again to another pupil.

Even though the ‘inhabitants’ of one region could visit the other, they were clearly performed as outsiders there. Each region was different from the other and it was itself a homogeneous region consisting of the teacher in the blackboard region and pupils in the other. The boundary, the distance between the regions and the homogeneity of each region were what allowed the one-to-many relationship. Only as long as the pupils were all ‘the same’ could the teacher instruct all of them at the same time, as one. She could teach in a broadcasting mode because of the performance of homogeneous regions with a boundary between them.

**Boundaries contributing to performing subjects and authority**

While the section above focused on describing the ways in which elements were connected and separated making up the regional pattern of relations, this section looks closer at some of the implications of this pattern of relations. I shall argue that the blackboard and the regional pattern of relations make available the performance of authority.

Writing on the blackboard created a visual field which attracted the attention of pupils to what was going on on it. As described, the blackboard let the teacher hold all pupils’ gazes – the whole class – in his hand. Much like a puppeteer controls his puppets with slight wrist movements, or like a child controls her avatar in an online 3D virtual environment, as we shall
see later. The geographical place at the blackboard, the distance and the boundary which performed two regions made available a one-to-many relationship in which the teacher held the class in his hand, just as it performed a broadcasting mode of interaction. This way the blackboard contributed to performing the teacher’s presence as that of an authority vis-à-vis the pupils.

Furthermore, what was written on the blackboard could be seen and witnessed by all pupils at the same time. This made it important.

\[ T: \text{David, will you read out your speech for us?} \]
\[ D: \text{I didn't know I had to bring it} \]
\[ T: \text{But it was written on the blackboard!} \]

Field note 2509_53

The writing on the blackboard was official and could be referred to as such\(^{54}\). Contradicting the statement about what was written on the blackboard meant turning against the perception of everyone else in the class. Through the blackboard and the arrangement in parallel directing all children’s gazes towards the blackboard the teacher was allied with all pupils’ perceptions. Contradicting the statement was thereby not only contradicting the teacher, but contradicting everyone’s perception. This alliance contributed due to the blackboard to performing the teacher’s presence as an authority.

The region of the blackboard was saturated with authority, with drawing attention to what was said and done, and to the individual who said and did. In the region of the rest of the classroom it was possible to say and do a lot without anyone paying particular attention to it, without it gaining authority.

I have tried to describe the teacher’s form of presence isolated from that of the pupils. It has however not been entirely possible which is due to the fact that the presence of the teacher and the presence of the teacher is co-produced. In the same way as one region is co-produced with the other. Althusser’s notion of \textit{interpellation} helps us understand this.

Althusser discusses ideological state apparatuses. Here, the subject comes into being through \textit{interpellation}\(^{55}\). Interpellation happens in moments when we recognize ourselves because we have been addressed, called out to. “‘Hey! You!’ And round we turn to face the po-

\(^{54}\) Thanks to Herbert Kalthoff for drawing my attention to this point.

\(^{55}\) I follow Law’s (Law 2000b) discussion of Althusser and as Law I abandon much of Althusser’s theory, for instance the discursive foundations of interpellation. Like I did with Asplund’s notion of the collective I use Althusser’s term ‘subject’ as an \textit{empirical metaphor} not as explaining a certain presence emerging necessarily or logically in the ideological state apparatus, as Althusser does.
liceman, the head-teacher, the priest” (Law 2000b p.14). Being confronted with an authority we become subjects because we are subjected to a state Subject with capital S. Figure 11 is a reproduction of how ethnologist Thomas Højrup (1995 p.135) depicts Althusser’s relationship between the subject and the state Subject. Apart from the emerging letters in the middle of figure 9 Højrup’s figure is similar to the way I have depicted the relations between the pupils and the teacher with the emerging letters on the blackboard in figure 9. Only is Højrup’s figure puts upright with the state Subject on the top and depicts thereby the region of state Subject (the teacher) as being “up there” and the subjects’ (pupils’) region “down there”. With Althusser’s notion of interpellation and his depiction of the confronting forms of presences of the authority and subjects I borrow his terms and call the pupils’ form of presence that of subjects in the situation with the alphabet song and during Nina’s presentation.

Althusser does not talk about regions and boundaries. They are implicit in his discussion of subject and authority. However, as I have shown such boundaries and regions are not necessarily performed in the classroom, and hence neither are decisive components of the authority and subject forms of presence. This leads me to two important differences between my discussion of forms of presence and Althusser’s notion of interpellation. The first point is that as it is apparent in Højrup’s illustration in figure 11 Althusser does not involve any materiality but describes the subject-Subject relationship as purely human.

I have shown how the subject and authority were performed as separate through the specific socio-material assemblage of the classroom. Contrary to the occurrence with the Bulgarian song. There, you wouldn’t find regions, subjects and authority. Only where materials like the blackboard were available which contributed to establishing a regional assemblage were subjects and authority performed. Not as an effect of the teacher *a priori* being a state Subject but as an effect of the socio-material arrangement. This indeed differs from Althusser’s conception.

![Figure 11](source: Højrup 1995 p.135)
In Foucault’s (Foucault 1979) discussion of discipline he teaches us how the voices of teachers become a signal to which the disciplined bodies of pupils react instinctively. This was not the reality I experienced in the classroom. There was no doubt that the pupils were disciplined to listen to voices of the teachers differently than to other voices. And yes, panoptic powers were performed in for instance one teacher unexpectedly and frequently reprimanded individually not only pupils disturbing the lesson, but also pupils quietly doing what he or she was supposed to. To me, this indeed looked like the random punishment crucial to the disciplining powers described by Foucault. However, Foucault’s descriptions give the impression that any materiality may be formed to exercise disciplinary power. Through my descriptions it becomes clear that it is not any materialities that can be formed to work as instrument for discipline or authority.

Discussing play, Vygotsky (1978) observes that the some things can be used as substitutes for ‘real things’ in children’s play and some which cannot (p.98ff). The different materialities make different actions and presences available. Vygotsky moreover discusses how drawn figures need to have certain properties in order to be able to stand for specific things like a bucket or a bench when evaluated by children (p.47ff). Similarly, Hatch and Gardner (1993) describe how the materiality of the sand in the sandbox allows the children to play ‘baking’, which they don’t do in the drama corner. Especially, they note, the sand is good for ‘baking’ in October. In November the children dig tunnels because then the sand is wet. As these different materialities make available different activities and presences it became clear through my observations in the classroom that the different materialities of the classroom gained different abilities to attract children’s attention. While teachers’ voices were good at attracting the attention of individual pupils, who were busy with something else, the blackboard was far superior when it came to attracting and keeping the whole class’ attention, and therefore crucial for the performance of the pupils’ and teacher’s form of presence as subjects and authority.

**Otherness in the classroom**

The second point at which I depart from Althusser’s is due to the unidirectional character of interpellation: whereas the subject needs the recognition from the state Subject to become a subject, the state Subject does not need this recognition. It enters a struggle for recognition with other state Subjects. Describing the relationship between the subject and the authority as performed through an assemblage of a variety of *weak* socio-material actors rather than of two.
Authority and subjects in the classroom

opposed actors of which one is considerably stronger than the other, my description draws a quite different picture. Before closing the discussion of forms of presence in the classroom I turn to look at the ways in which pupils contributed to performing the authority of the teacher. Especially how they contributed to the teacher's authority even when directed away from the region of the blackboard. Look at these field note excerpts:

The teacher is going through common errors from this week’s dictation. I notice Steven is carefully drilling his pencil into his eraser. He puts the eraser on the desk. The pencil stands as a flagpole in its eraser base. He drags a little ball out of the pencil case and carefully rolls it towards the flagpole. The flagpole sways as it is hit by the ball. Steven looks at Ariane next to him and smiles. He rolls the ball again. This time the flagpole tips over as the ball hits it. His left hand, which as a shield all the time has been lying behind the flagpole, he silently saves the pencil from landing with a clack on the desk. He slightly drags his head between the shoulders and smiles at Ariane again, whose eyes flickers quickly between the teacher and Steven’s face.

Field note 2509_ 35

The English teacher is pointing at a drawing of roads, houses, shops, a school and a church on the blackboard. He practices the prepositions with the children. Just in front of me, in the opposite end of the classroom from the blackboard Lana carefully tears out the corner of a sheet in her note book on which she has just been writing. She folds gently the note and puts it under the desks with her hand. She carefully nudges Thomas’ knee with her own under the desk. He looks at her. While passing the note to him under the desk, she silently says “Nina”. Thomas takes the note and passes it to Nina next to him. Nina looks stiffly at the blackboard while receiving the note from Thomas, taking her hand with the note casually up from under the desk, opening it with both hands, and waiting a while until she quickly glances down at the note and back up at the blackboard. Only a moment later Nina looks at Lana, nods and looks back at the blackboard.

Field note 2409_25

The teacher is rehearsing the multiplication tables with the children. One after the other pupils are asked to say a multiplication table. Susanna sits next to me. While attending the teacher and pupils saying the tables Susanna opens her hair clip. She shakes her long hair and puts the clip on the desk. She fumbles a bit with her necklace, drags it over the chin and puts it into her mouth. She plays with it a bit with her tongue. Her fingers find the hair clip on the desk and opens it. For a while she closes and opens the clip. Then she raises it to her hair again, lets the fingers comb through the hair a few times and attaches the clip. She lets her head rest on her hand while the other hand fumbles with her bracelet. At no time her gaze deviates from those reciting the multiplication tables.

Field note 2709_85

While most of the field note excerpts I present from the classroom in this thesis are related to the educational activities in the classroom there were many other things going on. The three field note excerpts above show some of what went on apart from the educational activities. Much may be said about such activities that were taking place all the time parallel to the educational classroom activities. For instance, I can't help mentioning how I noticed again and again
that girls due to their jewellery, long hair, hair clips and elastics, etc. had many more materials available than boys to keep their hands busy without the teacher noticing it\textsuperscript{56}. Apart from the gender issue I find it interesting that the activities children were involved in, which in different ways were alternative to the educational content of the lesson, generally involved materials that were either writing utensils or other contents of the pencil case or different kinds of personal adornments. These materials were not banned from the classroom like for instance mobile phones, toys, newspapers and magazines. As legitimate materials of the classroom or personal belongings they were inconspicuous and could hence be involved in activities alternative to the educational while not being sanctioned. Furthermore, as the excerpts show, pupils exercised such activities with such skilful caution that they would not be noticed by the teacher. As a parallel alternative these forms of presence did not confront or challenge the authority. On the contrary, the cautiousness by which the alternative activities were exercised contributed to performing the authority of the teacher. While the children clearly established that an alternative agenda to the educational was indeed possible in the classroom, they at the same time showed recognition to the authority of the activities the teacher was directing by carefully taking place without disturbing the educational activities. By creating the region of the pupils as alternative they contributed to performing the authority of the blackboard region. The identity and norms of the pupil’s region were performed as different from the identity and norms of the blackboard region, altogether confirming the regional pattern of relations. In other words, it is not only the subject that emerges by recognizing itself as subjected to the state Subject. The existence of the authority is dependent on the subject’s recognition of it as such. And this mutual recognition is dependent of the socio-material assemblage they are entangled in.

Finally, I feel the need to mention that this does not mean that all activities went smoothly without being challenged, with all and everyone all the time contributing to the singular agenda of performing the activities as a regional pattern of relations. As it appears, especially from the video transcripts, that the teachers invested a lot of efforts in repeatedly calling for silence and correcting and sanctioning different kinds of behaviour. Often the teacher would open the door to the hallway referring to other teachers, the headmaster and parents that might pass by on the hallway, and who would hear if pupils were not behaving themselves. Sometimes, the teacher even left the classroom with the door open, noting that when she came back,

\textsuperscript{56} In her discussion on rebellion and resistance in secondary school, Brenda Simpson (Simpson 2000) shows similarly how dresses, hair colours, adornments, etc. for boys and girls are available in different ways as means for resistance.
she wanted to find them quiet and busily working. The class was never as quiet as in those occurrences. So yes, the elements involved in performing the regional arrangement were not simply in place once and for all, but all the time actively sustained and repaired.

**Conclusion: social-materiality of authority**

I have described regions in the classroom. They are homogeneous fields separated by boundaries. A region at the blackboard inhabited by the teacher separated from the pupils’ region. Imagining the classroom we can almost draw a chalk line on the floor noting where one region ended and the other began. This may lead us to the idea that the two regions are ‘geographical’ areas, which belong to the room in the sense that it is there before we enter and after we leave. This is how we usually think about space. As a stage that lays before us, upon which we can act. This is however not how I have described the regions. I have carefully described that the boundaries were created by the pupils crossing them. But not only by that. Then, it would be a social space created by humans, as classroom researcher Leander (2002) describes it. I have described the region as not entirely material, not entirely social, but as a social-material pattern of relations involving the co-ordination of blackboard, song, desks, gazes, letters, etc.

As I discussed in the introduction to the chapter, authority is usually related to persons. I have described how the teacher was connected to the blackboard, the chalk pencil, the emerging letters on the blackboard, and the layout of the classroom directing children’s gazes towards the blackboard. And how these social and material elements and their coordination contributed to performing the teacher as an authority opposed to subjects, who were co-performed in the same instance, as opposite to the authority. I continue discussing authority in the next chapter and describe how the lack of regions in the computer lab lead to a lack of authority. This will make the interrelation between authority and regionality even clearer.
In this chapter I look into the teachers’ and children’s forms of presence which were performed with the online 3D virtual environment. I do so by studying the relations between the teacher and children as an effect of the fluid pattern of relations performed and I describe the separations performed between them. The focus will be on the online 3D virtual environment but I recurrently compare this with observations from the classroom, discussed in chapter 8, and I especially discuss the availability of authority in the pattern of relations performed with the online 3D virtual environment.

I start out with the teacher’s restlessness as it appeared on a video from the computer lab. It is the third session of Femtedit. The children arrived a little while ago and everyone is busy in Femtedit. The camera is positioned in the corner of the computer lab and with an overview over two thirds of the room it produces the following sequence:

Most of the researchers are seated turning from side to side. They look into the computer screen to the right talking to the child at that computer and turning to the other side talking to the child at the computer there. Some researchers spend longer time at one side before turning to the other. Others move at a higher frequency as if they try to be in both places at the same time. The teacher moves around differently. He is rarely seated. He wanders around between children in the computer lab. He looks restless. His head and upper body moves in staccato rhythms. He looks around uneasily. He bends down over a child, looks into his screen and talks to him. After a while he gets up, goes to another child as if just because she was in his way. He squats down and talks to her. He gets up and looks around. He walks to another computer, stands behind a child and looks into the screen for two minutes. He points at something on the screen and talks to the child. He straightens his back. His eyes quickly scan the room. He turns around and scans the room again. He goes to an available computer, sits down and works at the computer for four minutes. Then he gets up again, goes to a child, looks into her screen while bending over her from the side.

Their shuttling movements between two computers on the video gives a touch of restlessness to the researchers. But they are seated, anchored between two computers which makes the unrest less apparent. The apparent restlessness on the video belongs to the teacher. In this chapter I discuss this restlessness by studying the moments at which the teachers interacted with the children and the moments at which breaks in the interaction occurred. The video transcript
alternates between describing the teacher in interactions with the children and breaks in the interactions. There are several issues to discuss before I return to the restlessness of the teacher.

Just as I described the separations performed as boundaries in the classrooms I focus in this chapter on the separations performed with the online 3D virtual environment. The literature provides an impression of fluid patterns of relations as creating no separations. In this chapter I show that fluid patterns of relations indeed performed separations. I compare the fluid separations with these performed in the regional pattern of relations in the classroom. No boundaries were performed with the online 3D virtual environment, and consequently, the question asked in this chapter is what shape fluid separations took.

Separations and connections are interdependent. I set out by describing the connections performed between teachers and children with the online 3D virtual environment. Two ways of connecting are shown in the video transcript. Either the teacher was offline looking into the computer screen of the online child while talking to him or her or he was logged on to the virtual environment and interacted with children online.

Performing one-to-one relationship with virtual environment

The field note below involves offline as well as online interaction between child and teacher which are the same two ways of interacting we saw in the video transcript above.

It was Tuesday morning. Half of the 4th grade class of St. Marc Street School was in the computer lab with four researchers and a teacher. They were already logged into Femtedit. The field note reports:

I was sitting on a chair between two computers. At my left hand side Claus was busy and on the other Alena. Claus had read the message from his Femeditian Duni: "I can sense a picture has been added to my home. A picture of a sweet little girl. This gives me energy. But the picture is so far away. If only you could bring it closer to my Duni's home. Then I can absorb its energy. Then, oh, I hope, I will be soon reanimated". Claus logged into the virtual world Femtedit.

Sitting halfway behind Claus I asked him if he knew where the picture was he was supposed move to Duni’s place. He said yes. He hit the arrow keys and his avatar, Dunidk, hastened ahead inside the virtual world. The landscapes passed by quickly on the screen and I couldn’t see where he was heading, only that it wasn’t to where the picture was.

I turned to the computer next to him and logged in to the virtual world Femtedit. I searched around with my avatar, Estroide, until it faced Dunidk. I posted in the chat field that we could help one another moving the picture. We (our avatars) went together to the location of the picture. Claus clicked on the picture and dragged it a little. He hadn’t moved it very far, though, before it disappeared from his visual field on the screen. I saw his avatar fading into the distance. I ran after him. I stopped to write in the chat: "Where are you? let’s
move the picture”. I got no answer. And since I had stopped my avatar while writing the chat message, I had lost track of Dunidk in the virtual world.

Field note 2011_7

The field note excerpt consists of three paragraphs. The first mainly sets the scene and provides the context for the following two paragraphs. I do not discuss that paragraph further. The second paragraph is about interaction between the offline teacher and the online child whereas the last paragraph is about interaction between the child and the teacher both online. I discuss each of these two latter paragraphs in the following two sections.

*Offline teacher* interaction with *online child*

The interaction between Claus and the teacher started with the teacher asking Claus a pseudo-question about whether he knew where a specific picture was. According to Lindblad & Sahlström (1998) it is common for teachers to communicate with pupils in schools by asking so-called *pseudo-questions*. Pseudo-questions do not follow a question-answer format (Goffman 1981 p.6ff). The query is not supposed to be followed by a reply giving the inquirer information he does not already have. On the contrary, the question is posed because the inquirer *does* know the answer and the sentence to follow is expected to provide exactly the information the inquirer already knows.

Because the teacher further down in the field note enters the online 3D virtual environment and tries to make Claus move the picture it is reasonable to suggest the teacher’s question did not expect an already known verbal answer but rather that Claus would find the picture and move it. Claus was expected to act in accordance with and instead of the answer. With reference to Sinclair & Coulthard Lindblad & Sahlström (1998) describe what is literally a question like “isn’t it a bit chilly in here” in practice may work as the order “shut the window”. Even if it is literally a question it does not expect a *verbal* answer. Rather, it expects an action as response. In the computer lab the teacher asked “do you know where the picture is you are supposed to move to Duni’s place”, which according to the same principle meant “find the picture and move it to Duni’s place”. However, Claus answered “yes”, and did thereby perform the dialogue in a question-answer format and not as a request for action.

Conversation is often taken to be the most important element of social interaction, and granted this position it is often relied on as the only data for studies of social interaction in

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57 As I explained in chapter 5 I treat teachers as well as researchers as *teachers* in this chapter due to their similar position in the Femedit project. Thus, the ‘teacher’ in the description refers to the ‘I’ in the field note.
schools. However important conversation may be for performing patterns of relations, it is only one element among a heterogeneity of elements. An isolated focus on conversation does not only overlook other important constituents of a pattern of relations. It also over-exaggerates the importance of conversation in performing the pattern of relations.

Apart from conversation the visual materiality of Claus’ avatar Dunidk was involved in the field note. Having configured the settings of the Active Worlds browser to show the “first person view mode” Claus could not see his avatar on the screen. What appeared on the screen was the avatar’s visual field. With the arrow keys Claus moved the imaginary avatar around which he would visually experience as the avatar’s visual field moving when he pressed the arrow keys.

Compare this to the visual materiality of the emerging letters on the blackboard I described in the previous chapter. I showed how the visual materiality as an assemblage effect was distant and separate from the pupils singing the alphabet song. Contrary to that Claus literally had the avatar in his hand. Punching the arrow keys or moving the mouse he could move the avatar, make it make gestures, etc. His relation to the avatar was rather comparable to the classroom teacher’s relation to the emerging letters on the blackboard. Just as she wrote the letters on the blackboard Claus controlled the avatar in the online 3D virtual environment. And like the chalk and the letters on the blackboard were an extension of the teacher in the classroom the avatar was an extension of Claus. While the pupils in the classroom were separate from the letters on the blackboard, no clear separation was performed between Claus and the avatar. It adds to this impression that children usually talked about their avatars in first person – “I am running as fast as I can”, “I am over here”, etc.\(^\text{58}\)

The description of the conversation, the avatar Dunidk and Claus provides an image of two lines reaching out from Claus (\(\bigcirc\)) as shown in figure 12. In one direction there was a line of attention towards Dunidk (\(\square\)) as an extension of Claus partly through the arrow keys on the keyboard, and partly through the screen with the avatar’s visual field. In the other direction was a line of attention towards the teacher’s question (\(\bigcirc\)). The two lines of attention did not

\[\text{Figure 12 Two lines of attention reaching out from Claus}\]

\(^{58}\) That this however was not the only way children were related to their avatars is discussed in Sørensen 2003a.
meet. Along one line Claus moved around with his avatar, and along the other he answered the teacher’s question. The conversational line of attention towards the question was not aligned with the visual and motor line of attention to the virtual environment. In the classroom the rhythm of the alphabet song was closely coordinated with the emerging letters on the blackboard which provided the pupils with a strong bond of attention towards the blackboard. In the computer lab the attention was split in two between the online 3D virtual environment and the teacher. I will characterize this pattern of relations as one-to-a half. One teacher relating to a half child. Claus’ attention was divided between the teacher’s question and the online 3D virtual environment. The teacher looked into Claus’ computer screen and tried to get to interact with Claus but she succeeded only partly. Allied with his avatar Claus soon gave her the slip. Because she was only related to the listening Claus but not to the material he was working with – the online 3D virtual environment – she didn’t succeed in creating a very strong bond with him.

**Online interaction between teacher and child**

I now turn to the last paragraph of the field note excerpt above. The teacher logged into the virtual world and in the shape of the avatar Estroide she approached the avatar Dunidk. Claus could now see Estroide opposite his own (not visible) avatar on the computer screen. While Dunidk was not clearly separated from Claus and his hits of the arrow keys, Estroide indeed was separated from Claus. Claus, the avatars and the teacher entered a line of relations with Claus/Dunidk on the one side and Estroide/teacher on the other. While we in the preceding sequence had Claus as a bifurcation point of two diverging lines of attention, we now have two sets of elements connected with one single link, as depicted in figure 13.

![Figure 13](image)

**Figure 13** Claus/Dunidk in serial relation with Estroide/the teacher

Interestingly, simultaneously with this shift from offline talk to visual presence online a change in verbal style occurred. Estroide approached Dunidk posting “let’s help one another with the picture” in the chat. This utterance points to collaboration while the verbal request in the sequence above was rather a kind of order or at least a request for Claus to act on his own. With Dunidk’s and Estroide’s common moving towards the picture this was coordinated with the
utterance similar to how the emerging letters on the blackboard were coordinated with the singing of the alphabet song.

However, this coordination broke shortly after Dunidk ran off. The teacher tried but had no chance of following him or having any idea of where he might be. This would never happen in the classroom. The classroom was enclosed by walls, which made it possible always to have an overview of all children\(^{59}\). Compared to this the online 3D virtual environment was large and the avatars were fast. At one moment the teacher was in contact with Dunidk and chatting with Claus and at the next Dunidk was gone and out of sight.

Before the teacher lost track of Claus they were connected through the mutually confronting visual materialities of their avatars. Compared to the one-to-a half relationship I described when the teacher interacted offline with Claus online we can call this a \textit{one-to-one relationship}, remembering that each ‘one’ is (at least) a human and an avatar. In both cases the teacher and Claus were separate entities connecting as such. Compared to the Bulgarian song in the classroom in which all elements were mutually related and acting as one collective act rather than standing out as individual participants, Claus and the teacher were present as separate but co-operated participants. CSCL scholars distinguish between collaboration and cooperation (Dillenbourg 2000; Lehtinen et al. 2000). The former refers to participants working together on the same task with a common goal, while cooperation describes a process in which each member works on his or her own part of a bigger task, whose product is a compound of the individual tasks. In this sense the Bulgarian song as well as Claus’ and the teacher’s interaction offline and online were collaboration. But the two CSCL terms – seen as a continuum rather than two entirely separate forms of presence – can help us in understanding the interaction between Claus online and the teacher offline as closer to the pattern described by cooperation whilst the Bulgarian song was pure collaboration. It has to do with the degree to which the presences of the humans were separated.

The video transcript of the restless teacher showed how he moved from one child to the next. After each one-to-one relationship came another. The one-to-one relationships were \textit{temporary} and \textit{sequential}. The field note describing the interaction between the teacher and Claus depicts a similar sequence of connections and breaks: the teacher connected (offline), separated, connected again (online) and finally separated from Claus when Dunidk disappeared from the

\(^{59}\) Lee (Lee 2001 p. 132) describes how the walls of the classroom ‘protect’ children against undesirable influences. Keeping out undesirable influences is another important component of performing an overview.
visual field of the teacher’s screen. Note, that Claus was continuously connected to the virtual environment through his avatar while the teacher alternated between connecting to and disconnecting from Claus and the virtual environment. Claus was involved in a continuous process in which the teacher was involved only temporarily but repeatedly. As such the pattern of relation had characteristics described by the fluid metaphor. The teacher was an exchangeable and optional element in the process. Similarly the teacher in the video transcript was an exchangeable and optional element of the children’s ongoing processes.

**Separating with discontinuities**

Separations were performed as boundaries in the classroom and these boundaries contributed to performing particular forms of presence. As a background for discussing the forms of presence performed with the online 3D virtual environment I look in this section at how separations were performed with the online software. I do this by talking about the extension of the patterns of relations and about the predictability performed through them.

**Separating through extension**

The teacher got separated from Claus in the online 3D virtual environment when loosing track of him. I compared this to the classroom and pointed to the extension of the online 3D virtual environment as a constituent of this separation. A extension that was performed differently in the classroom due to its walls. Loosing track was one way in which extension created separation in the online 3D virtual environment.

The second point about how extension contributed to performing separations in the virtual environment has to do with the impossibility for the teacher to relate to many children at the same time. There were only two ways of accessing what children were doing in the online 3D virtual environment. This was by either being offline and looking into a computer screen or by logging into the virtual environment. Neither of the two methods, however, provided the teacher with an overview of what all children were doing. They were dispersed over an area far bigger than that which could be seen on the computer screen at one time and the teacher could usually only follow what one avatar was doing. Sometimes she could follow a few due to the ruins in Femtedit where avatars gathered to collaborate. But it was insurmountable to get an overview of 12 children logged on from St. Marc Street School. Even more impossible was it to embrace how they collaborated with 10 children logged on from Pine Valley School in Sweden. This separation, or rather limited access, was due partly to the online 3D virtual environ-
ment being much bigger than the visual field appearing on the computer screen and partly to the children working at dispersed places in the virtual environment.

Was this different, you may ask, from when pupils worked individually in the classroom with exercise books? Did the teacher not have similar problems of following them here? The teacher often wandered around among pupils in the classroom attending one after the other. In order to compare the teacher’s ability to follow children’s work in the two places we need to look at more than the teachers’ behaviour in the room. We need to take the exercise books into account as an extension of the classroom just as the virtual environment was an extension of the computer lab. Thereby two crucial differences appear. First, by glancing down at a page in a pupil’s exercise book the teacher got an immediate impression of what the child was doing. The book was lying open on the desk, and the pupil wouldn’t suddenly be on page 4, then on page 23, then on page 16. Secondly, because all pupils’ exercise books were almost identical the teacher knew not just what one pupil was doing but what all pupils were doing. Because the exercise books were identical the class set performed one homogeneous region even though each child had his or her own book. This homogeneity limited the size of the extension of the classroom that the exercise books formed. All pupils were active in the same little region of the exercise books, so to say. This way of limiting extension was not available in the online 3D virtual environment and the teacher could not relate to more than one – or a few – children at a time due to the extension of the online 3D virtual environment.

A third separation was performed that had to do with extension. The field note excerpt above mentioned a picture Claus had put into the virtual environment. The picture showed a

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60 When I went to school in the 70s all exercise books were 100% identical. Since then, however, a new aspect has come into the centre of educational politics in Denmark. It is referred to as “differentiation of education” and means that learning has to support an all-round and personal development for the individual pupil. This is inscribed in the Primary Education Act, it is emphasized in curricula and it has changed learning materials. In the exercise books the “differentiation of education” was implemented by making them more or less difficult. In the Danish exercise books of the 4th grade class in which I did my fieldwork, the structure and content of the exercise books were the same. The tasks were to fill in words on empty spaces in the printed sentences. For instance: “This ice cream is big and tasty but that one is even bigger and even tastier”. The underlined words would be missing, replaced by blank lines and the pupil would have to fill in the right words on the blank lines. In some exercise books – for the most skilful pupils – both lines would be blank, while in the exercise books for the less skilled only one blank line would be in the sentence to fill in.

61 Due to this constellation of the exercise books all being the same the teacher could have a one-to-one relationship when attending the pupils one after the other while keeping a broadcasting one-to-many relationship to the pupils. The broadcasting mode of teaching discussed in chapter 6 was not only performed from the blackboard but could due to the homogeneity of the exercise books also be established through a one-to-one relationship.
character from Cartoon Network. I have described Pakistani music, the Twin Towers, satiric anti-terrorist web pages, etc. that were brought into Femtedit. As the time went on it got increasingly difficult to separate the ‘inside’ and the ‘outside’ of Femtedit. The extension of Femtedit as an effect of involvement of URLs was another point hampering the teacher’s overview. The online software was extended to involve elements that were out of reach of the teacher.

**Separation through lack of predictability**

Additionally to the separations performed through the extensions of the virtual environment the teacher was disconnected due to the *unpredictability* of the children’s activities. Children did not just involve links to web pages out of reach of the teacher; they *continuously* did so. Thereby, Femtedit gradually transformed and it did so in *unpredictable* directions. The teacher would have no idea which would be the next building blocks and the next hyperlinks children would attach to the homes of the Femteditians.

Comparing Femtedit to the classroom use of exercise books we see again two important differences. First, the teacher knew the content of the exercise books and secondly, the exercise books did not change. Knowing the content of the exercise book the teacher could quite precisely predict what a pupil would be doing next even after turning away from the pupil she had just been helping. This was not possible in the online 3D virtual environment due to its gradual transformation.

Secondly, imagine the exercise books would in some fantastic way suddenly change. If new sentences would suddenly appear with surprising blank lines, with pictures and video clips, the teacher would not know what the pupils would be doing when she turned away from them. It was only because the exercise books were *immutable* that the teacher could calmly turn her back on the pupils well aware of what they would be doing next. By being allied with *known* and *immutable* exercise books, the teacher could at any time predict the pupils’ activities. The possibilities of surprises to take place were reduced due to the predefined content of the lesson through the immutable exercise books and textbooks.

The online 3D virtual environment did not make it available for the teacher to predict what new things children built, what new hyperlinks they added or in which new ways they would interrelate with other avatars. While the teacher was watching the screen of a child or when he was online in the 3D virtual environment, he could see what the child was doing. But as soon as he got up and went somewhere else, he would be completely incapable of predicting the
continuation. The fluid pattern of relations of the online 3D virtual environment allowed the activities to turn in all sorts of directions. While the activities with the exercise book in the classroom were predictable due to the immutability of the exercise books, the virtual environment was indeed mutable. It was changing continuously, which rendered predictability impossible.

**Discontinuities and agents in fluid pattern of relations**

As described by Mol and Law (Law 2002; Law & Mol 2001; Mol & Law 1994) fluid space does not necessarily perform boundaries. I have however described several ways in which the fluid pattern of relations constituted with the online software performed separations. The teachers connected and disconnected from the children and the online 3D virtual environment. They were not kept out by a boundary as in a regional pattern of relations. The teacher did not have to wait for permission to connect to the child. But he could only connect to a child if his course of action would cross the current one of the child. It was the streams or flows they took that connected them. And it was the flows that separated them. Each child or groups of children were flowing along a stream that involved the online 3D virtual environment. The teacher followed another stream, which at times crossed and for some time followed the flow of one child, and at others flowed elsewhere.

*Discontinuity* fits to characterize the kinds of separations performed in the fluid pattern of relations. In the classroom pupils and teacher were separated by a boundary, which kept them at distance from each other, while at the same time constantly dynamically co-performing each other as subjects and authority. With the online 3D virtual environment children and teacher were sometimes connected, sometimes separated. When connected they were closely connected. The teacher logged on to the online 3D virtual environment and collaborated with the child. In the regional pattern of relations of the classroom teacher and pupils did not collaborate with the teacher. Each had their tasks and each their form of presence. They cooperated about the common task of educating the pupils but they did not collaborate. In the online 3D virtual environment, however, the teacher and child met at eye level, so to say.

Being at eye level and collaborating teacher and children had a symmetric relationship in the computer lab contrary to that of the classroom. Referring to sociologist and structuration theorist Giddens (1984) I characterize the children’s as well as the teachers’ form of presence as that of *agents*. Giddens states:
...to be an agent is to be able to deploy... a range of causal powers, including that of influencing those deployed by others. Action depends upon the capability of the individual to make a difference, that is, to exercise some sort of power. Giddens 1984 p.14

Like with the notion of the collective and that of the subject, I take Giddens’ notion as an empirical metaphor, as an image that helps us depict the particular form of presence performed by and through the described assemblages with the online 3D virtual environment. What is crucial for my choice of describing the performance of Claus and the teacher as agents is that it emphasizes the active, equal and powerful character of this form of presence. This is indeed different to the presence of a subject. A subject is opposite to the authority. An agent is not performed through opposition. Agents are placed side by side with in principle equal powers to make differences. This was very much what was going on in the computer lab. Claus acted on his own, engaged with his own process. The teacher did so as well and tried to engage with Claus, to make a difference. Claus did to a certain extent collaborate with her but he also had the power to stop doing so.

The active, knowledgeable and equal character of agents does not mean that they are ‘free’ in the sense of ‘not constrained’. The agent always acts in a context, to which she must adapt. A context of other agents for instance. This was indeed the case in the pattern of relations with the online 3D virtual environment. The teacher had to adapt her way and means of communicating with Claus to his activities. And he turned away from what he was doing to collaborate with her. This fits well with the characteristics of fluidity. It is flexible, it mutates to fit to new elements involved, it transforms as elements are exchanged and replaced.

In their discussion of the Zimbabwe Bush Pump as a fluid technology de Laet and Mol (2000) discuss Dr. Peter Morgan. Morgan is the maker of the Bush Pump. Or so, at least, some say. Morgan himself insists that the engineer, local communities, the Swiss visitors and many more are involved in making the Bush Pump. He doesn’t claim ownership of the pump. He regularly visits the pumps, not to monitor their functioning but to learn about the Bush Pump in its village environment. He has turned into a mere ‘facilitator’, to a ‘peripheral agent’, Mol and de Laet write. What is crucial in their description of Morgan is that he does not control, he does not claim ownership and he does not exercise authority (p.521-2). Law (2002b

62 Giddens uses the notion of agent much more fundamentally as a term to describe the active and knowledgeable character of human activity (Kaspersen 1995; Mørk 1994). I use it only to describe specific empirical findings; to characterize a specific way form of presence, and I do not claim humans in general are agents.
p.101) describes him as a *fluid subject*. In my terms Morgan is no subject. He does not come into being interpellated by an authority. He comes into being by *interacting* with a lot of other changing and exchanging elements in the fluid pattern of relations that make up the Zimbabwe Bush Pump.

As was Claus and the teacher, Morgan is an *agent*. He is not a strong actor like an authority is. He is a weak actor, an agent who flows along. His flow crosses and meets with pumps, visitors and engineers, etc. He may be peripheral but not more peripheral than any other element, since they are all peripheral. His acting makes a difference for the pattern of relations that makes up the Bush Pump, and he adapts to the pattern and to what other agents do. The same characterizes Claus’ and the teacher’s form of presence with the online 3D virtual environment.

Most contemporary scholars discussing presence do so in terms of subjectivity and base their theorizing on regional patterns of relations. For example, Althusser. Feminist philosopher Judith Butler states that the subject is defined by its boundary between the interior ‘own’ and the exterior ‘other’; “…the subject is produced by a condition from which it is, by definition, separated and differentiated” (1997 p.9). Mead describes how “the others and the self arise in the social act together” (1964 p.169). All three authors theorize that the subject is performed within regional patterns of relations. An important point to draw from my discussion of presence as agential is that presence may be other than regional.

**Fluid authority**

I have characterized the teachers’ and the children’s form of presence as that of agents and I have described the separations performed with the virtual environment as discontinuities contrary to the boundaries performed in the classroom. This was indeed a restless form of presence for the teacher. Due to the fluid pattern of relations she had to flow along. She had no rest as she did at the blackboard in the classroom. The agent had no place, no region to call her home as she had in the classroom. I noted that the teachers’ and children’s form of presence were equal when interacting with the online 3D virtual environment. However, the teachers did not interact with children all the time and when they did not they were not equal with the children. They were suspended from the fluid process. Their own form of presence was fluid. They were not in the centre of the stream. They rather seemed like a splash of water that had ended up as a pond on the river bank from where it could observe the stream proceeding without it. There is no centre in fluid space, Mol and Law repeatedly state (Law 2002; Law & Mol 2001; Mol & Law 1994). This, I think, is right from the perspective of the flow but focusing on separations
the distress of single elements in peripheral position have stood out. The teacher was such a single optional and exchangeable element which was sometimes involved in the fluid process, sometimes not. For such an element, there was a centre in relation to which it was peripheral. This was the awkward position of the teacher in the fluid pattern of relations performed with the online 3D virtual environment. This was the restlessness. The restlessness of being part of a flow and then sometimes being peripheral or even suspended.

With the online 3D virtual environment no boundaries were performed, no region, and no focal place toward which attention could be directed. With the lack of these, no authority was performed. Researcher of educational David Buckingham (2000) presents the common argument that IT provides children with access to information and to cultural and social worlds that are inaccessible, even incomprehensible, to their parents. Parents are not the focus here, but obviously, teachers share the fate of parents on this point and this exercise of authority is no longer possible, the argument goes.

The impossible authority, however, was the impossibility of regional authority. Authority performed as a clear separation between the authority and the subjected and with clear boundaries between the two. A pattern of relations in which authority is performed as having an overview of and being capable of predicting others’ behaviour. The question is whether there would be another way of performing authority. Would it be possible to think of authority in fluid patterns of relations? It could be authority of the preceding step. Since a fluid pattern of relations transforms gradually it always takes little steps at a time away from the preceding ones. The online 3D virtual environment preceded by adding a link, a building block, an image, a sound to the existing ones. Therefore, the existing, the last step in the ongoing gradual transformation of the fluid pattern of relations can be seen as having authority over the next. One step in the process always owes itself to the former. The former will always make possible and restrain the next.

If we think of authority in this way, it is no longer a matter of more or less authority, or of authority or not. It becomes a matter of different forms of authority and not, as would probably be a commonplace conclusion the experienced restlessness in the computer lab, a matter of compromising the fluid design and create a region which could contribute to performing authority. On the contrary, it could be improving and developing tools for the teacher to better exercise fluid authority. This could be by supporting the teacher in giving feedback to the children in blogger and through the virtual environment in a way that could better feed into the fluid processes. Feedback, which could better connect to what children were doing, ensuring
that the children would pick up on it and integrate it as elements in the ongoing transformative process of fluidity. Focusing on the differences in patterns of relations the descriptions have made available an analysis of how authority may be other than regional. The potentials of a fluid technology in a (regional) primary school setting could hence be to contribute to new – fluid – ways of performing authority.

The power of interactivity – the power of fluidity

Before concluding the chapter, I present sociologist of technology Andrew Barry’s (2001) sharp analysis of interactivity. Barry analyses the change in museum exhibitions that used to consist of objects speaking for themselves, carefully ordered in showcases for the public to observe at a distance. Placed behind glass in showcases objects presented in themselves an authority, almost sacred, indefeasible. You could observe them, accept them or not. But you could not touch them, alter them, or interact with them. In the more recent decades this has changed. Museums of science, which are Barry’s object of study, have increasingly involved ‘hands-on’ interactive technologies which museum visitors can interact and experiment with. Such interactive technologies deploy a different kind of power than disciplinary technologies as described by Foucault, Barry states.

Foucault (1979) notes the importance of what he terms body-object articulation for the exercise of disciplinary power. Discipline defines each of the relations that the body must have with the object it manipulates. It operates by fixing the relations between body and object to form a unified apparatus. In comparison interactive technologies imply a much looser bond between the body and the object. The interactive technology does not regiment the body but turns it into a source of pleasure and experiment:

\[\text{Whereas discipline is exhaustive in its application, interactivity is specific, instantaneous and intensive. Whereas disciplinary technology manipulates and manages the body in detail, interactive technology is intended to channel and excite the curiosity of the body and its senses...Whereas discipline is direct and authoritative, interactivity is intended to turn the user (visitor, school child, citizen or consumer) into a more creative, participative or active subject without the imposition of a direct form of control}\]

\[\text{Barry 2001 p.148-9}\]

It is striking how much Barry’s description of the power of interactive technologies resonates with the fluid pattern of relations and the agential form of presence it contributes to performing. I used other words in the previous chapter, but the relations between teacher and child performed with the online 3D virtual environment were indeed specific, instantaneous and
intensive. And yes, the frame story attached to the online 3D virtual environment design was blank in order to excite the curiosity of the children. And the form of presence they performed was certainly that of agents – creative, participative, active without the imposition of a direct form of control. The ‘natural journey’ for children today, Hultqvist (2001; 2004) notes, is about “being a motivated learner that is able to explore… The child has become an entrepreneur of him- or herself” (Hultqvist 2001 p.163). This description also resonates with what philosopher Gilles Deleuze (1995) calls ‘control society’.

Discussing the introduction of information technology in education, researcher in education and technology David Shutkin (1998) remarks – also with reference to Foucault – that the “authority that this deployment constructs does not form an oppressive power that says NO. Rather, it is a modern, productive form of power that says YES” (op cit p.211). Like Barry and Hultqvist, Shutkin emphasizes that we are still dealing with power, even if it takes another form.

I have characterized the form it takes as fluid. A power which makes available ongoing transformation and flexibility but which also creates discontinuities and unreliability. Hence, the debate about an active learner approach is not a discussion about more or less power or more or less authority, but about different forms of power and authority and with this different winners and different losers.

With these comments on fluidity I challenged Mol & Law’s (Law 2002b; Law & Mol 2001; Mol & Law 1994) and Mol & de Laer’s (2000) celebration of the fluid pattern of relations for being flexible, continuous and inclusive and the dishonouring of the regional due to its boundaries, exclusion and suppression of differences. I have noted that separations were indeed performed in the fluid pattern of relations but they take the form of discontinuities, while separations in a regional pattern of relations take that of boundaries. Furthermore, I am not so sure about the dishonouring of boundaries. As described, the clear difference between the subjects’ and the authority’s ways of participating in the classroom was among other things due to the blackboard as a centralizing device, and to the homogeneity of the learning materials. Boundary, centralising and homogeneity are words we dislike. But notice that the homogeneity of the exercise books, the central place at the blackboard and the boundary not only separated but also established a strong connection between teacher and pupils, constituting a shared place, shared

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63 I added that these relations were also easily discontinued, which Barry interestingly does not discuss. Just as Law and Mol for some reason have not focused on the kinds of separations a fluid pattern of relations also perform. As social scientist we may simply be too focused on describing relations that we tend to overlook separations.
learning materials and shared boundary, which everyone could refer to. Probably, these elements also contributed to constituting a ‘we’ in the classroom, a communality of the class. The strong duality performed by the clear boundary between teacher and pupils in the classroom constituted a *mutuality* in the relationship. Pupils and teachers were constituted as each other’s opposite, and hence contributed to performing one another. They were interdependent. Pupils contributed to performing and hence to legitimising the regional pattern of relations by *secretly* letting a note pass under the desks and using *legitimate* materials such as erasers, pencils and hair clips to play with instead of playing with illegitimate toys. Teacher and pupils contributed mutually to performing their regional positions. They were in it together, so to say. This doesn’t mean that their relationship was symmetric. As I have described, materials were involved in the pattern of relations which positioned them differently.

In the computer lab the teachers were recurrently connected to and disconnected from the fluid process with the online 3D virtual environment. The relationship between teachers and children was much looser. So was the relationship between children. They worked in groups, but since they did not share materials and had no common limited place elements for performing communality for the whole class were scarce. The regional assemblage in the classroom did not simply create separation and difference. It indeed also performed lasting connections. A feature that was scarce with the virtual environment.

**Conclusion: post-human presence**

Concluding the discussion of forms of presence I argue for the importance of taking materiality into account in these discussions. I have shown that presence is not necessarily founded on a regional pattern of relations as most contemporary theorists of subjectivity imply. Noting that presence is not necessarily regional we may start appreciating presence as an effect of the inter-relation of *weak* entities and we may abandon the idea of presence as belonging to or located in the *human* as a unified actor. By doing so, I have been able to show that materialities take part in the constitution of human presence which are not traditionally taken into account: as a blackboard, the visual field of an avatar, exercise books, hyperlinks, etc. Such different materials may contribute to performing human presences as regional. But they may also contribute to performing other forms of presence.

By *not* taking the point of departure in the human, in the subject, individual or agent, I have studied presence empirically as a result of the involvement of different technologies. By apply-
ing a *post-human* approach I have studied presence as heterogeneous, multiple and not necessarily regional.

Lee notes that the contemporary discussions of *active learning child* in for instance CSCL is a repetition of the child-centred educational approach from the 70s:

*Debates still continue over the issue of how active and free children *should* be allowed to be in schools. The question of whether teachers *should* be authority figures, of whether education *needs* to be based on the dominance of an adult over a group of children is very much alive.*

Lee 2001 p.82, emphasis added

Indeed the debates continue. And the discussions of this part of the thesis may be seen as a contribution to this debate. By discussing forms of presence in school as socio-material achievements, however, my descriptions implicitly challenges the understanding of the debates as being about whether teachers *should* be authority figures, and whether education *needs* dominance. Instead of dealing with forms of presence as cultural, moral and ideological issues I have discussed presence as a *practical matter* pointing to authority as performed not because we (humans) want it or as lacking either because it is undesired or because of lack of human ability to create authority, but due to socio-material arrangements of school practices. A humanist account of authority like the social psychologist approach I outlined in chapter 8 is dominating in school debates, authority and presence is almost exclusively discussed from a humanist point of view and consequently the influence of technology is ignored\(^64\). Applying instead a post-human approach allows us to realize how intimately technology contributes to performing presence and it may enable us to realize new areas of intervention when dealing with authority.

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\(^{64}\) Indeed, technologies are too often seen as remaining outside the area of politics altogether. For further different discussions on the relations between technology and politics, see Barry 2001, Sørensen 2005, Winner 1999.
Chapter 10

Conclusion

I opened this thesis with the wish to explore how technology takes part in practice without setting *a priori* aims for how technology should participate. Indeed, *how* was the empirical question of this thesis. As the first step in studying how technology takes part in practice and with what effects I turned in chapter 2 to ask how the virtual environment technology in focus in this thesis came to be a research object. Thereby I argued that what a technology is is not given by the technology in itself, in isolation. The characteristics of a technology are given by and through the assemblages it becomes entangled in through the process of *constructing* the technology. I defined the materiality of a technology as characterized by *the ways in which it connects* to other human and nonhuman entities. With this definition the focus on relations and especially on *patterns of relations* was laid out. I called a description of how the patterns of relation are distributed a spatial imaginary, and thus this thesis was about creating different *spatial imaginaries* of an online 3D virtual environment.

Now the research object and research field were defined and the research object was situated in a research question. Chapter 3 went a step further describing the ways in which Femtedit was designed to meet school practices. Following Law’s notion of *heterogeneous engineering* I showed how the design was assembled to be a *stable network* that could stay together and in place even after encountering school practices. While chapter 3 closed with a quite coherent and apparently exhaustive description of the Femtedit network design, chapter 4 opened a Pandora’s box of entities and relations that *did not fit* properly into the network pattern of relations described in chapter 3. I characterized these ‘other’ patterns of relations as *fluid*. Instead of deciding between whether the network metaphor or the fluid metaphor was right and adequate in describing the online 3D virtual environment, I argued that the technology performed network *as well as* fluid patterns of relations. The technology was *multiple*. This argument closed part one of the thesis, whose focus was on technology and how to describe and understand technology as a participant in practice.

Part two and three turned to look at the *performative effects* of the online 3D virtual environment’s participation in school practices. Both parts did so by comparing the participation of traditional learning materials in classroom practices with how the online 3D virtual environ-
ment participated in school practices. And both parts took their points of departure in problems encountered with Femtedit through the teachers.

Part two looked at the forms of knowledge performed by and through different materials. In parallel, Shapin & Shaffer’s (1985) presentation of Boyle’s ‘new experiments’ was discussed pointing to similarities between the patterns of relations performed in these mid-17th century experiments and the patterns of relations performed in current classroom practices. Chapter 6 described how a one-meter ruler contributed to performing a regional pattern of relations with representational knowledge as an effect, which was stable and was constituted by the reference to facts or standards located beyond the classroom. By enrolling a group of parents and the headmaster, a bed-loft contributed to perform a network pattern of relations in which communal knowledge as accounts about the bed-loft could circulate and thereby grant legitimacy to the activities of the class.

Chapter 7 turned to the online 3D virtual environment and looked at the form of knowledge performed here. I described how the ongoing transforming character of the virtual environment hindered a regional pattern or relations to be performed. Moreover, no communal knowledge was made available due to the lack of stability of the assemblage in which the knowledge was made to circulate by and through the virtual environment. Forming instead a fluid pattern of relations with the ongoing involvement of new URLs, and hence elements from outside, I characterized the form of knowledge performed with the online application as liquid knowledge. The liquid knowledge was characterized by its untraceable effects of ongoing transformation and absorption of entities from outside. I compared and described the different forms of knowledge and concluded that the liquid form of knowledge required withnessing instead of witnessing.

Part three discussed forms of presence as performative effects of the Femtedit design. Chapter 8 began in the classroom describing how the learning materials here – especially the blackboard – contributed to performing presences as an authority vis-à-vis subjects. This pattern of relations was characterized by a boundary performed between subjects and the authority. Chapter 9 described how the extension of the virtual environment made overview unavailable for the teacher. The lack of overview also meant a lack of authority. The form of presence performed with the virtual environment was that of agents, characterized by mutual power to influence each other. While no boundary was performed with the virtual environment separations took the form of discontinuities. The lessons of part three, I argued, was that presence is indeed a socio-material achievement, which should be studied through a post-human approach.
I close this thesis by reflecting upon the theoretical and practical contributions of this thesis. First, I discuss how the thesis may contribute to the theoretical discussions of technology and especially to the discussions of fluidity in after-ANT. Then I turn to the question of the practical usage of the insights I have provided. I discuss how to assess the value of the Femtedit design since it cannot be in relation to a pre-set objective, because I have deliberately avoided defining any such foundation of the design. I suggest the solution of accounting for the values circulating with the design, and consequently I list some of the values circulated by Femtedit. Finally, I turn to current debates in the Danish educational politics and discuss how the results of this thesis can contribute to these debates. I state the need for taking into account how technology participates in school practices when doing research, planning lessons, making educational politics, and in learning itself.

**Fluid technology**

I have in this thesis delivered an account of technology as deeply entangled in arrangements of social and material entities. An imaginary has emerged throughout these pages which enables us to understand the subtleties of how technologies can and can not connect to other entities and other assemblages. How technology may participate in *practice*. Thereby the thesis has provided an approach to technology which goes beyond an approach describing technologies apart from practice, or an account of the interaction between technology and single users, and more than accounts of technology as instruments for human practice. It enables us to understand the practicalities of how technology engages in practice. The account moreover makes it available to understand how technologies are involved in constituting parts of practice which we tend not to link to technology: knowledge and human presence.

Furthermore, I have shown that technology may participate in multiple ways in practice. This is indeed different from most descriptions of technology that provide one singular coherent account of what a technology is. Finally, I have especially focussed on descriptions of the online software as *fluid*. Thereby my descriptions have emphasized the need for remaining sensitive to technology as not only robust, stable and functional, but also transforming and variable without clear boundaries.

After-ANT has been especially fond of exploring fluid patterns of relations. Even though I have drawn extensively on after-ANT literature, my discussions of fluidity have, through my empirical descriptions, come to differ from how fluidity is typically depicted in the after-ANT
literature. In their 1994 article about spatial types Mol & Law express their personal preferences of fluid space:

True: We are especially fond of fluid spaces since they do without the solidity of regions and the formality of networks. We like the way they churn and flow. But we will try not to sympathize too much with all this movement.

Mol & Law 1994 p.643

Mol & Law do not wish this normativity to dominate the discussions of spatial types, and indeed they introduce several spatial metaphors in order to be able to describe the multiplicity of spaces. Mol and Law’s intellectual productions are remarkable in their contributions to describing multiplicity. However, looking at the way they treat the different spatial metaphors, they do seem to ‘sympathize too much’ with fluidity. Listen to these two sets of words:

- homogeneity, boundaries, delimited
- flexible, transforming, blurring boundaries

The first set describes the regional pattern of relations. The second set describes fluid patterns of relations. Are not the latter set much more agreeable than the former? Do they not refer to qualities that are generally positively valued in the beginning of the 21st Century? Whilst the first set describes qualities that are found problematic?

In their discussion of the fluid Bush Pump, de Laet and Mol (2000) use the term love to characterize their relationship to the pump. Authors discussing fluidity with after-ANT sensitivities rarely mention any disadvantages of fluid patterns of relations and they are not very concerned with the limitations of fluidity, with what it disallows or stops. Law (2002b) does discuss the limits of fluid space. He notes that fluidity does not tolerate abrupt changes. He speculates on the possibility of fluidity reaching a point at which the shape has moved on too much. The Bush Pump may become a set of bits and pieces for tying up cattle, he writes. At that point, it may have moved beyond the limit of what counts as a pump. Just as some fluids are immiscible: Oil and water, notoriously, do not mix. Law is clearly aware that his descriptions of fluidity give the impression that fluid patterns of relations tolerate any changes and any external intervention. He emphasizes that:

In fluid space it is not that anything goes. Fluid objects are enacted in practices which also recognize rupture. It is just that they do not coincide with those of Euclidian or network space.

Law 2002b p.100

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65 Thanks to Thomas Scheffer for drawing my attention to the implicit differences in values in the terms used to describe the spatial metaphors.
While appreciating Law’s observation that ‘not anything goes’ in fluid patterns of relations I find his empirical examples weak, e.g. the pump for tying up cattle, and of oil and water. With the present thesis I have contributed with more subtle empirical descriptions of fluid patterns of relations and thereby I have brought to attention the more questionable effects of technologies contributing to performing flexible and varying patterns of relations. I discussed the limitations and problems occurring when fluid software encounter the regional patterns of school. Had I exclusively celebrated the fluid patterns of relations of the online 3D virtual environment, which I indeed do think have fascinating potentials, then the just as crucial aspects of fluidity – that it does not coincide with regional patterns of relations – would have receded into the background. Pivotal circumstances of how the online software and how fluidity exists in the world would have been ignored. My point is that nothing is gained by favouring the flexible, transformative and varying. Just as several authors note the limitations and problems concerning network patterns, it is important to describe the limitations and problems with fluid patterns of relations, as I have done in this thesis.

I have shown how the online 3D virtual environment participated in multiple ways in school practice: in network patterns of relations and in fluid patterns of relations. The network patterns and the fluid patterns depended upon each other, I argued. Without the forces of the network drawing the enrolled entities together the fluid pattern of relations could not proceed. Similarly, if there had been no arrangement making available the fluid pattern of relations the inflexible network would have fallen apart when children started involving elements from outside. Discussions of technology are often too focused on how stability is established to take into account what any engine maker is aware of: that slack has to be built in between machine parts in order to allow the machine to keep working even if a part happens to diverge from its original position or if dust or other alien substances slip in between machine parts. This inevitably happens. Tolerance is the technical word defining the amount of variation allowed from a standard. Tolerance cannot be nil.

On the other hand, more recent accounts of technology, like after-ANT, seem to be so absorbed with the variation of fluid patterns of relations that they tend to underplay the obdurate patterns that contribute to establishing these more variable, fluid patterns of relations. All too often, de Laet and Mol (2000) write, governments and NGO’s have drilled wells without the nganga’s (local water diviner) approval and either the wells have turned out to be dry, contrary to all geological measurements, or the village women have refused to use the well and kept
drawing their water from a more distant and old well. Note that in order to perform the fluid character of the Bush Pump the community network around the nganga must be enrolled. In my reading the nganga version of the pump performs a network pattern of relations. Its entities are not flexible and optional. It has an obligatory point of passage. Similarly, the ‘national ‘B’ type Bush Pump standard’ version of the pump is a network. These networks contribute crucially to the fluid characteristics of the pump: to its abilities to work differently in different communities, to its diverse and changing purposes. Network and fluid patterns of relations, obduracy and variety, indeed go together.

This is a second reason why we should not start celebrating fluid patterns of relations at the cost of networks. As Law and Mol argue, but sometimes apparently fail to perform in their empirical descriptions, different patterns of relations interplay, intertwine, clash or repulse one another. Studying technology, no matter if it is characterized as robust and stable or as adaptive and varying, must always take into account how other patterns of relations contribute to performing the technology. I have done so in this thesis by writing about how network and fluid patterns of relations co-existed in the Femtedit online 3D virtual environment, and by showing how fluid and regional patterns of relations had problems co-existing in the school.

The practical values of design

It is time to consider the practical use of this study. Over the past years I have repeatedly been asked about the normative foundation of the Femtedit (and FEMTEDIM) design. Colleagues have found it difficult to see the potential use of the study when developmental, educational or other aims of the designs were not defined. I have stubbornly refused to define such aims, insisting on not determining the ontology of the technology in advance, which was necessary in order to make the technology’s participation in practice available for empirical scrutiny, as discussed in chapter 1. However, not defining an a priori aim has often made it difficult for people to see the practical usefulness of the study.

In order to evaluate its usefulness we need to look at my work differently than by assessing it in relation to its a priori objectives. Strathern (1996) proposes an understanding of value that is helpful for my endeavour. Value, she emphasizes, is an outcome of relational practice. It does not – as it is often presumed – lie in the intrinsic nature of things. Following Strathern it would be wrong to say that designers’ worldview are inscribed or interests are congealed in technology as it is often conceptualised in technology studies. As an anthropologist Strathern studies Melanesian bridewealth transactions. Valuables, she notes, circulate from one family to the
other: what the groom’s family receives is in terms of value a potential for growth; a reproductive wife. The value her family gives away, however, is a non-reproductive sister. A value circulates from one family to the other, and while circulating it transforms. In the socio-material relations of the bride’s family the value is one thing, in the socio-material relations of the groom’s family it is another.

In order to use Strathern’s discussions of value on Femtedit we need to imagine the Femtedit design as the bride, the design practice as the bride’s family and the school practices as the groom’s family. Femtedit travelled from design practice to use practice like the bride travelled from her family to the groom’s family. Which of Femtedit’s values is relevant here: The normativity of Femtedit implicit in the researcher’s theories and values during or even before the design practice, or the value of Femtedit performed through the design in the school practice? Indeed, the latter. The two values of Femtedit are not the same. The value transforms as the design moves. Whatever good or bad ideas the researcher or author might have had ahead of the study are thus different from the values circulated in school practice. And the researchers’ good or bad ideas are really subordinate to the values circulated or promoted in school practice through the design. As I have described in chapter 2 the graphic appearance, functionalities, etc. of the virtual environment technology, a research network, rules, contingencies and practicalities, etc. were involved in making the research object as it came to be. Reducing the object to a result of the researchers’ aims would be misleading and defining the value of Femtedit as similar to the researchers’ a priori ideas is clearly wrong. Like the value of the bride transforms as the bride enters a different arrangement, the values circulating with Femtedit changed. If we want to know the value of a design and not the value of its humans antecedents, we need to stop thinking of value as something defined by humans prior to constructing a design and we need to start appreciating what is circulated in socio-material practice. We need to move from a humanist to a socio-material approach if we want to understand the substance of value, and not only discourses preceding it66.

If we look at values as circulating and transforming, the importance of a ‘foundational’ theory disappears. Relevant values and norms are those that circulate in the working of the design,

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66 This position also poses a critique of the often demanded self-reflexivity of scientific authors. I would appreciate much more discussion in methods sections of scientific literature about the consequences of research practices and the values they circulate rather than about authors reflexive self-examination. Again, this is a turn away from the one-eyed focus on humans in social sciences and to focus on the socio-material qualities of the research objects.
that were performed by and through the design and not those that might have been formulated by researchers or designers prior to the implementation of the design.

Among the values circulating with Femtedit, which I have especially discussed in part two and three, were those of untraceable effects, of withnesssing, and of loosely connected agents. The fluid stream of entities that were absorbed in the online 3D virtual environment moved to places that were not traceable from the teachers’ immobile perspective from the school. Maybe the stream travelled to the school yard, to cousins, to the street, to the club, home, etc. each place involving other human and nonhuman entities. As such it circulated the fluid value of mutable mobility, it circulated liquid knowledge and celebrated the constant involvement of new entities as well as transformation as an effect of moving on. The value of what some call child culture (Jessen 2001; Mouritsen 1996) was circulated. Travelling in informal and unpredictable (unreliable from a network point of view) ways between children, it engaged with the interactions of the child culture. It circulated and valued child culture.

The liquid knowledge cut (Strathern 1996) the value of witnessing. Witnessing was not circulated. Instead, teachers or whoever would want to follow this knowledge had to engage with it, to be with it. The value of withnesssing was circulated. Of ‘going with the flow’. A fluid authority was celebrated. An authority, which does not perform distance but allows itself to be absorbed with the ongoing transformative process of the fluid pattern of relations.

Furthermore, the value of loosely connected agents was circulated by and through the online 3D virtual environment. Human presences were favoured in a way that let them make a difference and influence other entities. This implied the value of humans being susceptible to influence from other humans and entities. Moreover, the value of a presence altering between being continuous and discontinuous with the flow of ongoing transformation of the online 3D virtual environment was circulated.

**Multiplicity**

It is one thing that the Femtedit design circulated, another thing is what this thesis circulates. I would like this thesis to circulate multiplicity. I would like multiplicity to be a result that researchers, educational politicians, school professional and pupils see as a practically useful result of this thesis. Philosopher of science Helen Verran (1999) discusses the practical effects of multiplicity in her account of how to “stay true to laughter in Nigerian classrooms”. Verran reports her experience with a Yoruba teacher who taught length by letting children measure an object with a string and subsequently wound the string around a 10 cm card and counted the number
of winds. Multiplying the number of winds by 10 told the children the length of the object in centimetres. As the teacher’s lecturer Verran was disconcerted and had to laugh because of the fact that this method had rendered extension incidental, contingent upon multiplicity. Extension is a crucial ‘abstract’ element of the standard English conception of length and according to this conception extension cannot be left out of the understanding of length. Verran summarizes two explanations of the incidence near at hand:

1. It is a story of failure, stating that Verran had failed in imparting the ‘proper’ knowledge of length to the teacher and of the Africans now adopting a ‘primitive’ way of quantifying.

2. It is a story of resistance, explaining how the teacher resisted Western incursion and taught a Yoruba version of quantification.

Both stories, Verran notes, imply a singular order: either the order of one proper knowledge or the order of one supreme power. They both explain away Verran’s laughter and thereby the disconcertment she felt by the confrontation of the English and the Yoruba ways of quantifying. Verran tries otherwise. She rejects “deleting and hiding the messiness and lack of smooth fit between the ‘ideal’ and the actual [way of] of quantifying” (p.149). She suggests we describe what she calls symbolic-material routines, repetitions and rituals instead of applying an imaginary of one singular order – of either kind. In other words, we should accept how different ways of quantifying (multiple orders) are performed in socio-material practice and account for them in ways that stay true to the different ways in which they are performed and the tensions between them. Instead of trying to fit the different practices into one single order. Then, Verran states, we can start training children in the routines of both Yoruba and English quantification and training them to adopt routines which translate between the domains.

In a similar way, it has become possible in this thesis to avoid describing Femtedit either as failing to provide ‘proper’ knowledge or ‘functional’ presences and to avoid depictions of the teacher as resisting the new technology. I have done this by going through two steps. First, I have described the different forms of knowledge and the different forms of presence as simply different juxtaposed patterns of relations. Contrary to making descriptions that follow one order or one principle of, for instance, more or less failing or more or less powerful knowledges or presences. This step made descriptions available of the co-existence of multiple forms of knowledge and the co-existence of multiple forms of presence.

Secondly, I compared these patterns of relations. Comparing enabled me to describe the tensions between different patterns of relations: how different forms of knowledge and differ-
ent forms of presence interplayed, intertwined, clashed or repulsed one another. Just as Verran succeeded in creating a description which taught us about the Yoruba form of quantifying, the English form of quantifying and the tension between the two – the laughter – I have described forms of knowledge and forms of presence without explaining away the teachers’ critique of lack of resemblance and the teachers’ restlessness.

The teachers’ critique and restlessness are in my descriptions neither expressions of failure nor of resistance. The teacher’s critique and restlessness expressed the tension that exist in school practices as a result of the different technologies in use. Would there be only the ruler, only the bed-loft, only the blackboard or only the online 3D virtual environment, the diversity in forms of knowledge and forms of presence might decrease in school practices and so also tension would be decreased. Verran’s disconcertment arose by the introduction of the technology of winding string around a card. The teachers’ critique and restlessness arose by the introduction of Femtedit. Enrolment of technologies in practice evokes multiplicity. I have been able to keep the tensions between the different socio-material practices because I have taken into account in my descriptions how technologies participated in multiple ways with other entities of the socio-material practice.

It is an important result of this thesis that taking the ways in which technologies participate in practice into account allow us to understand how different patterns of relations, different forms of knowledge, different forms of presence and the tension between them contribute to performing multiple socio-material practices. But the next point is even more crucial: that due to the description of practices as socio-material performances this account makes it possible for us to make it an explicit aspect of learning practices how technologies participate in performing different forms of knowledge and presence. This would teach children to evaluate forms of knowledge and forms of presence in relation to what they are engaged in. Instead of taking any specific singular form of knowledge or presence as universally good or right, children may start handling the different forms of presence and different forms of knowledge according to the practices they are engaged in. They may for example realize that if they are preparing for examination Femtedit may not be the most adequate technology to employ. If pupils, on the other hand, need to experiment with how to come up with adequate methods for solving problems in unpredictable environments Femtedit may indeed be a helpful technology. There may be situations where the Yoruba form of quantifying is appropriate, and there may be situations in which the English method is the appropriate. I have described that there are practices in which representational knowledge is appropriate, and others in which liquid knowledge is ap-
appropriate. Practices in which authority and subjectivity are suitable and practices in which agential presence is apt. Practices for regionality and practices for fluid patterns of relations. And indeed for their interrelations.

With this approach professionals as well as pupils may come to realize that different forms of knowledge and different forms of presence are good and bad not in themselves but for different particular arrangements of technologies, humans and other entities. And because different arrangements are different, they may not fit together smoothly. Instead of taking this as a problem professionals and pupils may understand and accept tensions between different forms of knowledge and between different forms of presence as a necessary effect of engagement with technologies.

Spatial imaginaries and educational politics

As I was writing up this thesis OECD published their latest PISA reports assessing how well qualified 15-16 year olds in the OECD countries are to meet the demands of information society. Denmark received an average position in the evaluation which was inconsistent with the expectations most Danes, Danish schools and certainly Danish politicians have of their school system. The discussions of schooling were everywhere, and everybody seemed to have an opinion about what should be done. I was deeply immersed in creating descriptions about how an online software participated in school practice, and even though my obsession with socio-material details made my study appear distant to these overall discussions, I found the value of my study dependent upon whether it was able to contribute to this debate. Therefore, I end this thesis by turning to the discussion of two main political consequences that were drawn from the PISA report. The discussion is illustrative of the ways in which the results of this study might be useful for thinking about how to organize education – on a political level as well as on the level of planning individual lessons, implementing new technology or new ways of learning. The two interventions decided by the Danish government were that Danish pupils must be tested more often and that discipline has to be reinforced.

As I write these sentences, three consortiums are working hard after being invited by the Danish ministry of education to submit tenders for a battery of tests for all school year groups except first grade. The tests are to be introduced in 2006. It is important to note that Denmark has a strong tradition for schooling without testing, and currently the first formal exams a primary school pupil will meet is in 8th grade, the same year pupils' performances are marked for the first time. In 1st to 7th grade pupils' performances are evaluated orally during parent-teacher
meetings. The new tests shall make it possible for teachers to monitor pupils’ competences and thereby enable teachers to quickly start helping when it appears that a pupil is behind the current milestones of the age group. The tests are to be seen as a tool for the individual teacher in his or her planning of the teaching and extends the general line of the educational politics of the current Danish liberal government, which has over the past years focused on more evaluation and more goal directed education. In 2001 the government introduced the program “Clear Goals”, which require of teachers to ensure that pupils pass specified milestones every four months.

The teacher’s form of presence performed by and through testing is that of the authority of a judge, who – equipped with the national tests – has a distant national view on the children’s achievement. The teacher has to witness the pupils’ achievement, and in order to do so a necessary distance is established between, on the one hand the teacher with the national tests, and on the other, the pupils. As we saw in Boyle’s experiment, witnessing requires the establishing of a distance between the object to be witnessed ‘over there’ and the witness ‘over here’. Now, the tests are combined with the Clear Goal guidelines. The teacher has to compare the test results with the guidelines and plan the activities in the classroom with reference to the guidelines/test results. Thereby school teaching is consolidated as a regional pattern of relations with the classroom activities and children ‘over there’ and the teacher, test results and guidelines ‘over here’. The knowledge performed constitutes a representational relationship with the child’s achievement referring to the definitions of national tests.

The problem this intervention is supposed to solve is that of children not achieving well enough in schools. PISA emphasizes that what is required in contemporary society and the labour market is the ability to act under unpredictable circumstances, often with unclear goals and without standard methods. The Danish government agrees with this analysis. To me, this sounds like a demand for liquid knowledge. A demand for agents who can engage in an ongoing transformative process, capable of involving entities from outside, rearranging and varying along the way.

Does the regional pattern of relations performed through the increasing control and monitoring of school activities provide liquid knowledge? Following the results of this thesis, I have to answer no. The problem, it seems from the perspective of this thesis, is that the patterns of relations the required knowledge on the one hand and the form national tests/guidelines on the other perform are not taken into account. Knowledge is seen as content to be tested – sentence structure, arithmetic, history – and hence knowledge is, as a matter of course, taken as repre-
sentational, as performing a regional form. The form of the knowledge – establishing relations with external entities in an unpredictable environment – is not taken into account and knowledge is treated as representational. The performative effects of the socio-material practices in which the knowledge is established – and which the tests, Clear Goals, etc. contribute to performing – are overlooked, and regional patterns of relations are reinforced to support knowledge, overlooking that other patterns of relations may be more suitable.

In order to circulate liquid knowledge as required by the PISA report, I suggest on the basis of the results of this thesis taking fluid patterns of relations more seriously when arranging school practices. The online 3D virtual environment presented in this thesis was good at creating unpredictable practices without clear goals and without standard methods for solving emerging tasks. This was possible because it made available an exchange of elements between what was going on in the school and outside of school. The ways in which different materials contribute to performing the boundaries of the school has been a recurrent theme of this thesis. Representational knowledge performs unambiguous and stable relations between the activities in the classroom and the world ‘out there’. Thereby it is incapable of performing unpredictability. Unpredictability requires variation, which is dependent on new entities entering the pattern of relations. It is dependent upon a permeable boundary between inside and outside of school. If we accept PISA’s analysis that children are required to develop abilities that enable them to act under unpredictable circumstances with unclear goals and no a priori methods at hand, then from the perspective of this thesis it is necessary to have learning materials in schools that contribute to performing permeable boundaries of the school in order for unexpected elements from outside to enter and contribute to creating unpredictable circumstances. National tests and Clear Goal guidelines do not live up to these requirements.

The second governmental solution to the disappointing PISA results is to reinforce discipline in order to create more peace and quietness for the pupils to be able to concentrate better on learning. As I am concluding this thesis the Danish minister of education has appointed a “Committee on Discipline, Good Conduct and Bullying in Primary School” (my translation). The task of the committee is to compose discipline guidelines to help schools formulate their individual regulations. From the point of view of this thesis, this is a very peculiar solution to the observed problems.

Conduct is seen as a result of following regulations. In this thesis I have described conduct – in terms of forms of presence – as a result of socio-material practices. Introducing standard rules of conduct in schools overlooks the point that different socio-material practices contribute
to performing different forms of presence. The standard regulations imply that there is one ‘proper’ form of presence in the school but in the actual socio-material practice of the school children and teachers experience is that the materialities necessary to make available such forms of presence are not always at hand. Indeed, sometimes learning materials, technologies and other materials will contribute to performing forms of presence disagreeing with standard regulations. From the perspective of this thesis, schools should rather start taking into account that different learning materials contribute to different forms of presence, and start making these different forms of presence part of the teaching, making children familiar with different forms of conduct, and aware that some are adequate for some socio-material practices, while others forms are adequate for other practices. As implied in chapter 9, children stopped taking the teachers seriously when we tried to reinforce discipline and ‘proper’ conduct with the online 3D virtual environment. I think the children felt the inconsistency between the form of presence made available through the online 3D virtual environment, and the form of presence reinforced by the teacher. My suggestion would be to take seriously the different forms of presence different materials contribute to performing, and start thinking about and teaching children how to behave differently in different socio-material practices, and the different consequences different forms of presence have. Taking into account that all educational policies promote increase in proliferation and the use of digital technology in schools, it is indeed about time that schools and educational politics start accepting that different forms of presence will be present in schools. Accepting and learning to handle different forms of presence in school is also more suitable in relation to the analysis of what is needed in contemporary society: flexibility to adapt to current, varying situations.

The normativity of materiality

With these final considerations of some current discussions in educational politics, I will conclude by noting that this thesis has contributed an approach as to how materialities contribute to performing schools practices. The normativity of materiality that is implied in this approach circulates values of multiplicity and favours the patterns of relations of socio-material practices over the content of these practices. Thereby I have been able to show that learning materials have performative effects contributing to different forms of knowledge and different forms of presence in school. This normativity of materiality recognizes technologies and other materials not as tools but as actively participating in making up school practices. Technologies are indeed political machines that contribute to making school practices as they are; to their knowledge
and to their presences. This, however, is far too often overlooked by researchers, politicians, school professionals and pupils. All too often politics are deployed, lessons planned and learning achieved without taking into account how materials and technologies contribute to performing the practices in question. Consequently, politics, plans and learning turn out to work quite differently from what is expected.

On the basis of what I have learnt through my work with this thesis, I would like politicians, school professionals, researchers and pupils to start focusing less on the content of schooling, stop setting more and more narrow goals for learning, and dare to let go of the tendencies to control. Much could be gained by focusing on technologies and introducing into schools a variety of those used in contemporary society. This would contribute to the performance of a variety of different forms of knowledge and a variety of forms of presence – many of which would probably be unpredictable and require new methods of handling – which the learning practices should indeed explicitly cultivate. Furthermore, this would turn children’s lives outside of school into as a vast source for school learning. This source is currently largely ignored, yet if accepted competences could flow in unpredictable ways in untraceable directions inside and outside of school. This does not exclude reading, writing, maths, languages. On the contrary, these are indeed skills needed in socio-material practices with many technologies. Neither does it exclude representational knowledge and regional patterns of relations. Such indeed exist, and it is important to be able to work within them and contribute to them. But they should not be the only nor the most cultivated patterns of relations of schools. As I believe my thesis has demonstrated, it is important that multiple patterns of relations, multiple technologies, and multiple socio-material practices be cultivated in school.
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