Authorisations

A STS approach to computer based teaching

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Thesis submitted for PhD
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May 2009
ACKNOWLEDGEMENTS

I have been fortunate to meet and work with a great number of talented and encouraging people and to participate in a number of supportive and exciting research communities, without these this thesis would have turned out radically different.

First of all I would like to thank all the children and teachers that I joined throughout their Lego Robolab weeks at the primary school in Copenhagen. Without their contribution this research would not have been possible.

I would like to thank Hans Siggaard Jensen who led the Institute Learning Lab Denmark at the time I started my scholarship, for creating a convivial environment where I always felt welcomed and at home. Thanks also to the research programme of Media and ICT in a Learning Perspective, for challenging my work in progress. A warm thanks goes especially to my supervisor Birgitte Holm Sørensen for believing in the project all the way, even though the theoretical path turned out to go in a surprising direction that was unfamiliar to both of us.

I have been very fortunate to be able to visit the Faculty of Education, Deakin University in Melbourne, Australia for a four month period in the middle of my study. Thanks and gratitude first of all go to Catherine Beavis for her great hospitality and her valuable comments on my work. When my Actor-network interest became persistent Catherine introduced me to Chris Bigum, to whom I also owe major thanks for all our discussion on ANT and education, and to Sue De Vincentis who prepared the ground for our ANT Skype study sessions.

From Melbourne I skyped Estrid Sørensen, and I am sincerely grateful that Estrid was willing at first to be my second supervisor and later to become my main supervisor. Estrid has persistently encouraged and challenged my thinking and strengthened my belief in the endeavour even when I was not completely confident in my project. Estrid is a great inspirational model for ways to be an academic and be in academia with enjoyment and engagement.
After my return from Melbourne I discovered the well established STS study group of Copenhagen. Thanks to all the more-or-less consistent members of this group for providing enlightenment to me and for always being such a lovely crowd of talented scholars to learn from.

At around the same time I joined Anders Blok and Bjørn Schiermer Andersen’s study group on ‘things’. This fabulous group of people have changed and grown over time yet I want in particular to thank Marie Bruvik Heinskov, Maria Duclos Lindstrøm, Helene Ratner, Cecilie Juul Jørgensen, Anders Blok and Katia Dupret Søndergaard. It is always fun, challenging and exciting to be together with you.

Anders and Katia, Finn Olesen and Cathrine Hasse are also given extra thanks for reading and giving valuable feedback on parts of the thesis towards the end of the process, and Katia for becoming a dear companion along the way of this study.

The last half year I have been so fortunate to share the office with Camilla Balslev Nielsen. A warn thanks goes to her for always having an encouraging attitude, supplying far too much ‘fusse tea’ and for being able to turn tension into a productive atmosphere. This has been invaluable during the last part of writing up the thesis.

Hazel’s work with my language has also been priceless in making the thesis more readable for everybody. A big thanks goes to her. Any remaining inaccuracies or lack of clarity in the thesis are solely due to myself.

Last, but surely not least, the support of my family and friends have been invaluable. Thanks to my parents Peter and Anne Grete, and my sisters Gry, Liv and Sidsel – Lindegaard Rasmussen, Benjaminsen for always believing in me and supporting my decisions. Thanks to Britt Marie Gustavsson and Thomas Bang Jespersen for helping out with the children when I have been away at conferences or having sabbaticals for writing, or in life in general. And finally a sincere thanks goes to my two wonderful daughters Vigga and Regine for just being, and for teaching me to balance my life and work. Patrik Gustavsson, for the endless support for every choice I have taken in my career, as well as in our more private circle – for that I give you my deepest gratitude.

Nana Benjaminsen
May 2009, Copenhagen
ENGLISH SUMMARY

In spite of heavy governmental investments there has been little change in the use of digital learning materials in schools in Denmark over the last 13 years. This work is inspired by my amazement at the stagnation of the integration of computer based teaching in primary school. This thesis investigates especially the processes of authorisations in these forms of teaching, and is theoretically inspired by ideas related to the field of Science and Technology Studies and in particular Actor-network Theory, since the thesis aims to describe the apparently human capacity of authorisation from a post-human position.

Part I of the thesis, chapters 1-4, introduces the empirical and theoretical foundations for the study. In 2006 I was invited for a seven weeks visit to a school in a suburb near Copenhagen, where I observed four different classes using the construction based learning platform Lego Robolab. Lego Robolab is a Lego Brick and computer based system where children can build robots with sensors, bricks and engine and then programme their creations to do certain tasks through a software programme running on the computer. With this material, I ask how Lego Robolab – the bricks, sensors, computers, and manuals – affect the processes of authorisation in the classroom.

The founding fathers of philosophical discussions about authority, namely Adorno, Weber and Foucault are introduced, and contemporary empirical studies of authority in classrooms, both with and without computers are examined in order to position this study as one which learns from these descriptions. It examines authority as a human construct but takes a possible deconstruction into account and this helps me to identify that I with an ANT approach is adding materiality (as Foucault) and a symmetrical approach to these descriptions.

Studying matters symmetrically means that all different sorts of actors (human as well as nonhumans) are allowed to participate in the creation of the world. Actor-network theory is introduced as a position concerned with the emergent enactments that are crafted by a vast number of hybrid entities relating. With this approach it is argued that epistemological questions of how we know authority are turned into ontological ones, asking how is authority enacted. This has methodological consequences for the way authority is examined and for the way knowledge production is thought about in this thesis. Some of the more important consequences described
are that it is the actor’s world building capacities that are in focus, and that articulation in contrast to accuracy is taken up as an ideal for the knowledge production of this thesis.

Part II of the thesis marks the descriptive and analytical part of the work and includes chapter 5-8. First I follow the children’s introduction to the Lego Robolab system. This situation resembles an ordinary teaching situation where a teacher is instructing the children. I ask how the teacher Pete becomes an authority in this setting and it is realized that Pete is not an authority by himself, but that the walls, the floor, the children’s bodies placed on the floor and eyes directed towards Pete, are all entities partaking in the arrangement that, using Vinciane Despret’s words, is making authority available to Pete. What is made available for one of the children at a specific time through the formation of groups and the floor indicates that the way bodies are enacted is also important to the way authority configurations of the classroom are enacted. This finding makes it possible to conclude at the end of chapter 5 that in order to examine authority not only the activities of humans but the emergent arrangements of humans and nonhumans need to be examined in the specific temporality and spatiality of the enactment.

In chapter 6 I ask what happens to the teacher authority made available to Pete when the centralised teaching situation is decentralised. Children, materials and computers are distributed to different spaces in the working area and the manual becomes a central object because it holds a fixed procedure which all the children are asked to follow. The teacher sets the expectations of the children becoming good constructors by building a Lego Robolab car and, by that, authorises the children to build with the material. Yet authorisations are discovered to go beyond human relations; one of the children tests the length of the Lego bricks against the manual’s instructions and by that authorises the manual to be a proper manual holding useful instructions. The manual is pointing towards the bricks making them a good collection of bricks. And the ‘right’ brick being there, according to the manual’s instructions makes the children build the car as intended, and what I call the circulation of authorisation has gone full circle, where every actor involved ends up looking competent. Further investigation of this circulation of authorisation points out that three other elements are crucial for authorisation to circulate: Pete’s knowledge about Lego Robolab, making him able to set meaningful and manageable expectations of the lesson, together with the emotions of trust and interest which are considered as effects of different actor-networks. Borders between authorisations and domestication are also discussed in relation to these three dimensions and to the given empirical example, and through this differences are identified.
that reveal that authority and authorisations are not the same. Authority is the result of stabilised authorisations over time, whereas authorisation encounters the dynamic process of the making of an authority.

Not all the children and the material line up with a circulation as described above and three different configurations are described in chapter 7 where the entities involved are only peripherally related to the manual and the teacher’s agenda. The configuration shows that other expectations of engagement co-exist with the teacher’s intention of children becoming good constructors. Topological imaginaries described within the field of STS are related to the relational descriptions in order to capture the spatiality of the different actors’ relational arrangements, and a fluid and network arrangement are identified. Through these arrangements the differences between availability, expectations and authorisations are examined. In this it is also identified that other expectations existing in the classroom create other authorisations, which means that other circulations of authorisation can co-exist with the one initiated by the teacher.

Chapter 8, the last analytical chapter, takes up questions concerning this existence of several authorities in the classroom. The descriptions follow one boy’s affiliations with three different authority configurations, the first one where the Lego Bricks is authorising, secondly one where the manual is authorising and lastly a configuration where the boy becomes the one who is authorising. Through these descriptions it becomes apparent that both the object Lego Robolab and the concept of authority can be described as multiple. Recognising this multiplicity might also provide an alternative explanation as to why the use of computer based learning materials are not the preferred choice of teaching material, nor are they much appreciated by teachers.

Chapter 9 marks the concluding part III of the thesis. Apart from the contribution of detailed descriptions of the enactment of authority and authorisations in computer based teaching, the work of this thesis offers two concrete contributions to two different research fields. The contribution to the STS community can be found in the descriptions of the existence of multiplicity in one setting; the classroom. In the classroom the spatial and temporal displacements are minimal and this adds empirical insight to Annemarie Mol’s description of the enactment of a multiplicity across several displaced practices. To the field of computer based teaching this thesis contributes the detailed descriptions of how authority is configured when Lego Robolab is used in teaching. It is argued that authority is not only social, but is a sociomaterial enactment stabilised over time.
The thesis concludes that the examples described throughout the thesis have made it increasingly clear how authority is enacted in different configurations in the classroom, and how Lego Robolab is effecting and affects the authorisation processes. I end by discussing a way to work with the tensions arising in IT teaching, and by that show how, from a post-human position, this thesis can contribute to the discussions of the integration of digital learning materials in everyday teaching. I suggest, through Eduardo Viveiros De Castro’s notion of ‘the smallest common multiple’, that the ontological multiplicity can be taken seriously and used as a guide for further investigations in the field of educational research. If the world(s) is proposed as multiple and as emergent accomplishments then we cannot know if we are all seeing and experiencing the same thing. It might therefore be useful for teachers to allow themselves to imagine children as something that is radically different from themselves, in order to overcome the interpretation that common understanding is possible. By allowing actors to build different, and not necessarily alienated, worlds, and recognising that this is what happens in the classroom of computer based teaching, a valuable step is taken that offers researchers, as well as practitioners, new ways to re-articulate and re-specify the enactments of authority in computer based teaching.
DANSK RESUMÉ

Autoriseringer - en STS tilgang til computerbaseret undervisning

I løbet af de sidste 13 år er anvendelsen af digitale læremidler i folkeskolen ikke forøget, til trods for store investeringer fra regeringens side. Denne afhandling deler forundringen over den stagnerede integration af digitale læringsplatforme i folkeskolen og undersøger især de autoriseringsprocesser, der finder sted i denne computerbaserede form for undervisning. Afhandlingen er teoretisk inspireret af feltet Science and Technology Studies (STS) og i særdeleshed af Aktør-netværks Teori (ANT), og afhandlingen sigter mod at beskrive den tilsyneladende meget menneskelige kapacitet; at autorisere fra en post-humanistisk position.


Adorno, Weber og Foucault bliver introduceret som grundlæggere af filosofiske diskussioner af autoritet, hvorefter nutidige empiriske studier af autoritetsfiguren i klasseværelser med og uden digital teknologi bliver undersøgt. Studierne bliver anvendt til at markere, hvad nærværende undersøgelse lærer af eksisterende empiriske studier, ved blandt andet at anerkende og bygge på den konstruktivisme og dekonstruktion studierne fremtrækker. Samtidig med at det tydeliggøres at nærværende afhandling tillægger disse nutidige beskrivelser, i kraft af dens sociomaterielle (som Foucault) og symmetrisk tilgang, der præsenteres her.

At studere materialitet symmetrisk vil sige at tillade alle forskellige typer af aktører (nonhumane såvel som humane) at deltage i konstruktionen af verden. Aktørnetværks teori bliver introduceret som en position beskæftigtig med emmergerende arrangementer, skabt af en lang række hybride entiteter, der relaterer til hinanden. Der argumenteres for, at denne tilgang forandrer epistemologiske spørgsmål om, hvilken viden vi har om autoritet til ontologiske spørgsmål om, hvordan autoritet
gøres i praksis. Forskydningen fra en epistemologisk til en ontologisk interesse har metodologiske konsekvenser for måden, hvorpå autoritet undersøges og hvordanvidensproduktion tænkes. Nogle af de mest centrale konsekvenser, jeg beskriver, er, at aktørmnes egen evne til at konstruere virkeligheder er taget til efterretning, og artikelutioner i kontrast til præcision er valgt som ideal for afhandlingsen vi-
densproduktion.

Afhandlingens del II markerer studiets deskriptive og analytiske del og inkluderer kapitlerne 5-8. Her følger jeg først elevernes introduktion til Lego Robolab systemet. Situationen beskrevet ligner en almindelig undervisningssituation, hvor en lærer introducderer nogle elever til noget materiale. Jeg spørger, hvordan læreren Pete bliver en autoritet i klasseværelset, og igennem dette spørgsmål anskueliggøres det, at Pete ikke er en autoritet i sig selv. Væggene, gulvet, børnenes kropspositioner og blikkene rettet mod Pete er alle entiteter, der deltager i arrangementet, som ifølge Vinciane Despret gør autoritet tilgængelig for Pete. Børnenes bliver inddelt i arbejdsgrupper og hvad denne inddeling og børnenes kroppe placeret på gulvet gør tilgæn-
gelig for eleverne indikerer, at også måden hvorpå kroppe performes har betydning for måden, hvorpå autoritetskonfigurationen i klasselokalet gøres. Disse iagttagelser gør det muligt i enden af kapitel 5 at konkludere, at for at undersøge autoritet bør ikke kun humane og nonhuman aktører medtænkes. Konfigurationer skabt af menneskelige og ikke menneskelige aktører må undersøges hvor de opstår, hvilket be-
virker, at de rummelige og temporale dimensioner må medtænkes.

I det følgende kapitel 6 spørger jeg, hvad der sker med den autoritet, der er blevet gjort tilgængelig for Pete, når den centrale undervisningssituation decentraliseres. Børn, materialer og computere er distribueret til forskellige steder i klasselokalet, og instruktionsmanualen bliver en central aktør, idet den indeholder en procedure, alle eleverne bliver bedt om at følge. Læreren sætter en forventning om, at eleverne følger manualen og blive gode konstruktører ved at bygge manualens robot-bil, og autoriserer herved børnene til at bygge med materialet. Autoriseringerne stopper imidlertid ikke her men går ud over de menneskelige relationer; en af eleverne tester en Lego klods mod manualens visualisering og autoriserer herved manualen til at være en fornuftig manual, der giver nyttige instruktioner. Manualen peger på lego-
kloenserne og gør på den måde kloenserne til en samling ’gode kloser’. At den ’rigti-
ge’ klods er til stede i samlingen af kloser i relation til manualens propositioner, får eleverne til at lave den intenderede bil, og det kan iagttages, at hvad jeg vælger at kalde en ’cirkulering af autorisering’ har fundet sted, og alle involverede aktører ender med at fremstå som kompetente. En videre undersøgelse af denne cirkulering idenificerer, at tre andre elementer er afgørende for at autoriseringerne kan cirkule-
re: Følelserne tillid og interesse (der anses som effekter af de eksisterende aktør-

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netværk), og Petes *viden om eleverne og Lego Robolab gør ham i stand til at sætte meningsfulde og medgørlige forventninger til lektionen. Grænserne mellem autorisering og domesticering bliver også undersøgt i relation til disse dimensioner og de givne empiriske eksempler, og det bliver endvidere identificeret, at autoritet og autoriseringer ikke er det samme. Autoritet er et resultat af stabiliserede autoriseringer over tid, hvor autoriseringer medtager den dynamiske proces ved tilblivelsen af en autoritet.


Kapitel 9 markerer den konkluderende del III af afhandlingen. Foruden afhandlingen detaljerede beskrivelser af hvordan autoritet og autoriseringer bliver gjort i computerbaseret undervisning, bidrager afhandlingens vidensproduktion til to konkrete felter: Bidraget til forskningsmiljøet omkring STS og ANT kan findes i afhandlingens beskrivelser af multiplicitet i relation til *et fysisk miljø: klassenværelset. I klassenværelset er de rummelige og tidslige forskydnings minimale, hvilket ligger til Annemarie Mols beskrivelser af, hvordan multiple fænomener gøres i relation til mange forskellige fysiske lokationer. Til forskningsfeltet for computerbaseret læring bidrager afhandlingen, som nævnt, med detaljerede beskrivelser af, hvordan autorit-
seringskonfigurationerne finder sted, når Lego Robolab anvendes i undervisningen, samtidig med at der gennem afhandlingen argumenteres for, at autoritet ikke kun er social, men også er en sociomateriel konfiguration stabiliseret over tid.

Afhandlingen konkluderer, at eksemplerne beskrevet igennem afhandlingen har gjort det stadig mere klart, hvordan autoritet i klasseværelset bliver gjort i forskellige arrangementer af aktører, og hvordan Lego Robolab på forskellige vis påvirker og bliver påvirket af autoriseringsprocesserne.

Jeg afslutter afhandlingen ved at diskutere måder at håndtere IT undervisningen på, og viser herved hvordan afhandlingen fra en post-human position kan bidrage til diskussionerne om integration af digitale undervisningsmaterialer i den daglige praksis. Jeg foreslår, at den ontologiske multiplicitet tages seriøst, og tages som ledetråd for videre forskning, via Eduardo Viveiros De Castro’s tanker om ’den mindste almindelige forskel’. Hvis verden forestilles multipel kan vi ikke gå ud fra, at vi ser og oplever det samme. I så tilfælde kan det være gavnligt for lærerne at tillade sig selv at forstille sig børnene som noget radikalt anderledes end dem selv for at overkome ideen om, at en fælles forståelse er mulig. Ved at tillade de forskellige aktører at konstruere forskellige og ikke nødvendigvis harmoniserede virkeligheder og anerkende, at dette ofte er tilfældet i den computerunderstøttede undervisning, kan der tages et afgørende skridt i retning af at tilbyde forskere såvel som praktikere nye måder at re-artikulere og re-specificere relationerne mellem materialer, børn og lærere i computerbaserede undervisningssammenhænge.
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PART I

This thesis explores some of the implications of digital learning in current teaching environments, focusing particularly on authority and authorisations from a post-human position.
1. INTRODUCTION

How can we produce better learning environments? How can we optimise teacher education? How can we develop better teaching materials to support the learning processes of human beings? These questions are central to the field of educational research in general and to the field of digital learning environments in particular. Within the field of digital learning a major challenge is to make appropriate digital learning environments and digital materials available to the teacher and to encourage the teacher to use them. Attention is mostly focused on human interaction; on how to optimise digital environments for the learning process, and the choice of digital material is often considered only as something that is affected by human policy decisions or economic considerations or as a result of human experience with technology. The major explanation for the slow integration of the use of digital learning material in schools has been attributed to these human factors.

The thesis takes a post-human position to explore the reasons for the stagnation of the integration of ICT, as it foregrounds materiality. A post-human attitude is not to be understood as a post-human influence, and as we shall experience, the focus on materiality might suggest that human beings do not always have control over developments. A recently published report entitled ‘Digital Learning Resources in Schools and High Schools’ is an example of this.¹ The report shows that Danish teachers’ use of digital learning material has not expanded over the last decade and the school textbook is the primary source of learning material today as it was in 1995. However teachers and educators believe that a greater integration of digital learning material will be present in the near future and this again exactly matches the response given by school leaders and teachers in the similar report of 1995. These two tendencies – a willingness towards the integration of digital learning materials, evident in the belief of a technologically bright future, and the actual use of digital learning materials which have not developed over the last 13 years, makes the report conclude that there seems to be significant structural barriers needing to be challenged if learning resources are to expand (Drotner & Hansen, 2009, p. 46). The report gives a number of barriers to be overcome: the political willingness to acknowledge digital competences as important and make appropriate legal statutes;

¹ The report is written by DREAM: Danish Research Centre on Advanced Media Materials and the National Knowledge Lab for Learning Resources. The report written in Danish can be downloaded at: http://www.dream.dk/files/pdf/rapport_laeringsressourcer.pdf, and the two knowledge centres can be visited at http://www.dream.dk, and http://www.laeremiddel.dk.
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economic resources are needed to develop and produce learning materials; the development of computer labs in schools, together with technical support for teachers inexperienced with using technology who therefore find digital resources less reliable as teaching materials than the printed text book.

This is interesting: The textbook is still the teachers favoured learning material, and at the same time one of the government’s official goals is that educational technologies shall hold a prominent place in the educational system; ‘IT shall be integrated in all subject matters at all grade levels where it is natural’ (Gertz, 2008). To support this goal the Danish government has over the period 2004-2007 invested 70 million euros to support an increased use of IT at all grade levels. In spite of this large investment and a legal framework of support, changes in the choice of learning material have not occurred. It is clear that there is something in the way we address the IT integration that does not promote the intended effect. This thesis suggests that there is another dimension to the problem. A post-human position, as the two words and the hyphen indicate, suggests we look for explanations that are not (entirely) driven by human action, it investigates the agency held by things, symbols, materialities, and therefore it goes beyond the human description and adds descriptions of the impact of materialities.

**Computer enhanced teaching - a challenge to teachers**

Computers in classrooms, computer enhanced teaching, educational technology, ICT based teaching: The field the thesis is addressing has many names, yet the focus is the same; different learning/teaching situations where digital learning platforms are used for educational purposes. Within this field it is generally acknowledged, nationally as well as internationally, that digital learning platforms challenge the teachers, and that the challenges are to be identified in several different dimensions (Bigum, 1997, 1998; Cuban, 2001; Drotner & Hansen, 2009; Egenfeldt-Nielsen, 2005; Holm Sørensen, 2006; Squire, 2005; Sørensen, 2005, 2009).

The teachers are confronted in the classroom by the children’s digital competences. In general children are more familiar with digital technologies, and it is therefore not unlikely that some of the children may be identified as being extremely IT competent. This would then alter the usual balances of knowledge resources in the classroom (Egenfeldt-Nielsen, 2005; Holm Sørensen, 2005, 2006; Squire, 2005; Stensaas, 1999).

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2 My translation from the Ministry of Education’s website: http://www.uvm.dk/Uddannelse/Folkeskolen/Om%20folkeskolen/Fokusomraader/It%20i%20folkeskolen/Programmer%20ITIF.aspx.
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Computer enhanced teaching is concurrently producing a movement away from the traditional teacher-centred practice with teacher’s desk and blackboard towards an often de-centralised teaching where the teachers have far less oversight of all the children all the time as is maintainable in traditional classroom teaching (Bigum, 1997; Stensaas, 1999; Sørensen, 2005, 2009).

‘Authority on trial’ or ‘teacher authority in decline’, such statements are not unusual today (Holm, 2008; Juelskjær, 2009 forthcoming), and the challenge to teachers to produce functional learning situations is not made easier when digital technologies are introduced into the classroom.

Two significant physical displacements occur in relation to the general teaching practice in ordinary classrooms. First the teaching may be displaced from the ordinary classrooms to computer labs (in the descriptions in this thesis to a ‘Multiroom’ with laboratory tables along the walls and no chairs). Secondly the teaching materials change from a somewhat stable textbook to an interactive teaching material.

Empirical and theoretical question of research

The displacements mentioned above make it centrally important to describe how authority circulates within these digital enhanced educational settings. The empirical project of the thesis therefore seeks to establish what happens when digital learning material in the form of Lego Robolab enters the classroom and asks how this affects authority. Lego Robolab is a construction-based learning platform developed from the ideas of the American computer scientist and educator Seymour Papert’s theory of constructionism. The theory states that children learn most effectively while they are doing (Papert, 1980, 1994; Papert & Harel, 1991). The ‘doing’ of Lego Robolab rests in the possibility of building robots with Lego Bricks, engines and sensors and to programme them to do certain tasks using a software programme installed on a computer. In order to investigate the configuration of authority I have followed children using this product at a school in a suburb of Copenhagen over a period of approximately two months in the spring 2006.¹ Three 5th grade classes had a one week introductory course to Lego Robolab, and one of the 6th grade classes were preparing themselves to enter a communal Lego Robolab competition over a two week period. Prior to my observations of Lego Robolab I spent two weeks in the school observing ‘ordinary’ teaching. The empirical questioning of what happens with authority when Lego Robolab is used as teaching material enables me to broaden the spectrum of the kinds of activities that become interesting to investigate. One of the advantages of the open empirical approach is that it first and foremost does not make any prior judgements about what learning

¹ All the real names of children and teachers mentioned in the thesis are changed.
is taking place before observing the actual practices and activities in the classroom. The empirical question on the other hand makes me capable of giving descriptions of the highly complex and often multiple environments in which learning (or not learning) with Lego Robolab takes place. This generates further types of insight about the challenges digital learning technologies create.

The thesis thus does not only have an empirical focus but is firstly theoretically based and conceptually informed. The conceptual point of departure arises from questions concerning the key concepts; authority and authorisations. Authority is most often thought of as a social phenomenon, but if authority and authorisations – as it most often is the case – is considered as social thing, how can we then explain that authority and the authorisations is affected by the presence of Lego bricks, sensors and computers? As already hinted in the way I phrase the theoretical questions, I discover clearly distinct differences in the two interlinked concepts authority and authorisations: Authority will enable me to encompass roles and routines of the classroom that exceed the space and time that I empirically investigate in the thesis. Authorisations allow me to identify how authority circulates in the locally enacted settings that I study.4

The empirical question - what is enacted in computer enhanced classrooms - and the theoretical – how do we explain authority’s material affectedness – allows me to formulate the following question which this thesis aims to answer:

How does Lego Robolab - the bricks, sensors, computers, and manuals - affect the processes of authorisation in the classroom?

With this focus the thesis explores how non-humans partake in the construction of authority figures and circulations of authorisations in the lessons I visited. More precisely it investigates the technological entanglement of the authorisation processes in an educational setting where the construction- based learning platform Lego Robolab is used. The contribution of this thesis can be found in the cartography the thesis produces of authority by mapping the infiltration of human and nonhuman actors in the production of authorisations. The thesis produces insights into the sociomaterial enactment of authority in these Lego Robolab classrooms. More specifically it produces empirical details of the difficulties inherent in teaching with digital learning materials. The material focus also helps to produce empirical descriptions of the complexity of the authorising processes.

4 The double focus on authority and authorisations will hopefully be clear through the discussion of authority in chapter 3 and in the first empirical analytical chapter (chapter 5). Until then the ambivalence and openness of the terms are deliberately left for later discussion.
Theoretically it produces the argument that authority can be considered as a social and material phenomenon, and through the empirical descriptions it illuminates differences between authority and authorisations.

The project addresses the field of computer enhanced teaching and aims to articulate in a more detailed way how authorisations socially and materially come about in computer enhanced classrooms. It is hoped that from this project researchers in the field of computer enhanced teaching and researchers with interest in teacher authority in general will find this alternative view of the construction of authorisations interesting. It may also be of interest to a wider field such as researchers interested in semi-formal learning environments, for example science parks and museums, since the same physical displacement of teaching arena and teaching material may also take place there. Finally the thesis especially draws upon the work and writings developed among researchers and scientists that relate to the field of Science and Technology Studies (STS) and in particular to Actor-Network Theory (ANT). Key texts for this thesis to mention are the Belgian philosopher of Science Vinciane Despret’s text, ‘The Body we Care for: Figures of Anthropo-zoo-genesis’ (Despret, 2004a) and the French Sociologist and thinker Bruno Latours texts; ‘How to Talk About the Body? The Normative Dimension of Science Studies’, ‘Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern’, and ‘Re-assembling the Social’ (Latour, 2004a, 2004b, 2005a), ‘The Body Multiple’, by the Dutch STS researcher and philosopher of Science Annemarie Mol, and ‘Materiality of Learning’ written by the Danish STS researcher Estrid Sørensen. I bring STS/ANT to a fairly new research field and apply the well known ANT ideas of symmetrical research, actor-networks, and multiple ontologies to the concept of authority that has so far only been described from this point of view by one other STS scholar (Sørensen, 2005, 2009).

**Authority and Actor-Network Theory**

The thesis will attempt to suggest an alternative account on authorisations within the area of computer enhanced teaching, and proposes that when teachers in classrooms and computer rooms attempt to gain control and authorise action it is an activity that is not entirely controlled by humans themselves. I will give a post-human description of the ways in which authority circulates in IT based teaching, and propose that human practice is always already entirely entangled with a vast amount of both high and low technologies such as computers, tables, floors, numbered cables and that it is this entanglement that establishes the processes of authorization.
Authorisation processes have been described as a matter unfolding between human beings by the German sociologist and philosopher Theodor Adorno and the German political economist and sociologist Maximilian Weber (Adorno, Frenkel-Brunswik, Levinson, & Sanford, 1950; Weber, 1958). The French philosopher and historian Michel Foucault adds materiality to his analysis (Foucault, 1979), and in the light of this Foucaudian thought the sociomaterial construction of authorisation processes is not new (Foucault, 1979). However by engaging with the field of STS, and especially ANT this thesis adopts the symmetrical approach which gives weight to both the human and non human dimension. As an effect of the symmetrical approach I am enabled to broaden the repertoire of material actors that can initiate the circulations of authorisations to encompass Lego bricks as well as teachers and children.

**Actor-Network Theory in relation to the field of education**

Only a few scholars have so far used the ANT approach within the field of primary schools, yet the interest for ANT’s symmetrical and sociomaterial approach is expanding. The American anthropologists Kevin Leander and Jason Levorne have used ANT to argue that the boundary between online and offline learning environments is an artificial one (K. M. K. Leander & Lovvorn, 2006). The American researcher Scott Waltz has used ANT to investigate the sociomaterial enactment of gender and schooling (Waltz, 2006). The Educational researcher Chris Bigum has written about the involvement of computers in schools from an ANT approach (Bigum, 1997, 1998). The philosopher of science Helen Verran has used the ideas of ANT to investigate bilingual Nigerian school children learning maths that, as we shall see, has generated some interesting insights that transfer fairly well into the context of a Danish school (Verran, 1999, 2007). Finally Sørensen has developed the concept of ‘Patterns of Relation’ to capture the different ways knowledge circulates in online and offline learning environments, and through these descriptions has developed a theory of the materiality of learning (Sørensen, 2005, 2009).

**Analytical symmetry**

It would seem to be appropriate to work with a social constructivist view on relations established in the classroom when it is basically the relations between children and teachers that one wants to optimise. Focussing on relations between humans creates knowledge limited to human interaction whereas in computer enhanced teaching another material dimension intrudes. This has analytically been handled within the research field of educational technologies by materiality friendly perspectives such as Activity Theory (Engeström, 2001; Wasson, 1997), or Mediated Discourse Analysis (Scollon, 2001). Both of these approaches grant materialities lim-
ited and one dimensional agency. In contrast ANT offers a sensibility that allows all sorts of actors agency on the same premises as ascribed to human beings, and it can also account for multiple objects and multiplicity as we shall see in chapter 7. Engaging theoretically with ANT means working symmetrically. In this study human and nonhuman agency is not decided in advance of the empirical descriptions, and human-human relations also are not determined prior to my descriptions. The latter may seem like a contradiction in terms, since the relation between teachers and children is created as an asymmetry, placing the teacher as a knowledgeable authority and the children as the learners before my analysis starts. Yet the symmetrical doctrine is considered one of ANT’s most powerful tools used to extrapolate new descriptions. Using symmetry has immediate effect on the analytical description – the teacher might be an authority, but is not prescribed as such. The French sociologist and philosopher of science Bruno Latour gives an educational example that finely illustrates this point:

If [...] you sit in a chair in a lecture hall surrounded by well-ordered tiers of students listening to you in an amphitheatre, I need only half a day’s work in the university archives to find out that fifteen years ago and two hundred kilometres away an architect, whose name I have found and whose exploratory scale models I have ferreted out, had drawn the specifications of this place down to the centimetre. She has no precise idea that you would be lecturing out loud today, and yet she anticipated, in a gross way, one aspect of such a scene’s script: you will have to be heard when you speak; you will sit at the podium; you will face a number of students whose maximum number, space requirements, etc. must be taken into consideration. No wonder that, fifteen years later, when you enter this scene, you feel that you have not made it all up and that most of what you need to act is already in place.

(Latour, 2005a, p. 194-195)

The situation is easily imagined in an ordinary classroom as well. The teacher’s platform is there, identifiable in front of the whiteboard or blackboard. To use an ANT term the physical elements easily ‘aligns’ with, and helps to produce, the teacher as an authority. What also becomes apparent is the material support of other things, such as lesson times, physical spaces and agencies present in classrooms. Rooms are built with an institutional idea of learning, walls separating the different grades, subject matters divided by a bell ringing, teachers and learning materials changing according to subject matters on the timetable (Brubacher, 1947). Each configures scripts of other times, other spaces and other agencies present in classrooms of today. The quotation above from Latour tells us that rooms are framed – they are scripted before we arrive. However the stage in the amphitheatre
which has been tailored for the teacher or lecturer does not mean that it determines what the lecturer or teacher is going to say, nor how they are going to say it. The teacher can push the tables together to form circular seating to support a less authoritarian style, nor can anyone stop the students from falling asleep when the teacher starts to teach. However, this does not mean that the materialities do not matter. Latour continues by assuring that just because some material elements are not deliberately determining an action does not mean that we can conclude that they are doing nothing. Things matter even though they may not say anything, or may not in other ways actively insist on human attention, Latour uses this to argue that we should give space to many more ‘ontological stages’ than the extremes of being or nothingness (Latour, 2005a’ p. 195) The point is made clear when Latour continues his example:

If you doubt the transporting power of all those humble mediators in making this a local place, open the doors and windows and see if you can still teach anything. If you hesitate about this point, try to give your lecture in the middle of some sort of art show with screaming kids and loud speakers screwing out techno music. The result is inescapable: if you are not thoroughly ‘framed’ by other agencies brought silently on the scene, neither you nor your students can ever concentrate for a minute on what is being locally achieved. (Latour, 2005a, p. 195)

Latour illustrates how things, material, technologies silently promote and help to produce the lecture(r). He also writes that the nonhuman actors help to make this both a local and a global place at the same time, and from this we can extract a central point.

Things are to be taken into consideration whether they are noisy or not. When teachers make their way to the stage of amphitheatres or classrooms, they are already heavily supported by nonhumans in the way other times, spaces and agencies have been folded into the construction of the building, the organisation of bodies in the room, the seating arrangement, places to act and places to listen. In a similar way the relation between the teacher and the children is a relation that exists before the time/space/agency relations I analyse, which also affects what can happen in these locations. It is however not these ‘global’ relations that are the primary focus of this work. I do not cultivate ‘knowing’ about these types of relations in advance of my descriptions. I make an experiment, I look at what is present in the small sequences I investigate and nurture what this insight can tell us about authority in computer supported teaching. It is the local arrangements that keep my attention, knowing very well that it is exactly the artificiality of the bifurcation of the
global/local destinations that Latour is showing in the above quotation: Dealing with the local arrangements of time, space and agency is always also an engagement with global arrangements.

When we turn away from Latour’s amphitheatre that has not changed for 15 years – and probably much longer – and turn to computer enhanced learning environments, a whole new universe of complex question arise. Here we would understand little by simply referring to the ‘script’ of the physical setting since this type of teaching goes beyond an amphitheatre setting. Of course the room still enjoys the ‘closedness’ produced by architectural restrictions and building regulations of traditional classrooms, but no architect has used a massive amount of creative, technical and intellectual capacity to measure and ‘script’ a place in which to support this often decentralised and distributed act of teaching that emerges when children, singly or in groups, work at several different digital workstations. These computer based teaching settings differ. Children and teachers use the materials simultaneously in very different ways, as we shall see (chapter 5-8). Other material is present here than in Latour’s amphitheatre, materials such as instruction manuals are influencing the activities, and the clearly identified teaching platform in front of a black board is often gone or transformed into other materials in these settings. Now, this is exciting! How can we account for the complexity of all these heterogeneous elements, their interrelation, and their spatial and temporal variation? This is what this thesis is about.

Articulated noses and reflections about authority

The analytical descriptions of the thesis (chapter 5-8) are created in a progressive attempt to sensitise myself to the world through developing my own sense of becoming a ‘nose’. To understand how to become a nose we shall follow Latour into the perfume halls of Paris (Latour, 2004a). Here noses are trained by the use of odour kits. Odour kits contain thousands of different fragrances arranged in series of sharply distinct scents, so that one can discern the sharpest to the smallest contrast. Following Latour’s analogy, before the sessions odours are present around the pupils without making them act, speak or sense. After the training, contrasts emerge. The noses have become sensitive to the world. Not all in the same way because some special odours have a great effect on some pupils and not on others. This, the teacher, the odour kit, and the sessions are what allow the different odours to make the trainees do something different every time.

In a similar way I have over the past three years been trained to articulate sensitivity to the world of authority in technology enhanced teaching, to see its multiplicity and its nuances. My odours differ from the ones in the Parisian Odour kit. I have been at a Primary School in a suburb of Copenhagen, writing field notes, talking to
INTRODUCTION

children and teachers, recording their voices and video filming their activities. I have read articles, books, newspapers; I have travelled to conferences, and joined study groups, been supervised and have listened, watched, spoken, written and rewritten.

Yet why do I use this analogy between the efforts of becoming an articulated nose and the articulation of my thoughts about authority? It is the body-world relation I want to reveal but in such a way that it shows the nature of this study and its science-philosophical position.

In both the cases of Latour’s pupils in France and with my own study, bodies learning can be described with the dynamic definition as bodies that are ‘learning to be affected’ (Latour, 2004a, p. 209). With this simple definition Latour intends to loose the subject/object division: Either we have the world, the science, the things and no subject, or we have the subject and no world full of things and science. Describing the body as an entity learning to be affected makes the productions of subjects and objects interdependent on each other. Latour makes the nose-world relations concrete. The dynamic definition of the body as one learning to be affected:

[…] is especially salient when we compare what happens to a pupil learning to become a ‘nose’ with what happens to her teacher devising his odour kit through a long enquiry among 2000 untutored ‘noses’, and with what happens to the chemists when they try to build instruments and apparatus to register chemical differences in the various disciplines surrounding the industrial branch of perfume manufacturing. Each of these different actors can be defined as bodies learning to be affected by hitherto unregistrable differences through the mediation of an artificially created set-up.

(Latour, 2004a, p. 209)

What is surprising here is that an articulated world and a sensitive medium, a nose – or more precisely in my own case the articulation of new thoughts about authority - are produced at the same time, and dependent upon each other. This does not mean that the world or the nose is not there; in the same way the school class I was to visit used the Lego Robolab whether or not I came to visit and whether or not I worked with the ANT literature to develop my thinking about it. Yet the development of the thinking about authority cannot be produced without the effort of sensitising myself to the world of data, text, study groups and guidance from supervisors. Even more concretely, it is suggested that it is exactly the non-human artillery described in the example above by Latour, it is the presence of the odour kit that

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4 The –ing form of learning in the definition is important as we shall experience shortly.
enables the development of the apparently very human capacity to smell. To give a
few examples in this study, my engagement with Despret’s text ‘The Body We Care
for: Figures of Anthropo-zoo-genesis’ (Despret, 2004a) gave me access to think
about and use the vocabulary in the mutual constructedness of ‘making available’,
and my engagement with Mol’s book ‘The Body Multiple’ gave me the ability to
think in multiple objects. So the becoming of a nose, or as here the becoming of
alternative thinking on authority, is not just a necessary praxis one needs to go
through to arrive at the result, because what is is a result of how it has become
what it is. This also explains and positions the procedural reflections in the thesis.
These are not written as a reflective self examination but they are about recognising
the process of the thinking about authority as a reaction to the more typical ways of
seeing authority. This has made me alert to the process of becoming, or ‘coming
into being’ of an alternative model.

Structure of the thesis

The sensitizations towards my research object can be seen in light of the process of
continually producing more contrast, to sense more differences - a process that by
no means ends with the print version of this thesis, but continues in further works.
Yet what is established in the following two chapters is an illustration of the
movement and transformations that the focus and research questions have under-
gone during the production of the thesis. Chapter 2 describes the process of estab-
lishing the field and research object, and chapter 3 focuses on the research object,
that is authority, which I established at the end of chapter 2 and discusses contem-
porary descriptions of this phenomena.

Materialities are not handled as silent partners, but as active participators in the
construction of the time, space and agency configurations that I aim to record, and
I argue that the local time/space/agency configuration of this ‘globalized’ setting
calls for a situated empirical analysis. This point is inherent in ANT practice which
reformulates the dichotomies of the particular/universal and the global/local that I
will return to in chapter 4, where the theoretical framework of this project is pre-
sented. The chapter describes the concepts of actor-networks, heterogeneity and
symmetry. It introduces what has come to be seen as the ontological turn, and it
describes the term additions, which is used theoretically as well as empirically
throughout the thesis.

Part II of the thesis consists of chapter 5-8 which describe the ‘becoming’ or genera-
tion of an alternative view on authority, and the structure of these chapters will be
presented in detail at the beginning of part II. Briefly, chapter 5 presents a descrip-
tion of authority as a social and material configuration available through the vo-
cabulary of Vinciane Despret, and one analytical dimension of bodies is discovered
as an important factor when investigating authorisations. Chapter 6 unfolds what is ‘made available’ when the authority is ascribed to the manual. The chapter investigates an example where a teacher successfully maintains authority in the Lego Robolab environments and illustrates that the success of using the education product in a scholarly setting is largely due to the coordination and entanglements of social and material agencies. The teacher must reconfigure allies in the human and material assemblage, and it is this reconfiguration that allows the teacher to maintain authority. This, in part, illuminates some of the difficulties with the integration of information and communication technologies in schools. The concept ‘circulations of authorisations’ is created through the empirical descriptions and the dimensions of knowledge, domestication and the emotions of trust and interest are added as central factors when examining the processes of authorisation. Chapter 7 contrasts with chapter 6 by describing three empirical examples where none of the children relate more than partially to the teacher’s agenda. Through these descriptions it is identified that other expectations co-exist with the one promoted by the teacher’s agenda and by the instruction manual that is distributed. With expectations and authorisations interlinked the existence of other circulations of authorisations emerge than the one authorised by the teacher. The investigation of these multiple and synchronically enacted authorisations is taken up in chapter 8 where an example is presented of a boy who initially does not relate to the manual but who later decides to follow it. The coexistence of several circulations of authorisations is used to generate and investigate questions of the coexistence of different authority figures. The chapter suggests that Lego Robolab is a multiple object and explores an example of co-existing authorities.

Chapter 9 forms part III of the thesis and present a final discussion and the conclusion of the thesis. It summarizes the knowledge produced throughout the descriptions in chapter 5-8. It demonstrates this knowledge by introducing one final empirical example and discusses the tension which exists between coexisting authorities. The thesis ends by suggesting ways to further develop the insights gained from the thesis, as well as suggesting how teachers may effectively deal with tensions that arise in computer enhanced teaching.
2. THE CONSTRUCTION OF RESEARCH FIELD
AND RESEARCH OBJECT

A research field and research object is never just there. They are continually being constructed from before the research starts, whilst it is proceeding and after data has been collected (Winthereik, de Bont, & Berg, 2002). This chapter will explore the movement involved in the construction of the field and research object of this project and through that elaborate the premises for the data collection.

First contact and access

When I started my PhD scholarship I was immediately connected to the research programme of Media and ICT in a Learning Perspective, at the Danish School of Education, Aarhus University. One of the main challenges for the research programme is to explore how and to what extent digital media challenges our understandings of teaching cultures and learning environments. Researchers within the programme have investigated prototypes or ‘first time use’ of several different digital learning materials (Holm Sørensen, 2006; Meyer, 2008; Rattleff, 2008). These studies help us to understand what seems to work in a particular empirical setting and we are gaining insight into the ways educational designs interact with, interfere with and create learning possibilities. While the potential of ICT learning and its challenges are being investigated the government, from the late 1990’s up to the present time, has invested massively in allocating sufficient computers to every municipal school in the country (see chapter 1).\(^7\) At the same time there has also been more digital learning materials developed that are designed specifically for use in school contexts (see among others Homicide, Global Conflicts: Palestine, Mingoville).\(^8\)

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\(^7\) Of the 70 millions euro invested during 2004-2007 50 million euro was used to increase the number of computers, while 20 million euro is used to develop internet based teaching materials and new teaching forms: http://pub.uvm.dk/2003/it/1.html. Denmark here follows a Euro-American trend. USA has for instance invested 30 billion US$ in computers in schools, which allocates one computer per every 4.2 child in the states (Sørensen, 2009).

\(^8\) Some of the first experiments with game based learning in schools for instance were graded in the commercial market in the sense that triple A games indicated they were to be used as teaching tools. For the potential and challenges this type of sessions produced, see: (Egenfeldt-Nielsen, 2005; Squire, 2005). The webpages for the product mentioned are: Homicide: http://drabssag.emu.dk/, Mingoville: http://www.dk.mingoville.com/da.html, Global Conflicts: Palestine: http://www.emu.dk/gym/3verden/projekter/SeriousGamesPalestine.html.
This situation; computers in the schools, a variety of products to chose between and their potentials identified does, in itself create the possibility for other research questions. We now have the possibility to focus on digital teaching materials which the teachers have chosen to use voluntarily – an option that was not present 5-8 years ago. It was important to my research that the teachers would use a certain product irrespective of my presence in the school since this would create a situation that could occur in the ordinary life of everyday schooling. The importance of investigating a ‘natural teaching situation’ can be seen as a reaction to the dominant approach within development psychology, where learning has been investigated in experimental ‘artificial’ settings, as, for example, in the scientific laboratory (Cole, 1996). It can also be argued that the naturalness of the setting I investigated was artificial in the sense that I do not have access to a teaching situation where digital learning materials are involved without my presence, physically or electronically. Yet to choose a research object that would have been chosen as learning material independent of my attendance, will present a research situation that comes closer to the everyday practice of computer enhanced teaching as it occasionally occurs in schools today.

With this aim in mind I started to search for a school to visit. Researchers within the research programme Media and ICT in a Learning Perspective had been doing research in several schools in a specific municipality just outside Copenhagen city centre. This municipality stands out because of its decision to put extra emphasis and funding into the schools IT equipment, into digital learning materials, and in pedagogical support opportunities for the teachers. I came in contact with one of the school heads in the suburban municipality. The letter that gave me access was formulated around the project description given to the funding body of my PhD scholarship. Central key words in the letter were; design principles for learning games, general investigation of game based learning – key words quite distanced from Lego Robolab and authority and authorisations that more accurately fit the current research.

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9 The notion of everyday is a bit odd when related to ANT since the term everyday tends to stabilise relations among actors as something we know how is, see also Latour (Latour, 1996c). Yet the term is useful here in the effort to reflect the wish to study IT teaching that would takes place with or without my presence.

10 Denmark has a long-standing and unique tradition of a decentralised public sector where the majority of the welfare tasks are dealt with by the municipalities. In order to ensure that the municipalities are also capable of handling more responsibilities in the future, larger municipalities were introduced on 1 January 2007. The number of municipalities in Denmark was reduced from 271 to 98” (source: www.kl.dk).

11 The letter is placed in appendix B.
In Denmark primary schools have one year of nurturing class and 9 years of obligatory primary school, and in addition a voluntary 10th year. Children normally stay in the same class throughout the nurturing and the nine primary school years. The 10th grade is often separated into specialisms such as sports or drama classes where the curriculum focuses on the specialism. It is also becoming increasingly common that the public schools are becoming specialist schools throughout all grades. The particular school I visited was part of the municipality’s IT strategy. The school was therefore rather better equipped than other schools, and many teachers wanted to work with the different IT learning platforms that the school had access to. The school also had an extra specialist ‘IT teacher’ participating alongside the teacher at one or two of the introductory lessons. At the time of my visit the school was very inspired and motivated by the American psychologist Howard Gardner’s theory of the 7 intelligences. This was partly reflected in the architecture of the school. Every classroom consisted of at least two, and sometimes three, rooms which made it possible for the teacher to separate activities in the class. The ‘computer room’ was partly mobile. The school had invested in a class set of laptops, which made it possible to have movable computer enhanced teaching. When used in this way the extra room connected to the classroom was often used, together with the corridors and the school library. The sessions I followed took place in a classroom which was connected to another area called the Multiroom. Teachers teaching the 4-6th grades can book this room when they want extra space for their class. The Multiroom consists of a large, high ceilinged room with a beamer in the ceiling, two worktables along the sides and no chairs. Each side of the Multiroom was connected by glass walls and two doors to two traditional computer rooms which each had four stationary computers, and one worktable. This was also geared for standing up whilst working.

Figure 1: The Multiroom

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12 As for example Bellahøj Sport School or Utterslev Music School, see:
http://www.bellahoej.kk.dk/Infoweb/Designskabelon10/Rammeside.asp?Action=&Side=&Klasse=&Id=&Startside=&ForumID=, and
Data collection

The school head that I met arranged for me to meet one of the teachers who was connected to the 7-9th grades. The teacher told me more about how the computers were used and that different software programmes were mostly employed thematically at these grade levels. For example a week might be themed towards fashion or healthy nutrition. Dedicated educational software was not in use at these levels. She informed me that in the Spring term of 2006 she knew that the 5th and 6th graders, aged 10-12 years, were to have several weeks using the constructional learning platform Lego Robolab.

The Lego Robolab sessions fitted with my agenda which was to observe a situation that was as close as possible to a teaching situation that would occur independently of my presence. Therefore it was made available to me to observe a class using ICT-driven learning materials which the teachers themselves had voluntarily chosen. I decided to follow the Lego Robolab teaching and this decision led to my engagement with the school.

It would be fair to characterise my ethnography as one made up by appointments. The Danish researcher Dorthe Staunæs, whose special research interest is in lived life with special attention paid to confusion and complexity, uses the phrase; ‘appointed ethnography’ which exactly catches my relation to the school (Staunæs, 2004). I was there at the appointed time, I did not just arrive at the school but I came when I had been invited by the teachers.

I met with one of the teachers in charge of the Robolab sessions in a lunch break and I plotted future appointments in my calendar. In the first weeks I was at the school I joined the 6th graders. The 6th graders had had an introductory course on Lego Robolab the year before and the class was preparing themselves for a communal Lego League competition. Robolab Lego League is a European competition centred on the programming and construction features of the Lego Robolab product. Once a year schools compete nationally to qualify for the yearly competition of Lego Robolab building, combined with a project assignment. The municipality had copied the concept and borrowed the assignment of the previous year from the national Robolab Lego League competition. All the schools in the municipality could participate in the competition to be held at the Science Experimental Centre in Copenhagen. For two weeks all maths and Danish lessons in the 6th grades were replaced by Lego Robolab sessions, and one weekend the children, teacher and I went to the competition at the science centre.

13 See the official Lego League competition site here: http://hjernekraft.org/ and http://www.usfirst.org/.
In the same weeks as I visited the 6th grades I had the possibility to visit the after-school centre, where I especially focused on the children’s digital play activities.

In the following weeks I participated in the introductory week to the Lego Robolab system in each of the three 5th grade classes. An introductory week consisted of approximately 13 Lego Robolab lessons spread over a week when the children normally had science and maths lessons. An introductory course gave the children the possibility to learn the basic features of the Lego Robolab system and to prepare themselves for more advanced use.

I was invited to meet and follow two of the three 5th grade classes one week prior to their Lego Robolab week. This did not, of course, make me a part of the schooling as it would if I had come to the school continually over a longer period. But it did make me a familiar face which, in some ways, eased my presence in the classes (Noblit, 1999; Pole & Morrison, 2003; Zou & Trueba, 2002). I visited both classes during their English lessons and one of the classes in their maths lessons. All these visits made me present at the school for a period of one month and three weeks. On average I was at the school three to four days a week during the Lego Robolab weeks, sometimes only for one lesson and sometimes for a full school day from 8am to 3pm. In the following weeks, when I interviewed teachers and children, I went only when appointments for interviewing had been made.

As already stated, this school promotes itself as being a school which makes a special effort to maximize the use of IT in the teaching. Firstly the school has made a detailed IT strategy specifying what types of digital learning material and software programmes the children should engage with at the different grade levels. Secondly the school has also been at the forefront of the general development concerning the number of computers per child. From 2003-2006 the school had less than 5 pupils per computer, which matched the general national level in 2006.14

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14 The school has 112 computers for the children, 20 for the teachers and 10 printers. (Interview with one of the IT teachers p. 2)
Thirdly two teachers with special interests in IT and flair for computers were appointed to be ‘IT teachers’. They were allocated extra hours to support other less experienced teachers conducting computer enhanced teaching, and they were given responsibility for the maintenance of all the computers at the school. The teachers in charge of the 5th grades Lego Robolab lessons that I observed made arrangements for the IT teachers to take the first introductory lesson to the Lego Robolab week (see chapter 5). For the rest of the week the IT teachers visited occasionally and were called to assist if problems arose that the less experienced teacher could not handle. The 6th graders were taught by one of the IT teachers themselves during the two weeks of preparation for the competition.

**Focus on Lego Robolab**

I have described above how observing Lego Robolab in use had some affect upon my engagement and presence at the school. The choice of following Lego Robolab also affected my focus. My attention in the observations was first of all focused upon what Lego Robolab helped to enact in the teaching sessions. It was not focused upon whether or not the children had learned anything. The interest of what was enacted with Lego Robolab in the room was rather fuelled by an interest in the relation between play and learning. I had the idea that this type of teaching resembled play-like learning. An idea that was fuelled by my reading of a mixture of game literature I read (BECTA, 2001; Bizzocchi & Paras, 2005; Makedon, 1984; Rieber, Smith, & Noah, 1998) and the texts I found on the educational use of Lego

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15 An English languages report published by The Danish Ministry of education is giving the same information slightly different. See the PDF report (The Danish Ministry of Education, 2007, p. 59-60)

16 The two teachers were each given 400 hours for this work per year.

17 A focus that later on was shown to be beneficial due to the latter relation of this data to an ANT cosmology.
Robolab that pointed towards play as a learning strategy (Johnson, 1907; Kline, Dyed-Witheford, & De Peuter, 2003; Resnick, 2004, 2006; Sutton-Smith, 1997; Vygotsky, 1933). Yet this focus - enactments of play - like (learning) with Lego Robolab - is still quite distanced from the focus of authorisation processes looked at from an actor-network approach with which this thesis engages.

**Types of data**

In the weeks that I did not visit any Lego Robolab sessions I went to the school with just a notepad and pen. In the Lego Robolab weeks I was more heavily equipped. I still had my notepad and pen and I noted things down about my many conversations I had with the children. At the end of each day spent at the school, I sat with my field notes writing my initial reflections about the visit, together with more details on the day’s events than I had managed to scribble down in the moment. Besides the notepad and pen I had a voice recorder that accompanied me around the class. The voice recorder was turned on and recording all the time that I was in the class room. These recordings ‘followed’ my field notes and caught my informal chats with teachers and children. Field notes and the audio recordings both followed my presence, which makes then into complementary sources of information. In addition I gave one working group a voice recorder which they had by their side throughout the Lego Robolab sessions. This gave me the opportunity to listen later to a group’s conversation independent of my presence.

Also part of the scene was an unmanned camera. The camera was placed near one of the doors between the Multiroom and one of the computer rooms. The camera was moved occasionally, sometimes filming the Multiroom and sometimes filming the computer room next to it. Movements of the camera were mostly done by myself and sometimes by the children, as we shall experience in chapter 7, but for a large part of the recording the camera was just filming in the direction that I left it in. The 5th grade lessons that I observed took place in the Multiroom and the computer room to the left.

![Figure 3: Illustrate the two common positions of the video camera](image-url)
At the start the camera was brought along merely to maintain a visual record of the classroom. However, retrospectively the recordings have been important to the research for two reasons. The recordings helped me to distinguish the different classes which would otherwise have become blurred over time. Secondly, the recordings became much more central for my descriptive analysis than I had first anticipated (see especially chapter 7). I will return to this at the end of this chapter because the shift in importance of the data that the camera helped me to collect produced some interesting, and even sometimes some odd cuts in data that I have had to keep in mind when analysing the data.

After the Lego Robolab week I conducted group interviews with four children from each of the four classes, and longer interviews with the three different teachers in charge of the Lego Robolab sessions.

Not recorded on tape, nor on paper but very important to mention is all the small talk and my physical presence among the teachers and the children during the breaks. The longer lunch breaks were often spent together with the teachers in the common room, whilst during the smaller breaks I often remained with the children in the classroom or the Multiroom.

**Participant observer**

I positioned myself as a participant observer while present at the school (Hammersley, 1990; Pole & Morrison, 2003). When the children were given collective instructions I normally placed myself at a distance near the video camera. In these situations my participation was salient – I tried to make my presence as unnoticed as possible, and did not at any time interfere with children or teachers.

Whilst the children were working with the material I walked around and talked with the different groups dispersed in the Multiroom. Occasionally I was addressed as a teacher resource and I helped the children if I could. I seldom spoke to the teachers during lessons, but we did discuss the lessons irregularly in the longer breaks, for instance during lunch, if I had a particular question or if something significant happened during a lesson.\(^\text{18}\)

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\(^{18}\) As for example the day where 5 of the seven engines in use ran out of battery at the same time (field notes from the 5\(^{th}\) of April 2006), or the day where a dispute in a group escalated and turned loud (field notes from the 20\(^{th}\) of April 2006).
At the end of the two month period of Lego Robolab sessions I had approximately 45 hours of video recordings, 90 hours of audio recording, 9 hours of interviewing, and a lot of field notes. The period of my presence in the school can be visualized in the diagram below.

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation in 6th grade class</td>
<td>Observation in 6th grade class + observations in afterschool care</td>
<td>Interview with 6th grade class + observation of ordinary teaching in 5th grade class</td>
<td>Observation in 5th grade class</td>
<td>Observation in 5th grade class</td>
<td>Interviews with 5th grade pupils and teachers</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 4 illustrates where I was in the school and in which order.*

**Lego Robolab**

Robotics, as an educational tool, allows students to learn in an active, constructionist environment, building physical objects and experiencing abstract concepts in intentionally meaningful ways.

(Chambers, Carbonara, & Rex, 2007, p. 57)

Access to the field of research was ensured, and I observed teaching sessions where the teachers used the construction based learning platform Lego Robolab. But what is Lego Robolab exactly? As this thesis proceeds it will partly dispel one view of Lego Robolab, and the reasons for discarding that view will hopefully become clear, but for now I will describe the version of Lego Robolab that I myself encountered when playing with the material and building a Lego Robolab car of my own. In addition, at the same time I read some of the literature about robotics used in teaching and especially where the use of Lego Robolab was described.

Before I began the observations in the school I borrowed a Lego Robolab set to examine at home. What I found were ordinary Lego bricks just as I remembered them together with a vast amount of specialised bricks, some sensors, a programmable unit called RCX and an infra red (IR) communication tower. The RCX is an autonomous micro-computer embedded in a Lego brick that can be programmed to
serve as the “brain” of any Lego construction. The RCX is programmed at a software interface running on a computer that is connected to the RCX by the IR communication tower (Portsmore, 1999). 

The software on the computer gives two entrances to the programming part. One is called ‘Pilot’ and one is called ‘Inventor’. Pilot guides you through all the special programming building blocks that compile the system, whereas the Inventor enables you to combine all the possibilities from the base. The 5th grades were introduced to Pilot, and Inventor was the platform the 6th grades worked with.

See also the Danish association for learning materials: http://www.mikrov.dk/sw5460.asp
Philosophy of Lego Robolab

Lego Robolab is developed in line with cognitive constructivist learning ideals, as understood by Seymour Papert. Papert developed Logo, one of the first digital construction based learning platforms in the early 1980’s (Papert, 1980; Papert & Harel, 1991). Papert extends the Swiss philosopher and scientist Jean Piaget’s constructivist theory of knowledge in that Papert emphasizes that knowledge production happens when a person is interacting with external models of the world. Papert himself defines the difference as:

We understand “constructionism” as including, but going beyond, what Piaget would call “constructivism.” The word with the v expresses the theory that knowledge is built by the learner, not supplied by the teacher. The word with the n expresses the further idea that this happens especially felicitously when the learner is engaged in the construction of something external or at least shareable [...] a sand castle, a machine, a computer program, a book. This leads us to a model using a cycle of internalization of what is outside, then externalization of what is inside and so on.

(Papert, 1990, p. 3)

Lego Robolab is designed in such a way that users are working with their hands, building a robot that can be programmed by the computer to do certain tasks. This constructionistic idea of knowledge can therefore be said to be inscribed on, or built into, the product (Akrich, 1992; Sørensen, 2006).

After the ethnographical data collection

Papert’s learning theory did not seem to fit very well with what I initially saw in my data. Occasionally it seemed to support what happened in the classroom – children using their fingers, constructing and learning – but other bodies were enacted, other things were done with the bricks and computers, and other things relating to neither bricks nor computer were also enacted.

I started to go through my data looking for patterns. The first time that I ran through all the field notes, audio and video recordings it resulted in an initial sorting of the material into abstract themes such as, bodies, Lego Robolab, school or not, gender and Lego Robolab, the competition(s), movements, inventions. With these themes in mind I looked through the data again with the focus on play and on informal and formal learning environments. The blurred borders between play and not play started to bother me, and also I was surprised by the amount of the material that did not fit into schemes of schooling.
Thoughts about the children’s engagement occurred – were the children highly motivated and engaged in this type of teaching because it reminded them more of their break times rather than of their lessons?

Questions of authority came up, first as a kind of normative indignation, why didn’t the teacher react to this, or shouldn’t the children be following the teacher’s instructions instead. Then the indignation turned to astonishment. Why did nobody, neither teachers nor children, or the materials seem to match the expectations of a classroom that broadly exists - as we shall see in next chapter – and which defines the teacher as the one who is in control and sets the agenda? And why did everybody seem to feel perfectly fine with this - even enjoying it? The astonishment turned into questions that remained with me. What if the relations that we normally tend to consider as social constructs are in fact sociomaterially constituted? What if authority is a result of stabilised patterns of relations among humans and non-humans rather than something established between human beings? The material impact on the authority figures in the room stimulated an interest in materiality and I started to formulate the ideas that focused the work of this thesis. I started to investigate the authorisation processes of the classroom and a complex picture started to emerge. In which ‘who authorises’ was occasionally a child instead of the teacher, and at other times the ‘who’ turned into a ‘what’ in the form of Lego bricks, cameras and computers.

**Focus on authority**

The focus on authority arose approximately at the same time as I read Despret (Despret, 2004a, 2004b, 2005), and Despret gave me the first tools with which to grasp authorisations as a social and material process. The shift in focus also made the video clips into an important resource. The video provided details that I was not aware of nor paid attention to during my data collection. Without the video clips I would not have been able to produce, for example, the argument for circulations of authorisations as accurately as I present in chapter 6. If I had not been able to watch a video clip over and over again I would not have been able to catch the way Julie authorises the manual during the time that she measures a brick’s length against the manual’s illustrations. This was firstly because I was not present during the action, and secondly, had I been present I am not convinced that I would have been able to catch this little detail.

The focus on authorisations also authorised me to use part of my data intensively and to discard other parts of it. The repetition of the same introduction, the same procedure with dispersed teaching arrangements and the centrality of the manual were features shared by all the three 5th grade classes. This gave me the opportunity to determine whether any deviation from the teacher agendas was a single instance
or a more general tendency, and the thesis therefore only draws on the material collected from the 5th grade classes, together with interviews made subsequent the Lego Robolab lessons with 5th grade teacher’s and 5th grade children.

**Summary - focus on authority**

In this chapter I have described the construction of the field and the research object of this thesis. As part of this description I have explained my entrance into the school where I collected my empirical data, and I have described how Lego Robolab became the guiding principle for which lessons to participate in. I have described how I tried to gather several types of data on the same event by using audio and visual recordings combined with field notes, observations and interviews. The decision to focus on authority came into being because I was disturbed by noticing that the data seemed to fit with patterns expected in school break times rather than those expected to be found in the teaching sessions. This newly acquired focus on the enactment of authority in classroom led me in two different directions. I wanted to investigate contemporary descriptions of authority, and secondly I was theoretically seeking approaches that would actively encompass materialities. The following two chapters will investigate this concept (chapter 3) and theme (chapter 4).
3. AUTHORITY

Authority means the probability that a specific command will be obeyed. Such obedience may feed on diverse motives. It may be determined by sheer interest situation, hence by the compliant actor’s calculation of expediency; by mere custom, that is the actor’s inarticulate habituation to routine behavior; or by mere affect, that is purely personal devotion of the governed. A structure of power, however, if it were to rest on such foundations alone, would be relatively unstable.

(Weber, 1958, p. 1)

Authority is by no means a newly invented concept and contemporary discussions owe a great deal of their insight to the 20th century thinkers on authority. This chapter will briefly, and as an introduction, illustrate how the understanding of authority can be said to be developed from a focus upon the individual (Adorno et al., 1950) to a social-cultural-structural approach (Weber, 1958) and to a socio-material approach (Foucault, 1979). This short introduction presents the philosophical discussions about authority, to which are related discussions of authority in classrooms in general. The central part of the chapter describes in more detail contemporary definitions of authority particularly as they relate to teaching with and without computers. These contemporary descriptions enable me to identify what can be learnt from the empirical examples I present, and in what ways the work of this thesis adds to what we already know.

Adorno, Weber and Foucault

I have chosen to mention Adorno, Weber and Foucault in this chapter because they all, in different ways, theorise about authority as a human relation, which corresponds well with the traditional understanding of authority as a matter between human beings, seen here between the teacher and the child.

Adorno in his very influential, but criticized, book ‘The Authoritarian Personality’ defines nine personality traits formed during a child’s upbringing. Authority is seen as a product of a strict upbringing where punishment for disobedience is used. This view on authority can be said to treat authority as a matter purely between individuals. Weber adds to this understanding. As the quotation at the start of this chapter illustrates, authority is described by Weber as a relation connected to, but distinct from relationships of power. The quotation also expresses that only to take human to human relations into account is seen as a limitation for the concept of
authority which Weber develops and ascribes to. Weber introduces, in the same
text, three types of authority which are of interest to this study since the role of
teacher might engage with each of them to a certain extent. The first form is the
rational legitimate authority – by law the teacher is given authority to determine
frames for action in the classrooms. Weber’s two other forms, traditional authority
– older knowledgeable person (teacher), younger unlearned person (child), – and
charismatic authority is also in play. Weber’s descriptions can be said to encompass
humans but also to add cultural and structural dimensions to the construction of
authority. A material view on domestication is found in Foucault (Foucault, 1979).
For Foucault, authority is established through an arrangement of the sociomaterial
technologies of domestication and subjugation. The teacher’s voice is produced as a
signal for silence. A part of the task of being an authority is here allocated to the
voice signal character, as an effect of the arrangement; it is not given to the individ-
ual teacher’s personal style. With this approach to authority Foucault can be said to
add materiality as an important dimension to the discussion of authority.

These philosophical reflections on the concept of authority, are in different ways,
recognisable according to the way processes of authorisation are described and
addressed in contemporary descriptions of authority in classrooms and computer
rooms. In the rest of the current chapter I will discuss such contemporary descrip-
tions of authority relations in classrooms. I will present some contemporary exam-
pies of how authority in classrooms is considered, and how authority in classrooms
with computer technologies is conceptualized. By identifying the characteristics of
these perceptions I make evident what seems to be the current and most common
ways of understanding authority, both in practice and in theory. The choice of ex-
amining authority with Actor-Network Theory came about because I found ANT
to hold many useful concepts with which to examine the socio-material practices
that are enacted around classrooms and Lego bricks. The current descriptions of
other contemporary views on authority are therefore used here as a means of fore-
grounding the value ANT can have for our understanding of authority, as well
showing what these other descriptions can bring to an ANT account of authority.

Authority in the ordinary classroom

Let us start in an ordinary classroom. In the book entitled ‘Classroom Authority,
Theory, Research and Practice’ edited by the American educational researchers
Judith L. Pace and Anette Hemmings (Pace & Hemmings, 2006), the American
educational sociologist Mary Haywood Metz writes in the introduction to the
book:
[...] adults have experienced [authority] from the cradle and believe they understand it. But members of our society have fundamentally different understandings of what constitutes authority and how it should (or should not) be exercised.

(Metz, 2006, p. viii)

Metz turns authority into something everybody seems to understand, yet understandings differ. There does not seem to be a consensus about what authority is nor how it should be put into effect. This opens up an idea of authority as something negotiable. Metz explains that teachers are not just per se having authority. There is something, however, that is still not questioned in this understanding. Metz continues:

In the last 30 years, the study of authority has fallen out of favour, as has the very word. But teachers must exert something very like authority if they are constructively to orchestrate the activities of more than 20 students spending 180 days together in a crowded room. Whatever they call it, they have to use it.

(Metz, 2006, p. viii)

Metz notes that the word authority seems to capture something that the teachers need to have and by that she makes authority into a property that goes with being the teacher. The above quote gives a particular view, whereby authority is seen as an element that needs to be sedimented into the role of a teacher. This in turn, produces certain raison d'être for the stories we can all tell about classrooms. The expectation that the teacher has some control assigned to them that can direct the activities of the children supports, an understanding of authority as residing in the teacher. The initial expectations that the teacher must exert something very like authority, Metz explains, sustains our approach to an analysis of authority as one already established.

The stabilization of this view might be even more visible when we look at a concrete analysis. The American educational anthropologists James Mullooly and Hervé Varenne write about the relation between authority and jokes made in classrooms (Mullooly & Varenne, 2006). They start by placing authority at the centre of what educational researchers should consider. But they do so with a caveat. They state that:
Authority must not be approached as a property of a position or person that others must accept. It is a property of an interaction, constituted by the active work of all involved, regardless of the position they may display.

(Mullooly & Varenne, 2006, p. 63)

Mullooly and Varrene’s definition does not privilege the teacher as the one having authority in advance of their investigation, and they nicely state that being an authority is interactional, it takes effort by the actors involved whether they are the one with authority or are under the influence of the one with authority. Yet it is still unclear exactly who ‘all involved’ are, or how being involved is defined.

The type of entities involved in the active construction of authority gets somehow clearer the closer we get to their analysis. Mullooly and Varenne write:

The classroom we discuss is another token of the type that has now been abundantly discussed in the literature on American schools [...]. It is, of course, unique, but this uniqueness is precisely produced by the participants playing close attention to well-described features of American schooling. We are particularly interested here in all that has been written about authority of teachers to ask questions and evaluate answers.

(Mullooly & Varenne, 2006, p. 71)

Examining Mullooly and Varrene’s open definition of authority, the two quotations given above hold two important messages: Authority is suggested as a ‘property of interaction’ done in practice (first quotation) and, when defining the actors that can actively produce authority, then the physical classroom becomes of less importance (second quotation). Classrooms have been discussed exhaustively, Mullooly and Varenne tells us, and every setting is still unique because it is produced by participants in the particular classroom and because these participants are aware of the features of American schooling. So the materiality of the classroom is already, through the participants’ close attention to the well described features of schooling, included in the discussion and is therefore not made an object of exploration in the analysis. This standardization of classrooms could be found likewise in Danish/European classrooms studies.

And as shown in chapter 1 by Latour’s exemplifications of the amphitheatre (Latour, 2005a), the standardization can also be seen as encompassing time, space and the construction of buildings, as well as the legal regulation of schooling.20

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20 The argument can be made that the emerging field of ICT based teaching diminishes the material unification of classrooms. It may be possible to dismiss tables, chairs, chalkboard as matters considered covered, while this is harder in computer enhanced teaching environments. The stance taken here is thus
Secondly and interrelated with the above, there is no hint in Mullooly and Varenne's description that I should understand 'participants' as anything other than the human actors, because the type of participants Mullooly and Varenne talk about can pay ‘close attention to well-described features of American schooling’ (Mullooly & Varenne, 2006, p. 71). The easiest way to do that is by reading, which is a skill humans can acquire. This, together with Mullooly and Varenne’s particular interest in all written material on teacher’s authority, makes their concept of authority seem negotiable only under quite precise terms: Acting participants are considered human, and the relation between teachers and the concept of authority is situated in advance of any empirical investigation that might be done through reading the literature in the field. That it is singly the teacher authority relation that is examined in advance is understandable, since educational literature lacks descriptions of technologies or children seen as authorities, but the distortion is maintained in favour of the teacher and this asymmetry is left unnoticed.

**Technology and classroom authorities**

Getting closer to the empirical field that this thesis investigates, I will look at how digital learning technologies and authority are related. The American educational researcher Starla Stensaas writes about the impact technology has on authority (Stensaas, 1999). She does this with the generalized expectation of the teacher having authority and being an authority.

> The unwritten assumption about classroom authority […] is that the teacher must be a more and more competent and skilled computer user than the students to be able to adequately teach.  
> (Stensaas, 1999, p. 3)

Stensaas makes an important observation here. She points out the materialities, here a computer, are pivotal to authority, and Stensaas explains that levels of knowledge are often redirected in computer enhanced teaching. To negotiate power and authority as a new teacher, or as a newly arrived teacher in a school, is challenging. To perform authority when the person expected to know might in fact be the one learning is even more stressful, she explains. Stensaas suggests that some of the well documented anxiety among teachers (Cuban, 1986; Holm Sørensen, 2006; Squire, 2005) arises from such situations where roles are reversed and the students are more technically competent than their teachers (Stensaas, 1999, p. 3).

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that the materials engaged in computer enhanced teaching are as easily overlooked as materials present in traditional teaching. And even if I would imagine all ICT based classrooms alike, the symmetrical doctrine I am working with would make me refrain from stabilizing the effect of the physical setting prior to the empirical analysis.
Stensaas continues by putting forward some concrete guidelines for teachers to follow in order to cope with their concerns about teaching in computer enhanced classrooms (Stensaas, 1999, p. 6-12). The guidelines all require that the teacher has the ability to deconstruct both the teacher’s role and their own motivation to learn, in order to be able to teach effectively. Stensaas is here working with the unwritten assumption about classroom authority, i.e. that the teacher must be a more competent, skilled and knowledgeable computer user than her students. One of the effects of deconstruction of the role of the teacher is that the teachers who are less afraid of being shown up by a technological savvy student, are the teachers who are also capable of determining what the ‘computer nerd’ has to offer the class. Stensaas admits that designing a pedagogy that includes teachers as members of the technological learning community is challenging, primarily because the students expect the teacher to be an expert, but also because of the expectation that the teacher should be in control. However, Stensaas says that explaining to the children that the teacher is not necessarily a problem -solver, but is also a solution- finder can also initiate a process that is;

[…] allowing students to mitigate their own discomfort with a classroom pedagogy that does not meet their expectations as they become familiar with the process and find it valuable.

(Stensaas, 1999)

Teachers are already deconstructing

Accepting deconstruction of the teacher role as a possible solution to the challenges the teacher meets in ICT based teaching is taken as a good foundational position for this study as it makes central the assumption that a successful outcome of teaching depends upon the teacher’s willingness to deconstruct or reformulate his or her teacher role into something else. Stensaas cautions me to be aware of how the roles of the teacher and children are reconfigured in the new network of relations that occur when Lego Robolab enters the classroom. Based on this foundation I intend to look at how authority is configurated, and from this decide who or what is said to have the authority.

Stensaas’ contemporary descriptions also make me aware that expectations of teaching is one thing, and that what is actually enacted is another, which makes me propose that the deconstruction needs to be taken one step further. What if deconstruction isn’t considered a privileged action of teachers and what if there are no distinct roles to deconstruct? What if it could be that teachers are always also learners, and learners are always also teachers? Then boundaries between being the teacher or being the student are no longer very distinct. Roles in the classroom are continually being produced, the teacher role (and all present entities for that matter)
changes incrementally or radically, no matter what we do. With this description of reality, then being effective as a teacher in ICT based teaching is not purely a matter of a deconstructing process done by the teacher. There are new alliances to be made. And not all of them are between humans.

With this insight about authority as being interactive, and that deconstruction or changes in relational configurations occur, I will use the Belgian philosopher of science Vinciane Despret’s suggestion to link authority and expectation in such a way that: ‘[…] we define expectations in terms of ‘who authorizes’ (Despret 2004, p. 120). I will accept for now this as a minimal definition of authority, which I will apply to the empirical examples. Further gathering of knowledge about the concept of authority will be collected through the analysis of my empirical data, and I will therefore refrain from expecting any particular entity to take part in the authorisation processes in advance of my empirical description. Authority is not given per se to the teacher, nor either to the children or the learning technologies.

**Summary - a minimal definition of authority**

In this chapter I have briefly introduced the founding fathers of the philosophical discussions about authority. Since authorisation will be suggested as an empirical endeavour I have in the remains of the chapter presented some contemporary examples of how authority in classrooms is considered and how authority in classrooms using digital learning technologies is conceptualized. By identifying the characteristics of these descriptions I have made evident what seems to be the current and commonly accepted ways of understanding authority, both in practice and in theory. These descriptions can therefore help to identify contemporary expectations of authority. The following analysis and description in this thesis may contribute further to our understanding of these issues.

I have learned that authority is constructed through interaction and negotiation, and that authority can be deconstructed. The deconstruction of the expectations towards teachers is taken as an excellent and useful observation on which to build this thesis. It is not only the role of the teacher that will be deconstructed but also the positions of children and learning materials will be part of the deconstruction process. The chapter ends by suggesting that a link made by Despret (Despret, 2004a) between authorisations and expectations provides me with a minimal guidance with which to begin my empirical descriptions of authority in the computer enhanced classroom.
4. THEORY, PRACTICAL METAPHYSICS AND METHODOLOGICAL CONSIDERATIONS

The online Oxford dictionary gives the following definition of the word theory:

A scheme or system of ideas or statements held as an explanation or account of a group of facts or phenomena; a hypothesis that has been confirmed or established by observation or experiment, and is propounded or accepted as accounting for the known facts; a statement of what are held to be the general laws, principles, or causes of something known or observed.

(www.oed.com)

I note here that the description makes theory into something stable, derived from an accumulation of facts and a confirmation of an hypothesis. Words like schemes, systems, fact, general law, and principle are also used. Seen in this way theory becomes something that serves as an analytical framework and shapes the boundary of the focus of an analysis. Theory becomes a formalised set of ideas that is intended to explain why something happens or exists. Reality is measured against theory.

I have already used framing words such as Science and Technology Studies and Actor-Network Theory in this thesis, and ANT has ideas about the construction of reality through the concepts of the symmetrical doctrine, the concept of actors-networks and the orientation towards ontology which I return to later in this chapter. However, the word theory used in relation to ANT does not give researchers any generalizations about the configurations of networks or how specific objects are enacted. Latour puts it this way:

With ANT we push theory [...] into abstraction: it is a negative, empty, realistic grid that allows us not to synthesize the ingredients of the social in the actor’s place.

(Latour, 2005a, p. 221)

This notion of theory makes sense if we imagine theory in a different way to that suggested by the first quotation above. Latour’s idea of theory gives space to actors’ own construction of their reality, and it enables researchers to articulate their research fields as heterogenic assemblages of both human and non-human agencies.
In ANT the world is made up of networks in multiple enacted ontologies, which I will return to later in this chapter. This fixedness (the world made up by networks in multiple enacted ontologies) can be considered as ANT’s metaphysical idea about the constitution of the world. What is special about the theory is that it allows different views of the reality to coexist – other actors, the ANT researcher, the teacher, might have other ideas, and this explains why Latour wants us to refrain from using any fixed theories about how actors relate to one another in advance of empirical descriptions.

In this chapter I will invite us to imagine the term theory as something that might emerge with, and in relation to, the analytical descriptions, and that theory is best considered as an indefinite, abstract frame - as an ‘anti-theory’, or ‘negative theory’ as Latour suggests. This chapter discusses the consequences of such a reductive theoretical attitude. Initially I will briefly describe the development of the field of ANT and by that make apparent the way in which what started out as a theory within science practice can beneficially be applied within the humanist discipline of educational research. Secondly I will present the key concepts of ANT; actors, actor-networks and symmetry, and discuss ANT’s focus on material objects and concepts as used in practice. I continually refer to the scientific philosophical consequences of refraining from making statements about reality other than metaphysical statements (the worlds made up of networks) and I discuss the methodological principles (the principle of symmetry, the parole of following actors) before the empirical study. The chapter ends with a presentation of additions as a method, and articulations as an ideal when researching the production of knowledge.

**Actor-Network Theory**

Actor-network theory is one of the more well known positions within the field of Science and Technology Studies. This section gives an account of the ANT readings I inherit as a basis for this study (de Laet & Mol, 2000; Despret, 2004a, 2004b; Latour, 1996c, 1999a, 2004a, 2004b, 2005a, 2005b; Law, 1999, 2002, 2004, 2007; Law & Mol, 2001; Mol, 2002; Sørensen, 2005, 2009).

One of the things ANT is known for is the laboratory study (Latour & Woolgar, 1986 (1979)). The work of Latour and the British sociologist and STS researcher Steve Woolgar focused on the way scientific facts are constructed and their analysis challenged the accepted view that the natural sciences work on radically different premises from those of the social sciences and humanities. The studies of sciences

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21 As it is increasingly apparent within the philosophy of science, a Luhmanian metaphysic in play would give me a different description, as would a socio constructivist analysis, but not only intellectual thinkers do own the right to do metaphysics, bilingual children also do it, as we shall see later in this chapter, and to take the ANT cosmology seriously, things would properly also do it if we paid attention.
helped to show that knowledge and the development of technology are practical outcomes of local negotiations. These realisations did not emerge out of the blue. Thomas Kuhn’s book about scientific revolutions stands out as an important actor in the actor-network promoting this recognition (Jensen, 2003; Kuhn, 1973 (1962)). Kuhn argues that the scientific discovery of nature is directed beforehand by specific social and cognitive schemes – also known as paradigms. Paradigms limit, and put boundaries around, the type of possible questions in advance of investigations within a field of research. New paradigms arise as ruptures or revolutions occur to challenge existing knowledge (Kuhn, 1973 (1962), p. 92-102 and 157-170). ANT is critical of such a description since negotiation and challenge are constantly present and are not only features of revolutions. Kuhn’s book was nevertheless inspirational to a large number of sociological studies of the construction of scientific knowledge. Among them is Latour and Woolgar’s ethnographic study of the scientific practice in a laboratory in California. After his visit to California Latour returned to Paris and together with the British sociologist John Law and the French economist and sociologist Michel Callon set out the fundamental positions in ANT.

In the late 1980’s and early 1990’s ANT was very successful in demonstrating the way that powerful, heterogenic networks produced knowledge in several different fields of research: for example in laboratories (Latour & Woolgar, 1986 (1979)), in an investigation of how Portuguese vessels make long distance control possible (Law, 1986), investigating how a heterogenic network centred around Louis Pasteur influenced the spread of pasteurization in France (Latour, 1984). These studies are versions of what has become known as ‘Classic-ANT’ (Sørensen, 2009). Classic -ANT has been challenged by feminist STS researchers who claim that these studies tend to reproduce one form of multiplicity, one form of power relations and one type of network (Star, 1991). The American Sociologist Susan Leigh Star pointed out that heterogeneity is quite different for those that are privileged (for example in Latour’s study of Pasteur (Latour, 1984)), than for those in less privileged positions. Star uses her own allergy to onions to demonstrate how multiplicity may be taken as a starting point for an analysis, and shows how humans, organisations and standardised technologies intersect (Gad & Markussen, 2007). This interest in less powerful networks is taken up by several STS researchers, among them Latour and Law (Latour, 1999a; Law, 1999), and a sensitivity towards multiple enactments of heterogenic encounters of reality now seems to be part of most ANT analysis today. The book ‘Actor Network Theory and After’ (Law & Hassard, 1999) shows how ANT has developed through different temporal and spatial waves of research, form-

22 Of other studies can be mentioned Karin Knorr-Cetina that looked at looked the construction of knowledge at a anonymous plant protein research site at Berkeley (1981), and Michael Lynch (1985) looked into the knowledge production in a neuroscience laboratory, also in California.
ing ‘classic ANT’ and ‘post-classic ANT’, however, throughout the development some essential positions remain intact. This thesis mainly draws upon later ANT literature, and in the following section I will outline the concepts that are fundamental to this thesis, namely: actors, networks, heterogeneity and symmetry. It will become clear, however, that these are not fixed concepts, and they may become distorted, to some degree, from their usual usage.

**Actors**

I simply want to note that actor-network theory may be understood as a semiotics of materiality. It takes the semiotic insight, that of the relationality of entities, the notion that they are produced in relations, and applies this ruthlessly to all materials – and simply to those that are linguistic.

(Law, 1999, p. 4)

The quotation above by Law precisely catches the central ingredient in ANT’s thinking. A sign is not to be understood independent of its relations. The meaning of a sign circulates in relation to the elements it relates to. For instance Lego Robolab means something very different in the classroom than in the children’s private homes. The semiotic insight applied brutally to all materials makes clear that practically everything can act. Or the other way around - if an actor is seen as a semiotically defined actant then it radically expands the notion of actors. It does not privilege the human and does not exclude things, ideas, symbolic orders (e.g. numbers) from being actors. Latour puts it this way:

An ‘actor’ in ANT is a semiotic definition -an actant-, that is, something that acts or to which activity is granted by others. It implies no special motivation of human individual actors, nor of humans in general. An actant can literally be anything provided it is granted to be the source of an action.

(Latour, 1998, p. 5)

A clear distinction between ANT and other qualitative approaches such as Activity Theory and Mediated Discourse Analysis, is made through the question of agency. When it comes to answering what can act, then ANT stands out by its inclusive definition of an actant. This might suggest that actors are a strong unit in ANT, yet this is not the case. In his definition of actors Latour tells us that actants are granted to be the source of action and from this follows two other important notions to consider. It is not actors in themselves that are in focus, since a thing does not exist alone. The ‘network’ and the hyphen between ‘actor’ and ‘network’ in Actor-

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23 And yet these meanings are connected as we shall see in chapter 8.
Network Theory reminds us of this (Latour, 1999a, 2005a). An actor is always part of a network(s) and the hyphen between actor and network marks the importance of the continual (re)production of actors and network. The hyphen also suggests the relation between actors is that which replaces the abandoned focus on single actors. This mutual construction gives the network metaphor at least three advantages:

First the far/near dichotomy is challenged. Elements that are physically close but disconnected to the network may be infinitively distanced if we analyse relations made (and not made). Latour exemplifies: ‘I can be one meter away from someone in the next telephone booth, and be nevertheless more closely connected to my mother 6000 miles away’ (Latour, 1996b). This view on distance is adaptable to any given situation. Bertil is more closely connected to the Lego bricks and his abilities to build, than to the teacher’s instruction manual, as we shall see in chapter 8. I am academically closer to my STS/ANT supervisor at the Humboldt University in Berlin than to the Luhmanian inspired educational researcher sitting in the office just across from mine.

Secondly the concept network allows us to dissolve the dichotomy between small and large, micro and macro. Latour explains:

The whole metaphor of scales going from the individual to the nation state, through family, extended kin, groups, institutions etc. is replaced by a metaphor of connections. A metaphor is never bigger that another one, it is simply longer or more intensely connected.

(Latour, 1996b, p. 4)

The topology of networks is at work here. There is no outside, over, under, inside structure to determine action. What is, is a rhizomatic network of relations (Deleuze & Guattari, 2005; Latour, 2005a). We do not have to choose between a global or a local view. A global entity is a highly connected one, with a large,
tightly connected network, which nevertheless remains constantly local. And the network of relations between the local and the global is identified if we follow the connections made between entities and see how these turn strategic through a number of connections (Latour, 1996b).

Thirdly, and already touched upon above, the inside/outside dichotomy vanishes with the network metaphor. The network has connections; there is no inside outside in network, visualized in its simple form as connected lines. As Latour puts it – a network has no shadow, nothing to fill in (Latour, 1996b, p. 5).

![Figure 6: Visualisation of a network](image)

Strength in a network thus does not come from a ‘strong’ actor but from the heterogeneous network that mixes up times, places and actors:

> Strength does not come from concentration, purity and unity, but from dissemination, heterogeneity and the careful plaiting of weak ties. This feeling that resistance, obduracy and sturdiness is more easily achieved through netting lacing and weaving, twisting, of ties that are weak by themselves, and that each tie, no matter how strong, is itself woven out of still weaker threads […].

(Latour, 1996b, p. 2)

The networks are made of several relating heterogeneous entities, as the quotation above tells us, and from this it can be seen why ANT can be described as an anti-essentialist theory. What makes an actor is not the notion of an inner essence. Attributes associated with a particular object (or subject) are a consequence of the myriad of networks the actor is a part of and relates to. It is the relation between networks and actor that creates the actor. An actor is thus the sum of its actor-networks, and by its presence draws upon an immense amount of network currency, as illustrated in the quotation below.

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25 See also chapter 5 for this discussion.
We say, without giving the matter too much thought, that we engage in "face-to-face" interactions. Indeed we do, but the clothing that we are wearing comes from elsewhere and was manufactured a long time ago; the words we use were not formed for this occasion; the walls we have been leaning on were designed by an architect for a client, and constructed by workers - people who are absent today, although their action continues to make itself felt. The very person we are addressing is a product of a history that goes far beyond the framework of our relationship. If one attempted to draw a spatio-temporal map of what is present in the interaction, and to draw up a list of everyone who in one form or another were present, one would not sketch out a well-demarcated frame, but a convoluted network with a multiplicity of highly diverse dates, places and people.

(Latour, 1996c, p. 231)

What also can be read from the quotation is that interaction itself constructs. ANT and the American/Canadian social anthropologist Ervin Goffman share this insight but differ about the way the notion of self is constructed. Goffman uses the imaginary of a theatre to portray the importance the humans’ social interaction. He operates with the concepts of a frontstage and a backstage, whereby humans can partly decide what costumes to bring before an audience in a staged performance. This imaginary, to a certain extent, bridges the divide between structure and agency (Goffman, 1971), but ANT collapses the displacement between reality and stage, because in ANT there are no discrepancies between reality and innerness, there are just different actor-networks connecting to different entities.

ANT investigates relations and grids of relatedness, or the entanglement of entities in relation to one another, which also is addressed as assemblages, arrangements or configurations - all words that encompass a collective of entities relating to each other.26 ANT tells us that everything can act, that every actor is made up of a myriad of different actor networks and that it is the relations between actors we investigate, which make movement central. With these notions of heterogeneous actors-networks at work in this thesis, it becomes exciting to investigate further how this cornucopia of different entities that possibly can act, can be of importance to the way authority is examined. To be more precise, we need to look more closely at ‘what is’, and this necessitates discussion of the philosophy of science to which this thesis is affiliated.

26 Assemblages, arrangements or configurations will be used interchangeably throughout the thesis.
Ontology(ies) and the metaphysic(s) of ANT

In the following sections I will display ANT’s view on ontology and metaphysics, and as the brackets in the heading of this section illustrates, I will assume a plural form of them both, since a copious number of each may exist. The description will be structured under three headings: The ontological turn in the late developments of ANT, ontology à la ANT, and ontology and metaphysics in the plural.

The ontological turn

ANT shares assumptions about the arrangements of the world with a number of qualitative approaches. Both ethnomethodology, ethnography and ANT agree that we get to know the world through the way it is enacted, and that these enactments are turned into knowledge through researchers’ description of them (Denzin & Lincoln, 2000; Kvale, 1997; Latour, 2005a; Markussen, 2007). The focus on the practical enactments of the world makes STS scholars discuss whether an ontological turn can be identified.

The Dutch philosopher of science and STS researcher Annemarie Mol reflects on the changed status obtained by the word is in her study of the enactment of atherosclerosis. This can be used to elaborate the consequences of such a turn to ontology:

[…] after the shift from an epistemological to a praxiographic appreciation of reality, telling about what atherosclerosis is isn’t quite what it used to be. Somewhere along the way the meaning of the word “is” has changed. Dramatically. This is what the change implies: The new “is” is one that is situated. It doesn’t say what atherosclerosis is by nature, everywhere. It doesn’t say what it is in and of it itself, for nothing ever “is” alone. To be is to be related. The new talk about what is does not bracket the practicalities involved in enacting reality. It keeps them present.

(Mol, 2002, p. 54)

The quotation presents several points for discussion. First Mol changes ethno- with praxio- in her praxiographic work to situate her study and investigations of the word ‘is’ in an everyday (Euro-American) practice, rather than in a distant region of the world (Mol, 2002, p. 31-33). Epistemological questions concerning how we acquire knowledge of the world are answered with a direction toward ontology.

27 Within the STS literature there has been an ongoing discussion about whether to use the word enactment or performance about the making of the world. To follow this discussion see: (Jensen, 2001; Mol, 2002; Sørensen, 2005). I lean towards enactment as Mol does.

28 The STS group at the James Martin Institute, Oxford University organized a one-day workshop entitled ‘A Turn to Ontology? 25th June 2008’, where, among others, Steve Woolgar and Mike Lynch were speakers and Mol and Law commentators. See presentations and comments at: http://www.sbs.ox.ac.uk/events/ontology/
Knowledge becomes a practical question of how it is enacted in practice, which directs the efforts of the researcher towards ontological premises – ‘what is’ is exchanged with ‘how is’. Similarly this thesis investigates authorisations in the classroom as situated in that time and place. I too do not describe how authority circulates in every setting, not even in every classroom; I generate knowledge about the circulations of authorisations in this localised place. Mol’s situated ‘is’ can also be seen as an anti-epistemological attitude. The world in not to be understood or known in a specific way, we are in the world, not separated from it, which makes borders between the world and knowledge blur.

Ontology à la ANT

My Oxford dictionary tells me that ontology in a philosophical sense means: ‘a branch of philosophy that deals with the nature of existence’ (Oxford Advanced Learner's Dictionary of Current English, 2000). The nature of what exists is not yet stabilised in ANT, which leads to the second point to be drawn from Mol’s quotation above. The transportation of the ‘is’ towards a praxiographic attitude, affects the notion of universalism. When the ‘is’ becomes situated then spatial and temporal specifications are required to reveal where the ‘is’ is the case. As a consequence this dispels universalism and multiplications follow (Berg & Timmermans, 2000; Mol, 2002). Or as Law and the British psychologist and STS researcher Singleton states: ‘Nothing is fixed and forever in the ANT world. Only some things are fixed, and for some time’ (Law & Singleton, 2005, p. 335).

The rupture with universalism is not unique to ANT but the ways in which the ‘situatedness’ is understood and framed in ANT might render visible some differences between a general situatedness as suggested by the American social anthropologist Jean Lave, and the Swiss educational theorist Etienne Wenger (Lave, 1988; Lave & Wenger, 1991; Wenger, 1998), and a situatedness organised around a relational matrix of time, space and agency relations, as in the ANT approach.29

Lave and Wenger aim to formalise the particularities of the ethnographies they investigate and from that formalise a learning theory where the concept of legitimate peripheral participation is developed to explain how some learning takes place through interaction with peers and older group members (Lave & Wenger, 1991). This search for the particularities of a given situation, and the following formalisations of it in form of a generalised learning theory correspond poorly with the way situated practices are dealt with through an ANT approach, since the particular in

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29 Such relational matrix is also described as different topologies (de Laet & Mol, 2000; Law, 2002; Law & Singleton, 2005), or as ‘pattern of relations’ (Sørensen, 2005, 2009).
an ANT view is as constructed as the global (and general).\textsuperscript{30} Both the global and the local is enacted locally. That the global is enacted as something more sedimented than the particular rests on the way matters of distance are enacted, and whether one relates to ‘packed’ or ‘black boxed’ relations. Here the notion of ‘black boxes’ is central.

The concept black box is made by analogy to the little black box placed in aeroplanes to record the pilot’s actions and used to recover information in the event of a plane crash. The concept of a black box in ANT is meant to account for all the packed relational connections that make up an object, which we do not notice and yet which help to stabilise an object in a particular way. A computer can be considered a black box in the sense that when I am working on it I do not need to know about all the packed relations, yet when not working these (or some of them) may become visible to me. The notion of black boxes can also help to explain why the universe for a president is no bigger than the universe of university students. The president is just relating to more packed relation on another string of abstraction (Fuglsang, 2004, p. 433). One could argue that the formalisation of particularities in the form of a learning theory, as with Lave and Wenger, creates such a black box as well. Yet the intention to have an ontological approach to my object of research and to see how authority is enacted, makes me especially observant not to take a formalisation of particularities stabilized over time in relation to a different ethnography - as for example Lave and Wenger’s learning theory -, and relate that formalised idea to my research object without paying attention to the changes in networks that occurs in the transportation.

The same is the case, as we shall see in chapter 5, when I relate my empirical data to a text by Despret. Authority is suggested in a special way in the text, I relate to this suggestion of authority stabilized through printed words on paper, yet the suggestion of authority is transformed by relations made to my data.

**Ontology and metaphysics in plural**

Thirdly, as already mentioned through Mol’s situated ‘is’, what is enacted cannot be described without referring to the temporal and spatial conditions the research object relates to. Mol’s situated ‘is’ explains why *empirical philosophy* is the name Mol uses to describe her studies (Mol, 2002, p. 4-7). The atherosclerosis Mol describes is related. It never stands out by itself as it is always enacted in a local time and space related to other actor-networks. This has consequences for the position of her study. Instead of approaching philosophy in a common epistemological

\textsuperscript{30} See also the prior section of actor-networks in this chapter for an explanation of the local and the global.
manner, where the golden horn is to acquire true knowledge, empirical philosophy is concerned with the enactment of objects in practice. This can be coined the practical/ontological appreciation which Mol and other ANT inspired studies, including this thesis, strive for. Mol puts it this way:

[…] ontology is not given in the order of things, but that, instead, ontologies are brought into being, sustained, or allowed to winter away in common, day-to-day, sociomaterial practises.

(Mol, 2002, p. 6)

This project does not talk about classical philosophy, rather it talks about empirical ontologies – actor’s ontologies – and therefore it is the philosophy of the actors (human as well as non-human) that drives the philosophical questions addressed in the thesis. This means that when I examine how authority is constructed in computer enhanced classrooms I am interested in the actors’ own ontologies. Derived from this then the metaphysics of the world are turned into multiple phenomena as well.\footnote{I thank Anders Blok, Department of Sociology, Copenhagen University, for reminding me that metaphysics from an ANT position cannot be understood as a universal metaphysic. Metaphysics can only be recognised as the actors own experimental metaphysics, and that we therefore must be open to multinationalism or multiple worlds in an ontological sense. See also: (Latour, 2005a, p. 50-52; Verran, 2007)}

The Australian educational Philosopher of Science Helen Verran in her article ‘Metaphysics and Learning’ nicely describes such a discovery of a mult metaphysical condition when studying the way that bilingual Yoruba children learn. Furthermore she discovered that the metaphysic of their learning is articulated simultaneously with that learning (Verran, 2007).

Verran conducted research in Nigeria in the 1980s and discovered that bilingual Yoruba children, as members of the Yoruba knowledge community speaking both Yoruba and English, expressed a number usage distinct from, yet equivalent to the logic used by the children learning in the English language at a scientifically- oriented school. Learning two profoundly different cognitive schemas generates a situation where the children are ‘learning to manage knowing along with doubt’ (Verran, 2007, p. 34). This is because the different numerical systems and ways of measurement recognise the contingencies of two different metaphysics. Verran writes:

I saw that if I was to do analysis that recognised as real the difference that Yoruba and English speaking children had revealed for me, I had to abandon my old working image of realness, of knowledge, and learning that
had the world as singular and ‘out-there’ and knowledge as habits of certain thought. [...] The new working imaginary I came to espouse conjures up multiple enacted realities. The singularity of the sciences’ reality is seen as a special sub-set of the prevailing multiplicity effected in collective action. Entities – both object and subjects, materialise or ‘clot’ as configured in particular ways in the here and now.

(Verran, 2007, p. 38)

Verran’s willingness to put her (kn)own metaphysic imaginary about the world aside, and her openness towards other enactments of the world enabled Verran to discover that learning for these bilingual children also involved doing ‘metaphysics on the run’ (Verran, 2007, p. 39). This willingness to question one’s own presumptions about the construction of the world and to hand over the world building capacities to the actors, is taken up as an ideal that I aspire to in this work.

Methodological Considerations - how to research the enactment of authority

So far I have described ANT as a metaphysical commitment to a world made up of actor-networks, and to research situated in practice in an ontological manner, focusing on practical enactments of the world in temporal, spatial and agent(ial) relations. This world view makes authority into something that is locally enacted as an entanglement of spaces, temporalities and agencies, where authority gains its specific status in a specific cause of events. However these metaphysical assumptions of how the world is enacted do not enable me to know or describe anything about authority in the classrooms I visited in advance of reviewing my empirical descriptions. But they do enable me to know something about how I can study my research object (Latour, 2005a, p. 142).

One of the most important assumptions in ANT, seen in the above discussion of ontology and metaphysics, is that it is the actors that do all the work. Actors frame their actions, produce their own theories, make contexts, have their own metaphysics and ontologies (Latour, 2005a, p. 147; Mol, 2002; Verran, 2007). None of these are done by the researcher. ANT can offer some methodological guidelines that help the researcher track, trace, connect and draw maps over the ways relations are made between actors, by actors.

When authority (and everything else) is done in practice, how are these enactments to be investigated? How do we investigate the multiplicity of social practices present in any situation, for instance in this study in a particular classroom? Latour (1987) argues that we need to focus on the dynamic of the interactions rather than on the stability of relationships. We need to follow actors in the making, and we need to make descriptions of it: We need to describe the topological patterns made
by entities relating (Law & Singleton, 2005; Sørensen, 2009). Two actors that I continually follow through this work are authority and authorisations. I trace the way authorisations are crafted, and sometimes this leads me to trail other actors that may be highlighted in the actor-network of authorisations that I am describing.

The second methodological guideline is about the cutting of networks: Latour writes:

> When your informants mix up organization, hardware, psychology, and politics in one sentence, don’t break it down first into neat little pots; try to follow the link they make among those elements that would have looked completely incommensurable if you had followed normal procedures.

(Latour, 2005a, p. 142)

The quotation can be used to illustrate the way I aim to follow my actors. Instead of initially making the empirical examples recognisable in accordance with existing explanations, I aim to follow my actor without any preconceptions. I will describe what is done in the examples I investigate, and by these descriptions make visible how actions made by heterogenic assemblages of different actors relating in time and space are produced and how they produce authority.

At the same time I am working with pragmatic boundaries that limit my descriptions, which marks another way to consider cuts in networks. I have used the word ‘classroom’ in the initial question about the relatedness and the affectedness between authorisations and digital learning environments that this thesis seeks to answer. Using the word classroom makes cuts in the networks I examine (Strathern, 1996). Looking at authorisation processes in classrooms produces the effect that most of the emphasis is put on actor-networks within the classroom, whereas sometimes relations are drawn by texts at other places, research in other empirical fields, virtual spaces like MySpace or MSN33 and songs that come from other networks.

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32 The descriptive aspect does however re-mobilize the dualistic explanatory frame that Latour tries to elude, because he needs to argue in the western language of binaries. Latour’s notion of hybrids can be used as an example (Latour, 1993). What are the hybrids hybrids-between? Latour needs to mobilize the dialectic because even his notions of hybrids needs to be hybrids between something; the pure subject and pure object, and the dualism re-enters through the language he needs to explain it. Yet the awareness of this paradox helps ANT to soften its effect, together with the exclusive notion of actors where everything has the capacity to involve increment and enactment.

33 Interesting to note that the mentioned virtual platform is nowadays overruled by Facebook and Skype.
This cut can also be seen as an effect of the premises of my data collection. I had not yet related my study to ANT at the time when I was at the school, and the Multiroom did, at that time, mark a clear frame for the study.

The third methodological guideline is the notion of generalized symmetry which means that no entity is given agency prior to an analysis (Latour, 2005a; Law, 2004). The teacher and the Lego Robolab boxes are both addressed through descriptions of actor-networks; they are both combinations or the sum of relations made up of heterogenic assemblages of entities. It is, however, important to mention that the principle of symmetry is not to be thought of as a principle of equal agency in actors. There are differences among actors and the agency they are enacting in any given situation. But the symmetrical doctrine provides an analytical tool that opposes a presupposed notion of agency as given to actors in advance of a study – for example the allocation of authority to the teacher. Latour puts it this way:

ANT is not, I repeat not, the establishment of some absurd ‘symmetry between humans and non-humans’. To be symmetric, for us, simply means not to impose a priori some spurious asymmetry among human intentional action and a material world of causal relations.

(Latour, 2005, p. 76)

The consequence of a symmetrical research position becomes clear when Latour explains how things can act. Speed-bumps are significant when you are driving, a remote control matters when the television is to be turned on, as it also matters that the book is replaced with the Lego Robolab system in the teaching situations I investigate. These examples show how things participate in the course of action. Yet Latour gives an important caution, which also marks and explains the difference between technological determinism and the way ANT encompasses material agency. Things participating in action do not mean:

[…] that these participants ‘determine’ the action, that baskets ‘cause’ the fetching of provision or that hammers ‘impose’ the hitting of the nail. Such reversal in the direction of influence would be simply a way to transform objects into the causes whose effects would be transported through human action now limited to a trail of mere intermediaries. Rather it means that there might exist many metaphysical shades between full causality and sheer existence. In addition to ‘determining’ and serving as a ‘backdrop’ for human action’, things might authorize, allow, afford, encourage, permit, suggest, influence, block, render possible, forbid and so on. ANT is not the empty claim that objects do things ‘instead’ of human actors: it
simply says that no science of the social can even begin if the question of who and what participates in action is not first of all thoroughly explored, even though it might mean letting elements in, which, for the lack of a better term, we would call non-human.

(Latour, 2005a, p. 71-72)

Although things might only pose as backdrops, they might be the cause of action and they might matter in ways entangled with human actions that we have not yet anticipated or considered. Yet it is not having preconceptions in themselves that is considered wrong. It is when these preconceptions hinder occasions for a phenomena to differ from what they might be expected (Latour, 2004a, p. 219), for example when preconceptions about teachers’ authority do not allow the possibility to ask who or what has the authority. The methodological symmetrical engagement is used in my research field precisely in order to avoid giving any type of actor the right to act in advance of the empirical study. Working with the symmetrical doctrine can be considered a methodological trick to avoid making hasty decisions about what affects what, who has the power and what is considered to act in the classrooms I investigate.

**Things as meaning**

I have stated that materiality becomes an important feature of ANT. This is not because things always are given agency but because if we do not examine every type of entity that might matter, then we might erase a whole bucketful of entities holding agency in a given situation in advance of an analysis. Relating to the symmetrical doctrine is an important step in the right direction of democratising what and who can act, as explained above. Yet things in the setting I investigate (seldom) speak out loud, and (often) do not move around unless this is done by a human hand. The question of how to discover the impact of things without re-inventing a meta-theoretical position is actualised. I will here refer to three different texts which all, in different ways, present an example of an ontological ‘flatland’.

The first two texts are written by Latour. He returns to nonhuman’s co-construction of society repeatedly in several texts (Latour, 1990, 1996a, 1996c, 2003, 2004b, 2005a), of which I will highlight two. The first describes how objects, according to Latour, tend to emerge in three different modes, and the latter suggests an alternative method to encompass objects in our empirical descriptions.

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34 Ontological flatland is an expression used by ANT researchers to describe the default position of the ANT researcher: Flat ontology does not mean that there is no differences, that there is no hierarchy or ups and downs – flatness is not a description of the world, it is the position of the observer when connected to ANT and operating with a minimal ontological approach, as this thesis does (Latour, 2005a, p. 220).
In the text ‘On Interobjectivity’ Latour argues for a wider definition of society than one that only encompasses humans in social life. He argues that objects have been performed in three different modes – 1) as invisible and faithful tools, 2) as the determining superstructure and 3) as projection screens. He explains:

As tools they faithfully transmit the social intention that traverses them, without taking anything from them or adding anything on to them. As infrastructures, they interconnect and form a continuous material base over which the social world of representations and signs subsequently flows. As screens, they can but reflect social status, and serve as a basis for subtle games of distinction.

(Latour, 1996c, p. 235)

Seen as tools objects can either facilitate or hinder action. As infrastructures a material world is composed that completely shapes and supports human relationship ‘as a waffle iron moulds a waffle’ (Latour, 1996c, p 235). And as projection screens objects become signs or differences that signal a difference in status in its ‘different-from-ness’.

These positions do not create much space for things to actively matter. In fact Latour argues that objects become asocial and marginal, which makes it even more impossible for things to engage in detail in the construction of society.

In the text ‘Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern’ as the title indicates, Latour suggests that we should work to transform the idea of things from matters of fact to matters of concern (Latour, 2004b). Latour draws on the etymology of ‘things’ denoted as a gathering place – a place for discussion and negotiation, which suggests that different meanings and negotiated meanings are already present in things. As they develop the actor-networks, so to say, bind explanatory forces around them, and the explanations cannot be disconnected (Latour, 2006). The division between description and interpretation, between how and why, between blind empiricism or a highly theorizing approach is meaningless, Latour stresses. For instance as researchers we do not jump out of an actor-network to explain and interpret our research object through a theoretical framework. We add a description, a cause, a factor, a series of events, we simply stretch out the actor-network of our research object, the network grows – just as the networks of noses were stretched in Paris, and just as I have worked to stretch my thinking about authority.

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35 This discussion will be elaborated in relation to the descriptive analysis in chapter 5.
Latour is not the only scholar proposing these ideas. The British anthropologists Martin Holbraad, Amiria Henare and Sari Wastell propose a heuristic use of the term ‘things’, and urge us to abandon the idea that we will eventually grasp our research objects by ‘evermore refined analytical strategies’. They suggest that:

Rather than accepting that meanings are fundamentally separate from there material manifestations (signifier v. signified, word v. referent, etc.), the aim is to explore the consequences of an apparently counter-intuitive possibility: that things might be treated as sui generis meaning. […] For in the image put forward, meanings are not ‘carried’ by things but just are identical to them.

(Henare, Holbraad, & Wastell, 2006, p. 3-4)

‘Things’ are defined as something that cannot be delineated in advance of the ethnographic encounters from which they surface. Holbraad, Henare and Wastell suggest that the meaning is already with things, no meta analytical level is needed, and the aim is a, ‘more open, heuristic approach to analysis that allows ‘things’ as and when they arise to offer theoretical possibilities’ (Henare et al., 2006, p. 3).

This view on things accords well with Sørensen’s definition of materiality since it is open enough to let the data ‘decide’ what for their actor-networks is materiality, yet specific enough to let readers know that this definition of materiality is informed by an ANT approach. Throughout the thesis I will subscribe to this definition: ‘Materiality is defined as the ability of a particular object – achieved through the socio-technical arrangement it is part of – to relate to (an)other particular object(s)’ (Sørensen, 2007a).

Latour and Holbraad, Henare, Wastell and Sørensen collapse any imaginable metaanalytical position, things has it already, the explanatory force is there, the meaning is there, we just have to ‘sniff it out’ and let ourselves be susceptible to other, often unfamiliar, descriptions of mattering that this flat approach can produce.

Knowledge production

Allowing research objects to kick back, surprise and expand their networks by giving them agency has scientific-philosophical implications. As already mentioned, the research moved to the premises of ontology - the idea that an epistemological position can explain and validate the knowledge produced is abandoned, or to be exact epistemologies exist, but they can never be anything other than political epistemologies (Latour, 2004a, p. 221). The epistemological position of ANT can be said to be produced through the move towards ontology, which means that the principle
of mapping out knowledge cannot be determined beforehand. With an epistemological position that refrains from prejudging the right way of cutting out what is, there remain questions about what kind of knowledge is produced after an empirical investigation, and about how this knowledge circulates in society in relation to what we already claim to know. The last sections of this chapter will engage with these questions.

The first question concerned with what type of knowledge is formed is already answered through Mol’s explanation of the situated and local ‘is’ that is produced. Knowledge is situated, and therefore always carries ‘facts’ along with temporal and spatial specifications. This, however, still does not explain how this local and situated knowledge comes to be important. The Belgian science philosopher Vinciane Desprets offers a way to position this situated knowledge production through the notion of additions.

Desprets turns the question of relevance into matters of epistemological belief. She works with the terms ‘making available’ and ‘being docile’, and writes on the scientist’s role in relation to an experimental setup in laboratories.

The contrast between a scientist who relies on the availability of both apparatus and animal and a scientist who requires docility (this scientist being himself docile to the perceived prerequisites of science) may be translated along another contrast: the contrast between the manner of addressing oneself to the system, on the one hand as a care-taker, as somebody interested in its possible becoming, and on the other hand, as a judge or a master.

(Desprets, 2004a, p. 124)

Desprets asks whether the most important scientific task is to uncover a reality, or to propose new ways of seeing reality, to add versions to it (them), and to enable new identities to come into existence. In the first suggestion science is about revealing a pre-existing (universal) reality whereas the latter suggests science as a process of creating a becoming. In addition there is also an implicit critique of perspectivism and an orientation towards multi naturalism or multi ontology, because things are done in practice. Restraining from judgement combined with allowing things to ‘speak’, it becomes possible for us to see how Lego Robolab, not only gives the

36 That again, as we will notice is an epistemological belief that moves the effect of knowing to the premises of ontology.

37 I will return to these terms in chapter 5 and 6.

38 The critique of perspectivism is taken up and discussed among several STS researchers, see for example: (Latour, 2005a; Law, 2004; Mol, 2002).
children opportunity to become good experimenters, but it also becomes possible to see how children give Lego Robolab the opportunity to add new meanings to Lego Robolab-with-humans.

**Validation of additions and the common good**

If we follow Despret’s ideal of science, then the most important task of science is to generate possibilities for realities to become. Question of validation therefore do not rest on the stringency of a methodological approach, nor on the theoretical recognition, but on its ability to add to what we already know. Latour takes a similar stance on validation. According to Latour an analysis should be evaluated according to how plausible and reliable the analysis is found to be in the field where the analysis wants to enact (Latour, 1988, 2005a). This credibility is not only gained by following certain methodological prescriptions, but by, in a very concrete way, being experienced as a satisfactory, sufficient and valuable description.

Validation, in other words, rests on the ability of the analytical descriptions to circulate in, and be related to the communities they want to address. Yet Latour does not stop there, his desire is to maintain the common good, for all types of acting entities, as he expresses below:

> [...] the extreme position I have taken might have some connections with common sense. In a time of so many crises in what it means to belong, the task of cohabitation should no longer be simplified too much. So many other entities are now knocking on the door of our collectives. Is it absurd to want to retool our disciplines to become sensitive again to the noise they make and try to find a place for them?

(Latour, 2005a, p. 262)

This quotation by Latour adds an intention to the knowledge production; that knowledge is also produced aiming for the common good, where ‘good’ is not merely something to be judged by humans, but is considered a concept that strives to encompass other types of actors, not just the human ones. I relate this study to Despret’s wish to add articulations to the world and to Latour’s intention of democratising the common good.

If validation is done through the text’s ability to matter in the communities it addresses, then it suggests a rather simple answer to the necessity of my reflections on the researcher’s role in relation to the research results. The answer is that it matters. It matters that I am the one working with this research project because I am made up of actor-networks that I draw into the analysis, and these actor-networks differ from ones that another researcher is affiliated to. Yet my ability to reflect upon the
significance of me doing the research does not add to the descriptions of what I investigate; it redraws from them (Latour, 1988). The effort put into these written pages is, therefore, primarily directed towards giving as precise descriptions as possible, rather than directed towards giving all my reflections upon the making of those descriptions. An example is the reflections I have allowed, in chapter 2, which only point out the possibility of an alternative description of authority, rather than exhaustively including all the reflections I have had.

**Additions as a method**

The notion of additions is also taken from Despret and offered as a useful methodological tool in two ways. Addition offers a solution to the question of the relevance of this type of research as it helps to position the production of knowledge in this thesis. I add other descriptions to the ones already given on authority in computer enhanced classrooms. Secondly, additions are used as a methodological tool in the analytical part of the thesis, which I will describe in the following section.

**Camels and Lego bricks - adding and redrawing**

Apart from integrating ambiguity in my forthcoming analytical descriptions, Despret’s scientific practice of adding is taken up literally. Despret has taught me to add. Add to the story, add to the sum, and add to the networked descriptions. Despret illustrates the principle of adding through a story about a legacy of the twelfth camel, which goes like this:

Shortly before his death a father explains to his three sons how they are to divide their inheritance of eleven camels; half of the camels go to the oldest, a quarter to the second son and a sixth to the youngest son. A little later the father dies and the sons are perplexed. How are they to divide their bequest? An old man offers to help the sons by given them his old camel. With the twelfth camel to hand the sons divide their legacy. Six camels go to the oldest brother, three to the second and two to the youngest, and what remain is the old man’s camel which they then return him (Despret, 2004b, p. 15-16).

The twelfth camel might easily be seen as the solution, but Despret notes that it is not. The camel suggests a solution to the problem (Despret, 2004b, p. 17), but we are not told how to think differently, or how to adopt our heritage. The camel simply offers a new proposition. The sons could have started to fight trying to divide what there was, but instead they accepted the offer of another camel offered by the old man. The acceptance of the camel by the sons is used by Despret to explicate another important insight, and that is the willingness and courage to risk what is – here, just the eleven camels that could easily have been fought over –, and thereby allowing new realities to be produced.
By analogy, we are not told how to think differently or how to adapt our heritage but to have the courage to risk what is known for what is unknown.

Despret’s tale of the twelfth camel had several effects on my writing. First, and rather basically, it prompted me to think in additions, and to allow myself to look at the empirical examples in my study differently. Furthermore additions enabled another view of the empirical descriptions, and thereby they were again redrawn. The fact that the camel was able to be returned shows that the camel was a means to find a solution. Finally, the imaginaries of adding (and redrawing) are used in relation to the data presented, the text related to and all the hybridisations of the two – I add the contemporary understandings of authority, I add theory – or formalised particularities - to my descriptions which are then to be redrawn again later. We shall see in chapter 7 that the result of this redrawing is by no means uninformed by the addition of theory. The camel analogy offered the insight that what makes a solution to a problem visible may not, however, in itself provide a solution. This play with what is related to the network of my research object and what is not, has contributed to my thinking and writing but it stands, however, in sharp contrast to the common understanding of knowledge production.

Articulation as an ideal for knowledge production

In the second half of the argument of becoming a ‘nose’ that I described in the introductory chapter, Latour argues for the decisive advantage of thinking about knowledge in terms of articulation rather than of accuracy (Latour, 2004a). There is no end to articulations, which is the opposite case with accuracy. Two important questions arise, first are all articulations good, and secondly why is it better to go from a less articulated situation to a more articulated proposition?39

For reasons that will shortly be clear I will engage with the latter question first. What sort of scientific ideal seeks additions and more articulated propositions? Traditionally science has generally been defined in quite the opposite way – as something that travels from variation to singularity - from many propositions to fewer ones (Latour, 2004a, p. 220). Yet the aim of a more articulated account of a phenomenon is found in Despret and the Belgian Science philosopher Isabelle Stengers’ reintroduction of a normative standard in science studies. Latour writes:

The emphasis on going from less articulate to more articulate propositions allows Stengers and Despret to sort out good ways of generalizing from

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39 Latour is inspired to use the term propositions from Stengers, and describes several advantages with the term. It denotes interdependency that has no definitive authority (as in pro-position), and it may negotiate itself onto a com-position (Latour, 2004a, p. 212).
bad ones. The good ones are the ones that allow for the connection of widely different phenomena and thus generate even more recognition of unexpected differences by engaging a few entities in the life and fate of many others. The bad ones are those which because they had had such success try to produce generality, not through connections of new differences, but by the discounting of all remaining differences as irrelevant.

(Latour, 2004a, p. 220)

One can be a reductionist (of thought) and accept some phenomenon and eliminate others, or one can subscribe to the Jamesian Whiteheadian attitude that Despret and Stengers draw upon, the attitude that no science can be reductionist but can only add to the world. Latour phrases it this way: ‘Reduction is not a sin for which scientists should make amends, but a dream precisely as unreachable as being alive and having no body’ (Latour, 2004a, p. 226). Latour exemplifies with a hospital setting. Even there in the stronghold of objectifications it is not possible to practice reduction. We are not reduced to ‘objective meat’ we are learning to be affected by masses of agencies adding to our unarticulated bodies. We are not becoming less, we are becoming more (Cussins, 1996; Latour, 2004a, p. 227; Mol, 2002). I have not introduced this quotation to start a normative discussion of what is good and bad science, but what I aim to do in the following chapters is affiliated to this position in the way I try to articulate descriptions of authority and authorisations as they are enacted in computer based teaching.

**Summary - descriptions of actor’s enactments**

I opened this chapter with a definition of theory from my dictionary. I have explained that ANT would not subscribe to this description of theory, yet ANT is not an uninformed position to take – it offers several prescriptions of the arrangement of the world as networks of actants, times and spaces linked together in practice by the human and non human (material, symbolic and temporal) actants themselves. This makes ontologies and metaphysics into something that can be enacted in the plural to encompass the world(s) of actors, as exemplified in Helen Verran’s study of bilingual children. ANT posits the importance of tracing ontologies – actor’s ontologies.

Important features of an ANT methodology include; commitments to the symmetrical principal, follow the actors, don’t cut the networks in advance of the study, don’t jump into networks made by the actors.

ANT is concerned with the investigation, the tracking, the tracing and drawing of relational maps (topologies) which have consequences for the ways knowledge production is thought about. Knowledge production has been described as additions
and it has, moreover, been stated that the aim of research is to make the additions as articulated as possible. This is precisely the aim of the empirical descriptions in the following chapters of this thesis.
PART II

Part II of the thesis is structured around two different principles that have emerged in the interplay between the empirical material and the production of the chapters. It is useful to know both of these principles before reading the descriptive and analytical parts of the thesis.

The first principle is the one of additions. Each analytical chapter discovers something about authorisation processes in computers enhanced teaching, and intentionally, no insight is discarded, which means that the knowledge a chapter puts ‘in motion’ is added as an analytical dimension to be considered in the chapter that follows it. This means that:

- Chapter 5 discovers the notion of making available and that body positions as important dimensions
- Chapter 6 discovers knowledge, domestication, emotions of trust and interest and circulations of authorisations as important dimensions
- Chapter 7 discovers different expectations as an important dimension
- Chapter 8 discovers multiplicity as an important analytical dimension

The principle of additions partly reflects my own process of discovering the complexity in the authorisations investigated, and also it is reflected in the composition of the chapters. It has been easier for me (and presumably also for the readers) to increase the complexity by adding a new dimension to the existing knowledge as the chapters proceed. It would have been easier for me to consider each dimension separately as it emerged rather than attempting, as I do, to handle all the evolving dimensions together in a cumulative way, but the complexity at stake would not have been reflected so well if the dimensions were taken one by one. The ‘price’ for this way of organising the material – adding dimensions of interest with each of the chapters, and at the same time retaining previous knowledge - is that it may seem as if body positions is the only dimension that is interesting to consider in all chapters,
and that expectations only matters in chapter 7, but this is not the case. Expectations, for example, is identified as an important dimension in chapter 7, but it is in fact also a dimension that matters in chapter 5, 6 and 8 but is not in focus there. Chapter 8 in part II of the thesis is the only chapter that does intentionally consider all the dimensions together.

The second principle is also empirically based. This principle structures the choice of empirical examples investigated, and exposes the possible combinations of two units: Relating to the instructional manual, or not relating to it. The manual becomes central because, as we will experience in chapters 6 to 9, the teachers distribute authority to it. These chapters are therefore organised around actors either relating or not relating to this entity. Having the two units; relating and not relating to, result in the combinations below.

Chapter 6: Children relating to the manual
Chapter 7: Children not relating to the manual
Chapter 8: A child initially not relating to the manual, and then relating to it
Chapter 9: Children relating to the manual, for then not to

Chapter 5 escapes the second ordering principle because it prepares the ground for the following four chapters. In chapter 5 the argument for a sociomaterial concept of authority is conveyed through an empirical example and this also explains the introductory processes that all the classes are guided through before they start using the manual. Chapter 5 is thereby producing a common background for the four following analytical chapters. Chapter 9 also differs from chapters 6-8 because the example placed there forms the basis for the final discussion of the thesis. It is also the chapter where the concluding remarks of the whole thesis are to be found. Chapter 9 makes up part III of the thesis and is briefly introduced here since the example mentioned in the conclusion relates to the two organising principles as well; all the dimensions are considered in the chapter and the empirical example highlights one of the four combinations of relating or not relating to the manual.

A brief outline of the chapters in the second (and third) part of the thesis is given below:

Chapter 5 starts asymmetrical. I describe the teacher as an authority but this is blurred by Despret’s notion of ‘making available’. It is discovered that the asymmetrical description is only possible as long as materialities are made silent, and this makes me look into authority as a social and material configuration. Descriptions of physical circumstances and material agency are normally absent in educational research, or at least only applied in a distributed teaching situation where children
are working in different places. In this chapter the sociomaterial argument is unfolded in relation to a centralised teaching situation where Pete introduces the children to the Lego Robolab system. This makes the argument for a sociomaterial authority in a teaching situation that, in many ways, resembles the usual classroom situation. The boundaries of the authorisation process are bodily challenged by one of the children, and this empirical example is used to identify one central dimension i.e. the way in which bodies are entangled in different authority configurations. The chapter concludes that authority is made up of the alignment of hybrid entities, and that the ways bodies are enacted are important and affect the authority in the classroom.

Chapter 6 brings the knowledge of authority as a sociomaterial phenomenon to an empirical example that builds upon the one given in chapter 5. It describes how authority is enacted when the children follow the manual as the teacher proposes. The chapter shows that it is not only human and non-humans that make up Pete as an authority. The concept ‘circulations of authorisations’ is invented and used to capture the situation where the teachers, children and materials are authorising each other, and it is identified that in addition to Pete’s knowledge, the emotions of trust and interest are important actors to initiate the circulations. In the circulation of authorisations all the engaged entities end up appearing competent. It is concluded that the circulations of authorisations can be considered as a process, and authority as a set of stabilised circulations.

Far from all the children following the teacher’s agenda. Chapter 7 suggests that other expectations might co-exist with the formal one discussed in chapter 6. These other expectations partly legitimize other ways of interacting with the materials in the classroom. Chapter 7 introduces three empirical examples that in many ways are contrary to the example described in chapter 6. In the three episodes none of the girls involved are relating to the manual or to the teacher’s expectations of them throughout the lesson. The expectations of engagement are identified and the children relate to this expectation in different ways. The circulation of authorisations produced between the video camera, the idea of an interview and two girls in one of the assemblages ends when the teacher enters the room. This might suggest that certain authorisation assemblages can coexist and that others cannot, - a lead that is pursued in the following chapters.

In chapter 8 the construction and translation between three different authorising assemblages is examined. Bertil’s movements from one configuration to others are followed. First he is authorised to act by the Lego bricks, second by the manual, and in the end he becomes the one who authorises himself. It is the transitions between the different arrangements of authority which will be in focus. The concept
of circulations of authorisations and the other expectations from chapter 7 are brought together, and it is suggested that there are coexisting authorisations as well as multiple versions of technological engagement. Multiplicity becomes a central dimension to consider, and the chapter concludes that Lego Robolab can usefully be thought of as a multiple object and that the circulations of authorisation are done plurally in the examples described.

The last chapter, chapter 9 marks part III of the thesis and sums up the insights gained about the authorisation processes taking place in the teaching situations described in chapters 5-8. A final empirical example is given where conflicting authorisations exist, and the notion of the ‘smallest common multiple’ is suggested as a way to identify possible coordinations of the different versions of authority that exist in the Multiroom.
5. SOCIOMATERIAL ENACTMENT OF AUTHORITY

When investigating authority processes in computer enhanced classrooms it seems reasonable to ask who or what is enacted as an authority in the examples I describe. A symmetrical approach, as explained in chapter 4, will refrain from deciding who has the authority in advance of an analysis, yet this is exactly what I will do in the beginning of this chapter. I let the teacher rule the classroom. Despret’s text ‘The Body We Care for: Figures of Anthropo-zoo- genesis’ (Despret, 2004a) does however guide me to accept that ‘things’ and human movements mutually affect and construct one another, and it shows authority as a sociomaterial effect of these heterogeneous assemblages. The text is central not only to this chapter but to the thesis as a whole. I investigate the notion of ‘making available’ and apply an example from Despret - Professor Rosenthal’s experiment with students and rats -, to the primary school teachers, children and Lego Robolab. This has in a very concrete way made me aware of, and authorised me to play with, relations of agency in the classroom in different ways in this and the following chapters.

The notion ‘making available’ will be introduced as an analytical tool to see the local heterogenic assemblage that makes up, and maintains the teacher as an authority. This is done through five examples, each part of the same lesson and following each other chronologically. The first part of the sequence demonstrates how the teacher Pete comes to control the communication by making alliances with technologies in the room and communicating with the children as a group-of-children rather than as 20 individuals. In these acts authority becomes an effect that legitimizes and makes it possible for the teacher to control the situation and set the expectations for the lesson. The second example explains how the teacher prepares to maintain order by matching the number of Lego Robolab sets with the computers and the arranged groups, and highlights the material coordination in these acts. The third example highlights nonhuman obstruction, and shows how this obstruction of order is managed to re-established order. Finally, bodily tension and verbal rejections among the children are discussed (example four and five). Bodily movements are identified as the central analytical dimensions to pursue in the following chapters.

Ordering actors

We are about to meet one of the 5th grade classes at the school I visited. I call it 5Y. This is the first lesson in 5Y’s Lego Robolab week, and the class are to be introduced to the Lego Robolab system.
1. Gathered in the Multiroom 5Y is introduced to the Lego Robolab system. I am placed in the corner of the room near my video recorder. The room is sparsely furnished. Some closets are placed at the end of the room and two built-in steel tables are placed against the wall behind me and the wall I am facing. There are no chairs in the room. Two teachers, Maria and Pete are present. Pete asks the children to take a seat on the floor in the middle of the room. The children place themselves on the floor and face the projection screen where Lego Robolab’s programming units are displayed. Eight boxes of Lego equipment join the children on the floor and three laptops are placed on the table opposite to me.

Pete takes a pre-prepared robot car in his hands, and walks back and forth between the laptop on the table along the wall and the projection screen, and explains how the engine can communicate with the computer via an infrared tower. (Field notes the 30rd of March 2006 supplied with video recordings of the same period)

Let me start by asking a simple question. What is at stake here, what is being enacted? It is tempting to stabilize the relation between the teacher and the children as a teacher controlling and organizing the children, because such an interpretation would ‘fit’ our commonsense imaginary of schooling.\(^{40}\) Throughout this and the

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\(^{40}\) See also chapter 3 on authority.
following analytical chapters I will challenge this view. I will put the symmetrical doctrine of ANT into practice and allow myself repeatedly and sometimes even stubbornly to ask basic questions of how this configuration of authority is achieved. This means that I will ask: Who gets to order this situation and be an authority, and how is this enacted? This is what I will set out to answer in the following sections.

Making available

I write in the field note that Pete directs the children to the floor. I could assert from this that the children are listening to Pete - they are doing what he tells them to do and they are willingly letting themselves be directed by Pete. Remembering the descriptions of authority in chapter 3, I could conclude that the teacher has authority over the children and I would probably make an assumption that most readers would agree with. However this picture would only account for the human action and the material part of the relational assemblage that makes this description possible is left out. Questions such as who guides who and who is authorising whom seem noteworthy to consider.

Opposing the initial statement that Pete has authority over the children and the materialities, it could instead be suggested that it is the alignment of the floor and children that makes Pete able to be an authority and not the other way around (Latour, 2005a). If we interpret the floor as the one that guides the children’s behaviour, by stabilizing their lower bodies, then cause and effect change place - Pete is no longer causing the action, the stability of the floor is doing it. Such an interpretation certainly sheds another light on the situation, albeit by maintaining a rather harsh (modernistic) distinction between cause and effect (Latour, 1993).

Despret offers a third position from which lines between cause and effect gets blurred. Despret hesitates to distinguish between what affects and what is being affected, by looking at matters in terms of what the situation is ‘making available’ (Despret, 2004a, p. 118). The notion of making available will here be understood quite pragmatically as what kind of opinions, things, and humans are obtainable and/or approachable in a given situation. What becomes interesting in this line of thought is to identify what is made available to the children, the teacher, and the Lego Robolab system in the situation enacted in the field note.

Pete is directing the children to the floor, and what tends to disappear in that act is what the floor is making available to Pete. One of the effects of this alignment of children and the floor is that it stabilizes the children’s bodies. Bottoms-meet-floor
resembles the bodily adjustment done by chairs and tables in ordinary classrooms.\(^ {41}\)

And even though bottoms-on-floor, and bottoms-on-chairs (often in connection with tables) stabilize the legs of the children differently, as I explore later in this chapter, then the floor meeting all the children’s bottoms, makes it possible for the teacher Pete to relate to them as a gathered unit. A rather gauche description of this unit could be; the unit group-of-children, which emphasizes that the teacher is not talking to the children as individuals, but as a group. The effect of this is notable; the teacher does not have to maintain control over 20 relations to 20 individual human beings, as long as he can maintain control over the one unit group-of-children.

![Figure 7: Illustrate the relation between the teacher and children, as a one to many relation on the left and as a one to group relation on the right.](image)

The stabilizations of bottoms matters here, however, bottom-meets-floor does not singly hand Pete the control - there are other things involved which are just as important. For example the walls, as Latour finely helps me to illustrate in the introduction, make it possible to centre activities and to exclude unwanted noise, together with all the bodies of the children more or less facing the same direction, which affects the children’s viewing possibilities. Imagine if the children were sitting on the floor facing each other or were seated without any indication of a privileged site of action. In such a situation Pete wouldn’t be able to catch the children’s eyes nor they his. Pete’s eye contact with the children is important for the authorisation. The children’s eyes fixed either on the screen or on what Pete is doing is an indication to Pete that a relation is made. Although eye contact may indicate attention it is surely not the same as having it. However the indication is important because, using Despret’s term, attention is made available through the aligned direction of all

\(^ {41}\) Bodies on chairs have, among others, been discussed by Michel Foucault in the book ‘Discipline and Punish’ (Foucault, 1979).
the bottoms on floor. Aligned bottoms cause alignment of backs and necks and through this make it possible or available for the children to face the same direction. I will enlarge upon this below.

Despret’s concept holds a rather subtle yet controversial consequence. When actors are made available to one another, then mutual possibilities of relating, affecting and creating each other exist, and from that the idea that different actors hold and bring certain clearly distinct properties or qualities can be questioned. Despret quotes the American physiologist William James to illustrate this point:

We see that joyous thoughts dilate our blood-vessels, and that a suitable quantity of wine, because it dilates the vessels, also disposes us to joyous thoughts. If both the jest and the wine work together, they supplement each other in producing the emotional effect, and our demands on the jest are the more modest in proportion as the wine takes upon itself a large part of the task.

(James, 1958, p. 462 in Despret 2004, p. 127)

The quotation is used to illustrate an experience of making available as;

[...] an experience by which both the body and what affects it produces each other. Each of the events (wine, thoughts, vessels, jests) creates an occasion for the others: should we say that the wine made us happy or that we made the wine joyous?

(Despret, 2004a, p. 127)

Despret asks us if we make the wine joyous. With this somewhat peculiar question Despret’s insight asks us to question what constructs an actor, and suggests we consider actors as being mutually constructed and constructing each other. It is exactly these joint constituents – these experiences of humans and material interactions being occasions for one another - which Despret’s notion of ‘making available’ captures well.

I will continue to look at the situation in this manner, where materials and humans are not only available to each other, as in the sense that the teacher can relate to the Lego bricks in the room, but also in the way that all these heterogeneous actors offer each other occasions of being in different ways. I have already identified the special way in which the floor enables a certain relation between teachers and children to arise, and I will continue by identifying other material actors that contribute to the authorisation of the teacher, since the quotation from Despret makes it increasingly difficult to reserve authority solely to (belong to) the teacher.
Translation of classical classroom equipment

The traditional material assemblage of classrooms can be characterized as chairs, tables, blackboard and books and these are all entities that are absent here. However the traditional expectations such as the teacher setting the agenda, and the children listening, can be said to be met, which is partly due to the materials present. The digital projector, floor, Lego Robolab and laptops can be said to fulfil traditional expectations if we exchange the function of chairs with floor seating, blackboard with a digital projector, and books with Lego Robolab. Yet the shift in materials does something to the situation. Structural recognition is present and at the same time translation has taken place.

Translation here is to be understood as movement and change. Translation is put in motion in the ANT literature by Callon as a concept used to explain the structures of power in a scientific and economic controversy over the decline in populations of scallops in St. Brieuc Bay (Callon, 1986). Callon identifies four moments of translations; problematisation, interessment, enrolment and mobilisation, that mark a process. Latour uses this insight to create a distinction between translation and transportation – or what he calls mediator and intermediary, where mediator stands for movement, mediation and change of what is, while the intermediaries faithfully transport what is. Latour uses Callon’s scallop example to conclude that: […] the word ‘translation’ now takes on a somewhat specialised meaning; a relation that does not transport causality but induces two mediators to coexisting (Latour, 2005a, p. 108).

Back in the Multiroom this means that although the translated materials are variations of the known themes expectations of a different teaching is produced and interest can be accounted as an effect, growing from known relations entangled with new materials.42

Pete introduces the different parts of the Lego Robolab system which causes him to move back and forth between the laptop and the box of Lego Bricks placed on the table, and the projection screen displaying the programming interface. The materialities are making it available to Pete to make a choreography by coordinating bricks, sensors, computer and projections on the screen in the ‘right’ way according to what he wants to tell the children, and also ‘right’ in the way that the choreography catches the eyes of the children.43 This confident coordination of materials adds

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42 Interest as an effect of the ways human and non-human actors relate will be described in further detail in chapter 6.

43 The use of the term choreography is inspired by Charis Cussins concept ‘Ontological Choreography’ that encompasses the oscillations between subjectivity and objectivity (Cussins, 1996).
to the position of authority that Pete holds. He wouldn’t gain the same acceptance from the children if he didn’t know what to do with the materials, and if he didn’t established some expectations for the lesson through his words and demonstration of the materials.

The construction of Pete as the one who authorises has so far been explained as an effect of the mutual effort of heterogenic actor’s involvement and intersections. I have explained how the walls, bricks, the bottoms on the floor, engines, sensors, grouping and eye contact help to construct Pete as the one who authorises. I have by this argued that Pete is not just having authority; the situation is making authority available to him. And being the one authorising, he is also the one capable of setting the expectations of the lesson. This suggests an argument for a procedural view on authority that will be pursuit in the following chapters. In the remainder of this chapter I will expand the argument of the impact that the physical things and the symbolic orders have on Pete’s authority. I will describe how the teachers Marie and Pete continue to control the situation, what happens when the children test the boundaries of the authorisation, and what happens when things obstruct the order. Through these descriptions I will discuss how the power to define action is transformed when relations among the actors in the relational assemblage change and how, as an effect, the different material arrangements that emerges makes other orderings of the children possible.

**Translation of the group-of-children**

I will look at the second example of this chapter where Maria starts to group the children in 5Y. The description and analysis will illuminate what it means to add something to actor-networks, and through this illustrate the point that translation of the group-of-children makes other availabilities arise, that Pete must adjust to in order to maintain authority. I will also briefly reflect upon the concept of subjectivity and the concept of materiality that I am working with.

2.

When Pete has finished explaining the essential features of Lego Robolab’s computer interface, the engines and sensors, Pete and Maria discuss how to divide the children. Pete suggests mixed groups with three persons in each, and Maria counts the children.
‘Twelve, eight’ she says, referring to the present number of boys and girls. She starts the division by calling the children’s names and pointing a finger, while she moves along the body of sitting children. When she points at the last girl in the end of the group, she asks if anybody is missing. No one responds and seven mixed groups are created out of the group of children. (Field notes the 30rd of March 2006, supplied with video recordings of the same period)

Maria and Pete agree that they are going to end up with groups of three children in each, containing both boys and girls. To get there, Maria wants to know how many girls and boys the group-of-children consists of this particular day. By counting she momentarily dissolves the group-of-children, and unites each child with categories of gender as she goes along. She counts twelve girls and eight boys, and is in that act not just adding gender as additional information to the individual child. Gender specification details are also added to the group-of-children, which also is the information needed to dissolve this group form.44

With the right numbers at hand, she walks beside the group of sitting children and constructs the mixed groups as she goes along. Again she dissolves the group-of-children into *individual-gender-child* by calling a specific child’s name and pairing them three and three into *working-groups*, while moving along the line of sitting children. The knowledge of the number of girls and boys is used to adjust whether to include one or two girls in the work-groups as she goes along. Maria starts and

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44 ANT frame gender identification as an effect rather then a category, see (Waltz, 2006)
ends her organizational act with the group-of-children. Capturing the difference between the group-of-children Pete started to relate to, and the one he takes over from Maria, the concept of translation can again be used here to identify the changes made (Callon, 1986; Latour, 2005a).

The group-of-children has been given some additions to its actor-network. Maria’s counting of girls and boys and making working groups adds information to the group-of-children which generates the possibility of gradually dissolving it. The first group-of-children is dissolved into gender-child (8a), where the latter group-of-children, also contains children clustered in mixed working groups (8b), which, as we shall see, comes to matter when Pete later on dissolves the big unit group-of-children.

![Figure 8: Illustrate the addition of gender to the group of children and the addition of working groups](image)

These two simultaneously existing categorizations point at different forms of actions. Group-of-children is mainly associated with the form of lessons, whilst working-groups indicate a more group-oriented working style. The coexisting organizational form is furthermore bound to a temporal dimension. The working-groups point to group related activities, but the mandate to act according to this organizational form has not yet been authorised, whereas the group of children points back to the common introduction which the children have been through.

The example with the translation of the group-of-children illustrates that an organisation such as this is not just a matter between humans but is an act that is also materially configured. In fact the foregrounding of the children’s gender and the addition of a group affiliation is what enables Maria to group the children.

To strengthen this argument I will find allies from two different yet interlinking sources. First by elaboration of ANT’s notion of subjectivity, whereby subjectivity is seen as being without inner essence. This way of understanding a subject allows certain versions of the subject, and not others, to be foregrounded and brought into
play in a given situation. Secondly I will take a more detailed look into the way the term materiality is used here to elaborate why bodily material signs of gender and immaterial group affiliations are both treated here as types of materiality.

**Subjectivity**

Imagine a subject without inner essence. How do we then imagine self, and furthermore, how do we then elaborate a sense of self? Latour writes in *The Pasteurization of France* that:

> I know neither who I am nor what I want, but others say they know on my behalf, others who define me, link me up, make me speak, interpret what I say and enrol me. [...] they impose an interpretation of what I am and what I could be.

(Latour, 1984, p. 192)

Latour writes ‘others’ in italic and thereby highlights the connection between the ‘I’ and the others. The quote illustrates that Latour sees engagement, agency and identity as relational effects, and even more strongly put; actors – human as well as non-humans, are not seen as having agency apart from the networked circulations they are a part of, actors are relational effects.

Effects of the generalized symmetry are prominent here. The way to ascribe identity to a subject does not differ from the way identity is ascribed to an object. Latour puts it this way:

> [...] it requires exactly the same semiotic labor, if I can use this expression, to produce a character as it does a concept or a corporate body. So, while we should remain attuned to small differences in figuration, there is no reason to forget that our own relativistic frame of reference should be indifferent to scale. But it remains true that beliefs in the indisputable existence of individuals is so entrenched, in our western climes at least, that people are only too ready to accept that, even though abstractions like structure, context or society should be criticized, the ego is to be left untouched.

(Latour, 2005a, p. 199)

Nothing is saved from – or everything is blessed with this scheme of semantic labour; teachers, computers, authority, etc. Let us apply this insight to the class. In the Multiroom the network circulations enact identities of tables, chairs, teachers and children, and the way relations among entities are made do not only bind
entities together, they also mutually create one another in the specific place of intersection: When Maria starts to create mixed working groups, a united group of sitting children, gender, numerical system, eight boxes with Lego Robolab are all elements that circulates her immediate network or, using Despret, all these actors are made available to her. Aiming to create gender mixed groups the children’s gender becomes relevant. She adds a gender label to each child in the act of counting them, and gender becomes a material label that sticks to the child and that is used in the second round of ordering when Maria organises the children into working groups.

I use the term add-on to indicate that in this particular event it is the gender of the children that matters and not other features of the child. So add-on does not only indicate an addition to the child’s actor-network, it also highlights what feature of the actor-network makes up the child with whom the teacher momentarily relates.

The creation of working-groups puts unarticulated group numbers to the actor-network of the working groups. The children didn’t have a group affiliation before, in the way that they had a bodily sign of gender. So the group affiliation and the unarticulated group numbers are additional signs that operate on another time scale to that of gender.

The working-group affiliation is added to the children in the situation, where gender can be said to circulate the individual child’s actor-network both before and after this situation. However, it is important to note that the process of gendering is done by exactly the same mechanisms as the one of numbering.

How do add-ons and identities as effects of circulations in networks then correspond? Firstly they give an idea of how coordination and distribution is made possible. Both child and teacher are made of their affiliations within a vast amount of actor networks, and when Maria is grouping the children large parts of the actor networks making the children are not addressed and it do not have to be. The children have been in these situations many times before. They know that a part of organizing school activities comes down to highlighting a feature (gender) already present or adding some kind of actor (number of group affiliation) to their identity (effects of circulations in network). That their presence is turned into their gender, or that they are aligned with group affiliations is part of what produces the ability to convey this way of organizing.45

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45 This objectification does not hurt the children. It does not pacify them. Objectification is a process that constantly is done. It partakes in making the world hang together. Cussins’ concept ‘Ontological Choreography’, developed in relation to the process fertility treatment women undergo, poses a good
Secondly, this is not just a matter of coordination and the ability to foreground certain aspects of the children’s networked identity. Gender and numbering are available for the teachers, and when connected to, then something is done with the relation between the teacher and children – a translation has occurred. The additions have effect. Even when redrawn, or when the additions are no longer being referred to the actors will have been translated, either slightly or significantly. In this case the children are (as often before) related to what we tend to call ‘boys’ and ‘girls’. The teacher recognizes them as being of one or the other sex and adds to the sedimentation of the gender of the child. Of course gender can (but not easily) change, thus as already mentioned above, gender operates on another time cycle, and stretches its network beyond this event. Making gender appear as a sedimented category takes up a lot of effort and strength. Gender categories are almost constantly reproduced and reinforced in verbal acts like this, together with nonhuman accounts where, for instance, the children recognize themselves as boys and girls in relation to visualizations on bathroom doors, locker decorations, and more proximal human actors like bodily components and adornments (Waltz, 2006).

The group affiliation is also transforming the involved actors. When the children are grouped boundaries among groups comes to matter according to what is made available to the children in the group. These processes become increasingly apparent when I analyse bodily reformulations of teacher requests and introduce a verbal objection to group processes later in this chapter. Both of these examples make visible that separating children into a certain group affiliation is making some things available to the children and other things not available to them.

The additions of gender and grouping have effects on the children and this leads me below into a discussion of my second point, in support of the argument that social relations are always also material, and that the material configuration often matters to a radically greater extent than we are initially giving them agency to do.

**Materiality as ‘matters of concern’**

When I mention gender in relation to the ability to count and group the children, I do not initially differentiate between number and gender as being more or less materially constituted, and with good reason. Our symbolic order in form of numbers would not have the same symbolic power if it wasn’t interlinked with physical materiality, and gender is, as I have briefly explained in the prior section, both material and socially constituted. The distinction between non-material and material gets blurred and unfolds a continuum of mixed entities constantly evolving and chang-
ing. Thus one thing that unites the two additions is that they are given agency. Re-calling the quotation given in chapter 4, where Latour states that actors are semi-otically defined, and that an actor can literally be anything that is seen to be (one of) the source(s) of action (Latour, 1996b, p. 373), then it is clear that agency isn’t just granted to the human species – things and symbolic orders can have agency as well.

Another important thing we learn from ANT about materiality is that materialities are not to be considered as matters of fact, they are matters of concern (Latour, 2004b). The material/immaterial discussion is centred on the terms human/non human by Latour and he teaches us, through the idea of generalized symmetry, to revisit things and give them back the agency that they have been denied. He writes; ‘Any time an interaction has a temporal and spatial extension, it is because one has shared it with non-humans’ (Latour, 1996c, p. 239). So everything can potentially have agency, and when something has both temporal and spatial dimensions, then both humans and non-humans are present. This is interesting when investigating authority as an effect of heterogenic assemblages, because for authority to matter – to have agency - then not only material, but also temporal and spatial dimensions have to be considered. This may seem to be obvious, but visiting modernity and the construction of facts, the need for the inclusion of temporal and spatial dimensions do not seem to be that self evident.

A modern world view tends to stabilize things, entities, body cells, materials by using either the word ‘fact’, or using a phrase such as ‘this is a fact’. Latour writes:

> The entity, bared of all characteristics except those of space and time, has acquired a physical status as the ultimate texture of nature; so that the course of nature is conceived as being merely the fortunes of matter in its adventure through space.

(Latour, 2004b, p. 245, quoting A. N. Whitehead (1920))

When we ‘fact’, we strip away spatial and temporal properties. Latour is therefore making the argument that ‘matters of fact’ ought to be considered as a matter of concern enabling spatial and temporal specifications to be included in the description of the thing having agency.

It is not the case that there would exist solid matters of fact and that the next step would be for us to decide whether they will be used to explain something. It is not the case either that the other solution is to attack, criticize, expose, historicize those matters of fact, to show that they are made up, interpreted, flexible. It is not the case that we should rather flee out of
them into mind or add them symbolic or cultural dimensions; the question is that matters of fact are a poor proxy of experience and of experimentation and, I would add, a confusing bundle of polemics, of epistemology, of modernist politics, that can in no way claim to represent what is requested by a realist attitude.

(Latour, 2004b, p. 245)

Latour urges us not to abandoned facts but to realize that every time we talk about a fact it is always a stabilization that has been denied its situatedness in space and time, and that in order to exist it requires, ‘a bewildering variety of matters of concern’ (Latour, 2004b, p. 247). The awareness of the process of ‘facting’ seems useful to bring forward here because it gives us a reason to revisit materialities taken for granted, such as numbering and gendering.

Through the description of how gender and numbering are added to the group of children and through the elaboration of subjectivity and materiality from an ANT approach, we can extract that the theoretical distinction between things, persons and signs is much less important than their performance, where humans, things and symbols are constantly occasions for each other in complex ways. And just as important; every entity whether human or nonhuman, material or immaterial is shaped with temporal and spatial dimensions.

A good example of this is the group-of-children before and after Maria’s reorganization. We still recognize the children on the floor as the group-of-children even after Maria has made the groupings. Yet two different groups exit. The same applies to gender. The gender affiliation is not just a fact, but it is a political act and is used as a factual category. In this present chapter I have examined numbers and genders as materialities without defining them as human or non-human, or material or non-material inventions. When we experience something as either material or non-human the experience is an effect of a material that has achieved a non-human character (Sørensen, 2009), resulting from relations formed by heterogenic assemblages of entities. I will now return to the performed teacher authority and add obstruction to the enactment of Pete as an authority, analysing the empirical example from an ANT approach.

An obstructing laptop and ordering cables

When two entities change their relation it affects the whole assemblage in which they are linked. I have already given an empirical example of this with the group

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46 A good example of our numeral system taken for granted is give by Helen Verran. She shows that universalities of number systems is also an enactment - enacted repeatedly over time - and that somewhere along the process the temporal and spatial dimensions are lost (Verren, 1999). See also chapter 4.
affiliations. Through the third field note excerpt given in this chapter I will describe how changes in relations alter both what possibly *can* relate, what *do* relate, and ways in which the new relations add and transform the way the children are organized. We are joining 5Y once more just as Maria has finished forming the children into groups:

3.

Pete takes over and he asks the first four groups which Maria has created to take a laptop. The first four groups Maria created rise from the floor, whilst Maria reminds Pete that there are only three laptops in the room. Pete looks in a box, pushes it aside, and grabs an infra red (IR) communication tower from one of the other boxes, and announces that the group that gets a box holding an IR tower with a *grey* cable should grab a laptop and stay in the Multiroom. The other four groups – with *black* cables on their towers - are directed to the computer room, where the four stationary computers there are available. The rest of the children get up and crowd together with the other children around the Lego boxes. Cable colours are examined and the children divide themselves between the two physical locations. *(Field notes the 30th of March, supplied with video recordings of the same period)*

In the field note excerpt above, Pete is aiming to divide the working-groups into two physical locations in order to supply all seven groups with computers. The computer room is already equipped with four stationary work stations and the Multiroom comes to be related with the laptops. Pete starts ordering by using the working-groups Maria has created. Maria did not number the groups but she systematically created them by working from one end of the group-of-children to the other. This makes it possible for Pete to ask the first four working groups to rise and move towards the laptops, which he does, and the situation instantaneously changes.

The children rise from the floor and although the children standing up together form four working-groups, the division of these groups is no longer visible. Maria interrupts and reminds Pete that only three laptops are present in the room. The laptops do not fit the number of working-groups who are standing. The standing working-groups and the number of laptops are not aligned and Pete recognizes his ordering problem. He knows that four cables are grey and four black which almost, but not completely, matches the number of stationary and mobile computers. It is important that Pete knows this - it does tell us that the relation between Pete and the Lego boxes precede this event.
Pete is aligning the number of grey cables with the number of laptops by taking the fourth grey cabled IR tower in his hand and pushing the box, now missing a tower, to the side. The alignment of grey cables with the number of laptops and the black cables with the number of stationary computers makes the cable-computer relation into an ordering tool that fulfills the purpose - grey cables stay in the Multiroom with the laptops, and black cables go to the computer room with the stationary computers. Pete is no longer relating to the seven numbered working-groups but to the two new units we can call colour-on-cables-groups. The children cluster around the boxes to see if they are a grey-cable-working-group connected to the Multiroom, or if they are related to the computer room because they are a labelled black-cable-working-group.

By taking hold of the coloured cables Pete helps to re-establish himself as an authority and in control of the situation. Authorised by the children, his knowledge of Lego Robolab, and the material setup, it is made available to Pete to distribute authority into the coloured cables. This distribution of power makes the cables become central actors in the ordering. They enact the distribution of the children into the two rooms, and they authorise the children to act according to their working-group constellation.

**Ordering actors - schematically overviewed**

At the beginning of this chapter I asked how the teachers authorise and organize all these materials and the children who are present in the room and I have in different ways, answered the question. Through my descriptions I have shown that the teachers are not organizing anything by themselves but that order is gained as an effect of sociomaterial efforts.

I have shown how authority is best considered as a networked achievement in which persons, things and symbols all take a part. I have through examples shown how materials co-constitute authority where we are hardly aware of it (numbers and gender), and offered examples where materials and humans were not aligned (the missing laptop). In order to sum this up I have presented the different types of breaks and shifts in the ordering sequences in the structured sequential table that follows:
In the first field in the upper left corner, I have written additions to actor-networks, add-ons and human-materials, which are all ways of emphasizing that a co-construction takes place. Additions to actor-networks remind us that any actor, as solid as it might seem, is always composed of a heterogeneous assemblage of elements. For instance in the example just described, authority is materialized in coloured cables given to the children. ‘Additions’ to an actor-network have the advantage of highlighting what part of the actor-network of an entity is highlighted. Yet addition might still tend to privilege our understanding of humans as always a superior materiality. By clinging on to an understanding of humans and materials as separated, we do not capture the mutual creation process. Perhaps the term human-material or material-human are the most precise way to capture what is happening. Isn’t the floor enabling the group-of-children into being, gender producing numbered working groups, and coloured cables bringing life to the distribution of boxes, laptops and working-groups? The hyphen between human and material exactly shows the mutuality of the human and the material in the process. This process is explored in detail in the following chapter.\footnote{Which is precisely the same argument Latour unfolds by vitalising the simple stroke in form of an hyphen between actor and network in Actor-Network Theory (Latour, 1999a, 2005a).}

<table>
<thead>
<tr>
<th>Additions to actor-networks, add-on's, or human-materials</th>
<th>Gender-Child</th>
<th>Group number-children</th>
<th>Cable colour-groups of children</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Materiality</strong></td>
<td>Gender</td>
<td>Group number</td>
<td>Cable colour</td>
</tr>
<tr>
<td><strong>Humans rules of ordering in relation to symbols, materials and children</strong></td>
<td>Maria counts the number of girls and boys, and uses this information to construct the work-groups while she walks along the group-of-children</td>
<td>Pete is using the (unsaid) numbering of the groups Maria made</td>
<td>Pete uses the colour of the IR tower cables to order the groups</td>
</tr>
<tr>
<td><strong>Translation process</strong></td>
<td>1) From group-of-children over gender-child and back to group-of-children again. 2) From group-of-children to gender-child to work-group, and back to group-of-children again</td>
<td>From group-of-children to work groups (Group-of-children still being the one ‘ruling’)</td>
<td>From work-groups to colour-on-cable-groups</td>
</tr>
<tr>
<td><strong>Effect of translation</strong></td>
<td>Adding to sediment gender categories</td>
<td>Adding group affiliation</td>
<td>Adding computer type</td>
</tr>
</tbody>
</table>

*Table 1: Different human-materials used in the ordering processes of the classroom*
The first row in the table above elaborates the human-material constituents. The second row describes the material or symbolic order that is the material part of the human-material relation. The third row in the model displays the humans’ rules of ordering and the fourth describes the translation processes, and finally row five shows the effects of the translation.

One of the disadvantages of visualizing and modelling in this way is that the table expresses a sequential chronology that actually is not present. For example, the children who are the first to be put into working groups are both part of the big group of children and part of a working-group, which makes other possibilities available to them. In the same way being the last children to be grouped also matters. This temporality made invisible in the schematically overview is explored in the next section.

**Possibilities and boundaries** - **bodily exploration and verbal objections**

So far I have presented how the teacher’s authority and orderings cannot be done without alignment of human’s materials and symbols. The children’s cooperation and acceptance is needed and this is visible by the way they actively accept the teacher’s proposals of where to sit and the way they silently accept and allow the groupings to take place.

The children’s relatively passive behaviour, and the focus of the chapter dedicated to elaborate the significance of material agency, can produce the interpretation that the children are just sitting passively during the 20 minutes introduction.

I will try to vary this interpretation of children being objectified by devoting the remainder of the chapter to the exploration of one example where possibilities and boundaries of the authority position are challenged by one child through a bodily exploration and I will briefly describe another challenge through a verbal objection. Both can be seen as children accepting teacher’s orderings but in different ways. The example with the boy Samuel will be described and discussed in detail here, and the example of Ida and her verbal obstruction will be briefly described at the end of this chapter and more fully discussed in the following chapter.

**Bodily exploration - what the floor and groupings make available**

I will return to the situation captured in the field note excerpt where Maria is walking along the group of children in order to explore some of the complexities that occur.
4.

Samuel is one of the first children to move into the working-groups which Maria has created, and when she passes him, he is moving away from the others toward the boxes that Pete is rearranging. Samuel is using a moving technique where he is on his knees and using his arms to drag himself forward. Arriving at the boxes he looks into one of the boxes for a minute and returns to his place on the floor, using his sliding technique, combined with a 180 degree rotation of his body sidewise. Back in his place he falls down on his back, and lets his legs flex in and out like a jumping jack on the floor.

![Picture 5: Samuel turning around on his way back to his seat](image)

Maria finishes the grouping, when a girl objects to the group she is put in. Pete is joining Maria, and Samuel is rising from the floor, getting to his feet and walking to the computer placed on the high table along the wall. Maria and Pete are turning around. Maria notes that Samuel is standing, but she doesn’t say anything. (Video recordings 30rd of March 2006, tape 1, time: 20:38 – 20:45)

After Maria has walked away from Samuel he is then related to two different orderings; the group-of-children and the new working-group he is now part of, and he waits. The other working groups are not yet formed, and Samuel is not yet authorised to act in his working group. The wait is making new ways of exploring the surroundings available to him, or to be exact, the wait, aligned with a given work-group affiliation, and with Maria’s body and eyes directed away from Samuel, makes new ways of exploration available.

What happens then? Samuel is pushing himself forward on his knees, as a sort of compromise. Through adopting this moving technique he points to an acceptance of the teacher’s authority. Prior to this experience Samuel has accepted the teacher’s alignment of floor and the children’s bodies. In the waiting time, the ability to explore the Lego bricks arises, and Samuel is therefore creatively inventing a way to maintain the bodily alignment of his lower body and the floor and at the same time makes himself able to move forward without getting up on his feet.
The example reminds us that children are more or less constantly offered other availabilities, chatting to their adjacent mates, turning around on their bottoms etc., so the example also illustrates that the alignment of children’s bodies and floor is not a matter of coercion, but an approval of the teachers’ proposals. Seated children can be seen as that, as well as Samuel’s more innovative way of translating the request of lower bodily alignment with the floor.

The other teacher Pete is not directed away from Samuel - in fact he is facing him and sees what Samuel is doing, whilst he is rearranging the boxes with Lego bricks (prior to the visualization above). He does, however, also see that Samuel is moving rather quickly back and forth. The little number with a bodily rotation is happening on his way back to his place, whereupon Samuel is aligning his whole body with the floor by falling on his back.

Significant to note is the temporality of Samuel’s adventure. The bodily turn is done on the return to his ‘seat’ and more controlled body movements are initiating the little detour to the Lego boxes. Samuel is here again acknowledging the boundaries of the relations he is making to his surroundings. And Pete’s silent acceptance of Samuel’s creative way of moving towards the boxes makes an even more inventive translation of the teacher’s request of bottoms and floor alignment available to him on his way back to his place.

Time is also a prominent actor when Samuel stops making rotations on the floor and gets to his feet. He is not making transformative inventions of the theme lower bodies and floor anymore. He is directly breaking the teacher’s request. But the fact that Maria has finished grouping the rest of the class, that the seated instruction is almost over, aligned with Samuel’s small watchful steps, is making a silent acceptance available to the teachers. Samuel is breaking orders here, but the teacher’s authority is not jeopardized. Time becomes a prominent actor in producing the availability to the teachers to recognize what Samuel is doing, but to let it be. All the children are to rise from the floor shortly. To direct Samuel to the floor would change the relation of authority between Pete and Samuel into one of domestication. Actually by accepting Samuel’s movements in this place in time both Pete and Samuel get to look competent. They can both relate to each other in ways where the teacher’s authority is not exposed or directly challenged. The teacher manages to be an authority with no use of domestication, and Samuel finds ways to be creative without pushing the teacher to control him. The situation would have been different for instance if Samuel was making his detour when Pete was present-

48 The concept of domestication is taken up and discussed in the following chapter.
ing the material at the very start of the lesson. At that time it would have been highly unlikely that Samuel’s actions would have been left without being commented upon.

Samuel’s act does also offer details to prior descriptions. I wrote in the beginning of this chapter that chairs and floor stabilises legs in radically different ways then the chair does, which is self evident here. Samuels doing would not have been possible in a room filled with chairs. When I discussed the grouping of the children I stated that the order in which the working groups are formed makes certain things available to the children and others not. Again Samuel offers an example of that, since his doing would not have been possible if he was one of the last groups formed.

It can be said that the teacher is letting Samuel slide on his knees and rise on his forearms, because they know that within a few minutes all the groups will be rising. But as I illustrate through the whole section, an articulated analysis includes other actors such as the floor, time and teacher expectations because they are all making Samuel’s actions possible.

**Verbal objection – borders of authority tested**

While new possibilities for relating to the Lego boxes and testing boundaries for the bottom-meets-floor logic are becoming available to Samuel in the back of the room, Ida is verbally objecting to her group affiliation.

*Picture 6: The teachers telling Ida to connect to her group affiliation*
Nearing the end of the group formations, one of the girl’s named Ida objects to the group she is put in, by telling Maria that she doesn’t work well with the boy she is connected to. Pete is standing closer to Maria, and they are almost synchronically asking her to give it a try. *(Video recordings the 30rd of March 2006, tape 1, time: 20:38)*

Ida is making verbal objections and through this is testing the boundaries of the teacher’s authority. The situation her obstruction creates does not give her many different availabilities to relate to, which indicates that this might be the exercise of a domestication, rather than an authoritative one. Changing working groups is not possible – resistance here does not matter.

The example is important because it can help to identify the borders between assemblages of entities relating that is making other acts available or docility present. The term docility is elaborated in chapter 6, where this example is described in detail.

**Conclusion - Authority as an effect of the alignment of hybrid entities**

I ask at the beginning of this thesis (chapter 1) how Lego Robolab affects the processes of authorisation in the classroom. Through the empirical examples explored in the current chapter I have aimed to convey an acceptance that all human acts are always materially, temporally and spatially entangled.

I have shown how authority is brought into being by alignment of cooperating hybrid entities (floor, walls, Pete, children, Lego Robolab, gender, cables etc.), and how the way in which order is made available, and can be achieved, changes according to the way present entities are relating. The description of the translation of the group-of-children over gender-child to working-group and colour-on-cable-group is an example of that. Despret’s notion making available has been introduced as a useful term to capture these mutual constructions of humans and materials that enact authority, and I have discussed the terms subjectivity and materiality through an ANT approach in order to argue for the concept of human-materials or material-humans. The descriptions given in this chapter enable me to conclude that Lego Robolab affects Pete and the children, as well as that Pete and the children affect Lego Robolab. This teaches me that the following line can be added to the overall question presented in chapter 1 to accord with the knowledge gained in this chapter.
How does Lego Robolab - the bricks, sensors, computers, and manuals - affect the processes of authorisation in the classroom, and how does the process of authorisation affect Lego Robolab with its bricks, sensors, computers, and manuals?

I am therefore aware in the following analysis that the affectiveness always already matters and travels both ways.

At the end of the chapter I have described different ways in which two children bodily test the boundaries of the material relations they are entangled with – the bottom-meets-floor relation and the working-group-child relation.

In both the examples of Samuel and Ida, the bodily adjustment seems to be an important actor: Samuel’s movements exploring the boundaries of authorisations, and Pete and Maria’s bodily alignment when dealing with Ida’s complaint. The bodily entanglement in the authorising is taken as insightful dimensions to explore in the following chapters.

As an accumulation of insights gained so far I can conclude that authority is a socio-material enactment done by a heterogenic assemblage of hybrid entities; children silently looking, Pete working the material, the floor’s contact with the children’s bodies, walls making this a special place, all entities relating in a specific way which makes Pete as an authority available. This empirical description of authority differs from the descriptions given in chapter 3. Mullooly and Varenne share the idea that authority is constructed, but the construction is limited to human agency (Mullooly & Varenne, 2006). In current descriptions actors mattering is the expanded to encompass non-humans as well.

The insights of this chapter are developed in relation to a centralised teaching situation. Questions about what happens to the assemblages which make up the teacher as an authority emerge when the working groups are distributed to the different working stations in the Multiroom and computer room. What happens when the children, boxes and computers are decentralised and the children build robotic cars themselves? This is the subject of chapter 6 where we will follow the instruction manual and see that authority is distributed to the procedure it holds.
6. FOLLOWING THE MANUAL - KNOWLEDGE, EMOTIONS AND CIRCULATIONS

In chapter 5 I have shown through several examples how things affect humans, as well as the other way around. In fact I took this mutual affectedness one step further and elaborated how things and humans mutually construct each other in different ways. In this chapter we move from a centred teaching situation to one where the teacher distributes authority through the handbook manuals that are circulated among the working groups, and I examine how these changes affect the authority. As we shall see this creates a radically different environment for the teacher to be an authority in.

I will present a minimal definition of authority, and elaborate, as hinted in chapter 5, that not only bricks, floor, silent children make up Pete as an authority. The assemblage also included Pete’s knowledge (gained prior to the example described) and the emotions of trust and interest. The distribution of the manual makes other actors especially visible and suggests that Pete’s knowledge and the emotions of trust and interest might also participate in the construction of authority. This chapter will explore knowledge, the emotions of trust and interest and, by means of Despret’s concept of availability, advocate that these emotions and Pete’s knowledge are entangled in the circulations of authorisations that occur: When the teacher’s expectations are fulfilled, then the teacher authorises the children to become experimenters and good constructers of robots and the children authorise Robolab to be a well designed system that enables them to build robots.

By supplying the Lego brick, sensors and computer software, the Lego Robolab authorises the children by making robot-building available, as well as the children being authorised by the teacher’s expectations of them to build the robots. Thus enabling a ‘full’ circulation of authorisation to be generated, trust and interest are included. Circulations of authorisations and knowledge, trust and interest all provide insights which give us more knowledge on the authorisation processes, and are the subject of this chapter. In turn, they contribute further dimensions to consider in the following chapters.

At the end of the chapter Ida’s verbal objection is discussed in relation to the concept of domestication, and highlights some differences between authority and domestication which help me to make a distinction between authority and authorisations.
The manual and the children relating

The empirical example I am about to present can be seen as a continuation of the examples described in chapter 5. We are in the same class. 5Y have just been introduced to the Lego Robolab system and divided into working groups, and in the combined video sequence and field note excerpt below we will follow one of the groups. The descriptions investigate an example where the teacher expectations are fulfilled and the manual is related to by the children.

One of the black-coloured-cable-groups finds a stationary computer in the computer room. When not labelled black-coloured-cable-group by me (retrospectively), or treated as such by Pete (as explained in the previous chapter) then we can call the members of the group Julie, August and Tim.

Julie, August and Tim examine the contents of the green box with Lego bricks, while Pete takes a tour of the two rooms to give every group a manual which he wants them to follow. The manual contains a fixed procedure with certain prepared assignments (see excerpt of the manual appendix A). Tim receives the manual and lets it slide out of his hands to the floor.

Pete takes a second round in the two rooms and addresses Julie, August and Tim directly this time. He asks them to look at the assignment on page 6 and to move the Lego equipment to the opposite table where there is more space for building with the material. Pete tells them that they can find building instructions on page 25, while he flaps an extra manual in his hand down into the table top.

Julie, August and Tim take the manual and the box of bricks to the other table. Julia places the manual in front of her in an upright position against the wall. They look at page 25 and start to search for the bricks they need by rummaging in the green box.

Julie picks up a piece of Lego and matches a possible ‘right’ with the building instructions page 25 in the manual. She places it on the table, looks at the manual again and starts to search for the next right match. This circle continues - fingers pointing at the manual, hands finding bricks, while the developing creations change hands between the members of the work-group. Julie, August and Tim are finished building their Robot car half an hour later. (Video recording, the 30rd of March 2006, tape 1, 26.30-36.00)
In the last chapter I used Despret’s notion of making available to soften the modernistic inclination to harden the lines between cause and effect. The same can be done here. I write above that Julie takes some Lego bricks and starts to match them with the manual. The notion of making available makes me hesitate to decide whether Julie works with the manual, or the manual works with Julie, and by this new propositions of the child-brick relation are brought to life.

I will start in the top of the field note excerpt. The children are spread out in the two rooms – most of them cluster in identifiable working-groups along the tables or by the computers or laptops in the two rooms. The group-of-children does not exist anymore so that constellation is not available for Pete to authorise action. He brought eight copies of the Lego Robolab manual into the lesson, and by that he has physically secured access to them before the lessons started. The children, computers and Lego Robolab sets are distributed among the two rooms. To also distribute the instructions in the manual would make it possible for Pete to expect a certain alignment of the activities in the classroom, because the manual as explained holds a fixed procedure that the children are expected to follow. The number of manuals is important to note here because the relation to eight manuals makes a distribution of instructions to each of the seven working-groups available to Pete, thereby creating conditions for a possible connection between the manual and each group. However a possible connection does not guarantee that bonds are automatically made. Recalling that the manual moved from Pete’s hand to the hands of the children and down onto the floor reminds us of that.
**Knowledge**

What makes the children relate to the manual? Pete takes another round in the Multiroom. The *knowledge* Pete possesses and the *authority* he is related to makes certain actions available to him that helps him to make the manual and children relate.

I will look at knowledge first. Pete concretizes his expectations by giving the children exact page numbers to look at. Pete can do this because he has a prior experience of the manual. The manual is not just 29 pages of papers for him, but a manual containing eight well-known assignments which he can distribute. Furthermore, the manual has page numbers which makes it possible for him to ask the children to look at the assignment on page 6, together with the building instructions on page 25 and to start working from there. Pete is thereby aligning his knowledge and intentions with a specific assignment written down in the manual, at a certain page. I will return to this arrangement which is made available for Pete and explain the relation between knowledge and trust, after some theoretical definitions of authority have been briefly introduced.

**Authority and expectations**

Gregory Bateson suggests that: ‘*a person is said to have authority when anyone who is under the influence of that authority does everything possible to make whatever this person said to be true*’ (Despret, 2004a, p. 118). Bateson’s authority figure can be read in relation to what he calls the ‘double-bind’ (Bateson, 1972, p. 206-207), where authority is created in relation between two or more persons, often an adult (teacher, parent) and the child (here called the victim), who is engaged in repeated experiences, with a primary negative injunction - do (not) do so and so, or I will punish you. The double bind as a recurring theme ‘does not evoke a single traumatic experience, but such repeated experience that the double bind structure comes to be an habitual experience’ (Bateson, 1972, p. 206). Despret’s reference to Bateson is used in relation to an example, which will be given later in this section, of Professor Rosenthal’s relation to his students more then 40 years ago. If we read relations between Rosenthal and his students through the double bind then

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49 I would like to give a direct quotation from Bateson here. Despret has left no explicit notes in her text, yet through an email correspondent with her, the 18th of March 2009 I am given two trails to pursue; (Bateson, 1972; Watzlawick, Beavin, & Jackson, 1967). These resources have been examined yet still without finding any exact reference. Despret uses Bateson to create the connection between authority and expectation. In the light of the insecurity of the quotation’s origin this connection is therefore considered a suggestion rather then an absolute statement, which makes it so much more interesting to follow Bateson and Despret’s lead empirically in this and the following chapters.
repetition (combined with sanctions) stabilises the teacher in a one-up position as an authority figure who has knowledge and sets the expectations to be fulfilled by the students.

Revisiting the field note excerpt with Bateson’s notion of authority in mind Pete as an authority might be questioned. Are the children doing everything possible to make what Pete said to be true? Although Pete does have influence, this would hardly be the words I would find adequate to describe the situation. When Pete concretises the relation he wants the children to make with the manual into a page number, it is then that they relate to it. Reading Bateson in a more modest way, he tells us that authority creates expectations. Despret turns Bateson’s definition around, and adds relational and movable aspects to it. She can do that because borders are fluid for her. She writes: ‘If we define expectations in terms of “who authorises”, we can see that everything is shifting, articulating many more things, giving chance to many more entities to belong to the real world.’ (Despret, 2004a, p. 120). Referring to the ‘real world’ partakes of a larger discussion, as I have presented in chapter 4 of this thesis, concerning whether science is about revealing pre-existing reality or creating possibilities for new ones to become. Apart from this (at least) one other point can be teased out of the quote. Bateson and Despret help us to understand the importance of observing who sets the expectations, because authorisation is interlinked with expectations.

Pete sets the expectations here, and he can do that because he is bringing eight boxes of Lego Robolab, and because he knows the manual and its content in such a way that he can direct attention towards the manual by referring to specific page numbers. It is exactly this relational assemblage where the available manual and knowledge of assignments is aligned with the working-groups, computers and sets of Lego Robolab that creates Pete’s authority. And by that he is also authorised to set the expectations. Put slightly differently, the material setup and the knowledge available to Pete makes him capable of setting expectations that simultaneously authorises him. Authority and expectations becomes a relational effect of this aligned assemblage. The circular entanglement is emerging and Despret helps us to understand this by relating expectations and authority.

Bateson’s definition of authority as subject-bound is added a relational dimension by Despret since authority is seen by her as an effect of the sociomaterial assemblage. She does not neglect that we are still initially inclined to give teachers authority. As she says in her own educational example below; ‘Rosenthal is a famous professor, he is an authority. The relationship between him and his students has to be constructed as a relation characterized by authority’ (Despret, 2004a, p. 119). I will, however, argue that Pete and Rosenthal’s authority can be seen as experienced
effects and can be explained relationally because according to Despret the relation between expectations and authority stabilizes authority. And these circulating movements – or circulations of authorisations - as I shall call them - can help me to explain that authority is not only set by the particular assemblage made possible for Pete to construct. But authority authorises. Despret notes this when analysing an experiment by a psychology professor, Rosenthal, which he conducted over 40 years ago with his students. She says:

Rosenthal (1966) asks students enrolled in a laboratory course in experimental psychology to repeat the work on Maze-bright and Maze-dull rats, work done years ago by a famous experimental psychologist from Berkeley, Tyron. Many studies, Rosenthal explained to the students, have shown that continuous inbreeding of rats that do well in the maze had led to successive generations of rats that do considerably better than ‘normal’ rats; and that continuous inbreeding of rats that do badly in the maze has led to successive generations of rats that do considerably worse that ‘normal’ rats. Each student is assigned in a group of rats to work with, some of them working with ‘bright’ rats, while the others work with ‘dull’ rats. Rosenthal tells the student that those who will be working with bright rats should expect to find evidence of good performances, while those who will be working with the dull once should expect to find little evidence of learning in their rats. […] The students tested the rats, and confirmed the effect of selection: the bright ones produced good performances in learning while the dull ones performed rather poorly.

(Despret, 2004a, p. 117)

What the students were not told however is that the 65 rats in the experiment were naïve rats. There had been no inbreeding; there were no differences among them. Even though the students were told they were different, the rats were, in fact, randomly labelled ‘dull’ and ‘bright’ rats. But still the rats did exactly what was expected of them, and so did the students. Despret uses Bateson to explain that the students did everything they could to make what their professor said to be true, ‘because it mattered for them that it was’ (Despret, 2004a, p. 118). Rosenthal’s own observations on these results suggest that the students taking care of the ‘Berkeley rats’, as they were called, did handle the rats with slightly greater care, and also the students working with the Berkeley rats themselves reported greater

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50 The notion of circulations of authorisations is in part inspired by Latour’s famous example of the circulating reference – following soil samples in the Amazon circulates into scientific claims in papers (Latour, 1999b, p. 24-79), in part, it is fertilised though discussions of the term authority with my colleague Katia Dupret Søndergaard, during the spring 2008, and in part by discussions of a paper presented at Lancaster Summer School June 2008.
enthusiasm in the study. But these privileging circumstances – better care, engaged care takers – do not solely explain why more then 30 rats steadily turned into better performers than those labelled ‘dull’ rats. Despret notes that what is most important for this process is the emotion of trust. The students trusted Rosenthal and his ability to give them solvable and meaningful assignments and this seems to have the greatest impact upon the outcome. This makes Despret conclude that Rosenthal sets the expectations and authorises both the students and the rats.

The expectations of a good experimenter have authorised the rat to become competent; the authority of Rosenthal allows the student to be entitled to produce competent rats.

(Despret, 2004a, p. 120)

Returning to a fifth grade teacher with younger students and an experiment with computers, Lego bricks and manual instructions, the same sense of authoritative circulations can be identified. By aligning children, manual and expectations, Pete is not only pointing activities in a certain direction, he is also authorising the children to become good constructers and problem solvers. He can produce these expectations because he knows what the assignments in the manual will lead them through, and presumes that the children are capable of satisfying his expectations. Expectations go the other way as well. The children trust Pete to give them assignments that they are capable of solving. Thinking of the relation between the teacher and the children as a relation of trust reveals the interwoven nature of authority, trust and knowledge. I continue to explore this below.

**Trusting the teacher Pete who knows**

Despret does not offer a generalized description of what makes up an authority, but she suggests that expectations and authority are interlinked (Despret, 2004a, p. 120). In the current example, Pete is the one asking the children to look in the manual which tells them how to build and programme a Lego robot car, and is through that expecting the children to become good constructers of their own robot cars. However Pete can only set these expectations because, apart from the human and nonhuman, he is also aligned with knowledge about the manual and the emotion of trust.

Trust is here not treated as a humanistic achievement, but as relational effects made possible in the way the different actors relate. Emotions are therefore treated as sociomaterial constructions – as effects of sociomaterial actor-networks. The question is how do we identify them? With Despret’s concept of making available, emotions become identifiable if they are doing something – when agency is given to them.
I will argue that the emotion of trust is an especially important effect of two relations: The relation between Pete and the material, and the relation between Pete and the children. To illustrate this I will shortly return to the situation where the children are introduced to the Lego Robolab system, discussed in the previous chapter, to elaborate the relation between Pete and the material where trust can be considered as an effect. The well coordinated dance between the materials and Pete is a performance that is made possible because the relationship between Pete and the boxes with Lego Robolab equipment precedes this event. A relation of trust is build up through the interaction between the different Robolab features and Pete. The time spent with the material produces certain confidence with the material, through which Pete expects some kind of predictable performance from the different parts of the system. He knows the material, and this knowledge matters. Yet Pete does not, per se, trust Lego Robolab - trust is not automatically present, and the trust that arises is not only brought about by the teacher trusting the material, but it is brought into being through the situation. Pete presents the connection between the IR tower, computer and robot build of bricks. He explains how to access the material and how the robot is to be programmed. This knowledge makes him capable of setting the expectations of the lesson, and as an effect he also sets the expectation of the relation between the children and the material as well; ‘you are going to build and programme a robot car like me in a minute’ – and a connection between expectations and knowledge is identified.

This situation reproduces the relation between Lego Robolab and Pete as a relation of trust. Another situation could have been imagined where an engine broke down, or where the software system did not work according to prior experiences. In such cases the relation between the system and Pete would change. Pete would not instantly distrust Lego Robolab, yet his repertoire of knowledge about possible situations that are available to construct in the assemblage of the Lego engine, introductory session and fifth graders is expanded, and the trust of the system to work every time would change.

The second relation where trust is entangled is in the production of the relation between the teacher and the children. If the children trusted Pete yesterday as Pete-a-teacher-who-knows-what-he-is-doing, then this effect will take part in the children’s actor-network and be important when they are watching Pete’s performance with the material. Pete will be met with the attitude, Pete-a-teacher-who-knows-what-he-is-doing, and the trust crafted into the relation between the children and Pete will continue to be there, as long as the assemblages of materials serve the purpose. If on the other hand the coordinations between Pete and the materials repeatedly fail to perform the clear expectations set by Pete-a-teacher-who-knows-
what-he-is-doing, then trust will be joined by other emotions of mistrust and insecurity of the purpose of the lesson, and maybe – if Pete continuously is not able to enact clear expectations – these other emotions would take over.

**Circulation of authorisations**

I have just put emphasis on trust as an important emotion enabling the production of expectations. With this knowledge I will return to the example of distributed teaching given in the start of this chapter, and follow Despret’s lead again and suggest that authorisations might continue beyond humans and animals to materials.

The children are authorised to become good constructors, in that I find it fair to imagine that the children authorise the manual to hold a proper set of instructions, which would be revealed by the way the children test the bricks and building material against the manual’s instructions. And furthermore it can be suggested that this interpretation of expectations makes the manual authorise the Lego brick to be a collection of good bricks would itself, like a boomerang effect, authorise and confirm the manual’s instructions. Bricks selected according to the manual, make the creation form in the hands of the children. A circulation of authorisation is identified that connects humans and non-humans.

This circulation of authorisation explains the movable and relational aspects added to Bateson’s definition of authority, and apart from humans, non-humans, knowledge and trust, another more emotional ingredient is present and is needed to make the circulations of authorisations exist. I want to follow the suggested circulations once again keeping both authorisations and trust in view, but this time, highlighting trust in order to reveal that interest is also another part of the circulation of authorisations.

**Interest**

The teacher trusts the children to build their robots. Julie, August and Tim might not be interested in the manual from the start, but they trust their teacher to give them manageable and meaningful assignments. A trust that is confirmed when the relational assemblage of working-groups, bricks and the manual makes interest available. If the manual was continuously left on the floor it could not help generate authority, trust nor interest. Positioned on the floor between the children’s legs, the manual could not relate to the bricks nor help to measure them, and authorise them to be good bricks. But when picked up from the floor these relations become possible. Placed on the table opened at page 25, however still does not guarantee a

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51 It is important to note that interest is not belonging to the children (as an essentialist might put it): Interest is made an available emotion produced in this particular arrangement of things and humans.
strong circulations of authorisation. Trust and interest and the relations between these emotions become the relational ingredients that make the circulations continue. The children are becoming interested in the manual on page 25, and they trust the manual to be(come) the key to solve their assigned problem. The manual points towards the Lego bricks and authorises them to supply the parts needed for the children. The manual is authorising the children to get the robot building going, and the children trust the ‘right’ bricks to be in the boxes, as well as trust the manual to hold a solution. Eventually holding a finished robot car in their hand, Julie, August and Tim authorise their teacher as competent, because they meet his expectations, and the authorisations have gone full circle.\textsuperscript{52}

The circulations of authorisations shows how trust and interest are interwoven and are part the heterogeneous assemblage that makes authority circulate. As a matter of fact, testing the strength these emotions might show that trust and interest are what is making the circulations of authorisation possible. Suppose I put Bateson’s notion of authority temporarily in brackets, and start with a symmetrical assumption that none of the actors have any agency prior to analysis (Latour, 1999a). Pete does not have authority but is, through the experimental setup he proposes, making it possible for the children to be clever students, and at the same time makes it possible for Pete to be a good teacher. Pete’s authority is, in other words, made possible by the arrangement of the experimental setup, children and manual. The manual makes it possible for the children to be well-behaved pupils that do what the teacher tells them to do, and the manual itself also adds up to the teacher’s expectation. However bringing the possible into existence would not happen if the relation between the teacher and the children were not coloured by trust, nor would the children start to build if there was no interest arising when the children, manual and bricks start to relate.

An interesting effect of this arrangement of Lego Robolab, Julie, August, Tim, Pete and the emotions of trust and interest is that all actors are mutually creating one another as competent – a competent teacher, who can control the class and give them challenging meaningful assignments, competent children who can live up to

\textsuperscript{52} Becomes interested’ and ‘trust arises from...’ indicates a temporal dimension in the circulations of authorisations that is inexpedient. Trust and interest is never post or prior relations. They are part of them. Circulations are therefore not to be understood as a circular circulation but rather that links are folded in and out, over and under each other. The expression ‘full circle’ should also not produce the idea that the relations are entangled in a temporal order. The teacher for instance looks competent during the whole process as long the children relate to the manual, and not just in the end, when a finished robot car demonstrates that expectations have been met.
the teacher’s expectations by relating to the competent educational system Lego Robolab, and a competent Lego Robolab system that can meet the expectations of the teacher and enable the children to make their constructions.53

**Children’s knowledge making other expectations available**

Circulations of authorisation are not necessarily only started by the teacher expectations but might be initiated in any place where expectations are set. In this case we cannot know whether it is the children’s relations to bricks and computer technologies from which expectations arise, or that trust and interest might only flow from the relational assemblage between teacher and children.

The children are presumed to have relations to computers and bricks, prior to this event. They know what computers and Lego bricks can be used for, and being with these actors in school makes expectations rise. Samuel, described in the previous chapter, is a good example of a child who accepts Pete as an authority figure, and at the same time it is clear by his actions that it is the relations between the Lego boxes, computer gear and Samuel whereby trust and interest becomes an effect. Or to be exact, the interplay between the boy’s expectations of the Lego bricks and computers, together with the waiting time, that brings interest as an effect.

Other relational assemblages bringing other expectations into play may not be very clear in Despret’s example with Rosenthal and his rats, since it is less likely that the students have personal relations to the rats prior to their participation in Rosenthal’s project. Also the two situations; Rosenthal, students, rats and Pete, children, Lego Robolab are composed within very different time, space and agency constellations as well.

**Different actor-networks making up the emotions of trust and interest**

In the previous section I have described how the emotions of trust and interest are important in getting circulations of authorisations going. To be teased out of these descriptions is another important difference between the two emotions since they are generated as relational effects arising from different parts of the actor network: Interest in the example with Julie, August and Tim is becoming available in the intersection between the manual, Lego bricks and August, Julie and Tim, while trust is a relational effect of the entanglement between the teacher Pete, August, Julie and Tim and the manual. Yet generating these different emotions is also connected to time and the stability of the actors within the assemblages that created (and are created by) these emotions.

I will look at the relations between the teacher Pete, August, Julie and Tim and the manual. All the actors here are relatively stable. Being a stable identity is quite an achievement, Latour tells us (Latour, 1996b, 2005a), and a vast amount of human and non-human actors take part in the process. In the making of Pete as a teacher to be trusted, for instance, the school building and its time schedule, the teaching room, his education, age, clothes, his relations to other teacher are all materialities and human relations that constrain and stabilize Pete as a teacher who is to be trusted. However, if the relation between the actors; Pete, a manageable assignment, and material that are present repeatedly fail to align, then ‘trusting Pete’, would not consciously be generated as a relational effect. Trust relates to relational assemblages that precede this particular place in time. One of the distinctive features of trust is the stability of actors in the actor-network which is bringing trust as an effect. Interest can, on the other hand, arise instantly. In the example of Julie, August and Tim interest arises several times; the relation between bricks and the children brings interest, the relations between the children and the computer brings interest, as well as the relation between the bricks, children and manual. All of these together bring interest.

Bateson teaches us that persons under the influence of an authority will do anything possible to make the expectations of the authority to be true. In other words trust and interest are important emotions even in more moderate authoritative relations. The descriptions in the previous sections (re)produced this knowledge empirically. In recapitulation it can be said that we now know that to make authorisations circulate expectations needs to be set and trust and interest are needed. Trust and interest can, however, arise from many different relations in the assemblage, entangled with different actors, which will be explored in length in the following chapter. Furthermore it has been identified that to bring trust as an effect the actors partaking in the actor-network that produces trust must be relatively stable. Interest, on the other hand, can be seen as an instant emotion. Julie, August and Tim are not initially interested in the manual, but together with the relation between bricks, building instructions, the children and the assignment, interest is generated as an effect.

<table>
<thead>
<tr>
<th>Actors in actor-networks / Assemblages</th>
<th>Trust</th>
<th>Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pete, the children, the manual</td>
<td>The children, the manual, the Lego bricks</td>
<td></td>
</tr>
<tr>
<td>Stability in relations over time</td>
<td>Yes</td>
<td>Not necessarily</td>
</tr>
</tbody>
</table>

*Table 2: Captures the different assemblages making trust and interest possible*
Docility

The descriptions in chapter 5 and in the current chapter’s investigations have taught us that relations made of trust and authority are not brought to life by the teacher alone, but are a relational achievement which includes a vast amount of heterogenic actors. With this knowledge present we need to look at Bateson’s definition of authority again, and it appears that Bateson’s definition of authority is not needed here, since it is trust and interest that keeps the authoritative circulations in movement. Yet what happens if the trust and interest that cement the circulations of authorisations are absent? Put differently, if trust and interest is what ‘glues’ together the relational assemblage of authority, what happens then if these emotions are not present? Is Bateson’s asymmetrical definition of authority then needed, and is Despret correct in initially laying out the relations between students, rats and the professor as asymmetry relations?

To examine Bateson’s definition further the contrast between authoritative and repressive relations needs to be examined. How can I, for instance, see that this experimental setup with Lego Robolab and assignments in a manual does not express a docile system, where the children are passively following the teacher? Despret gives an example where authorisations based on trust do not exist, and she differentiates between ‘being available’ and ‘being docile’. The line between the two forms is to be found in the possibility of being able to resist what the different settings are offering to the one that it addresses (Despret, 2004, p. 123). Despret exemplifies this with a rhesus baby monkey that is separated from its mother by being isolated in a closed apparatus. The baby monkey can do nothing other than to fulfil the researcher Harlow’s expectations and die alone. The system is, as Despret notes, ‘designed to create despair’ (Despret, 2004a, p. 123). Turning to the classroom again, Lego Robolab is also designed with certain intentions, and, similar to the rhesus monkey, Lego bricks cannot resist, whereas the rats in Rosenthal’s experiment are able to do so. So does this turn Lego Robolab into a docile system? The answer here must be no, not if we view the bricks as part of an assemblage of computer software, manual and teacher guidance, because as I illustrate in the following chapters 7, 8 and 9, resistance does occur. Lego Robolab is not a docile system, even though parts of it might perform docility there are possibilities here and many other things to connect to. Yet think of Ida’s attempt to escape her group affiliation at the end of chapter 5 for instance. Changing her working groups is not a possible act. Responses to her request are unified. Ida must accept the group affiliation she is given. The coordination of the teachers’ bodies makes it clear that expectations cannot be refuted. A border is revealed between assemblage making acts available and docile assemblage when both of the teachers are walking up to the seated girl. Their bodies perform a clear message that no negotiation is possible, and aligned with their verbal articulation that she should try this working group, the message is
transformed into an order; this is your working group. Ida gets the message and refrains from taking her request further. In the following section I explore what sets the boundaries for what is made available to Ida.

**Domestications and authorisations**

Circulations of authorisations, as discussed in this chapter, involve some sort of willingness on the part of the aligned entities – for one reason or the other. Pete, the material, Julie, August and Tim are all interested in seeing the car build and the children becoming good constructors. It has also been identified that the possibility of resistance needs to be available, since if this is not the case the authoritative assemblage turns into a docile one, which makes it possible to state that if availabilities exist then through that, the possibility to resist is enacted. One is setting the expectations, and here it is the teacher who wants the children to become good constructors. If the emotions of trust and interest are present, then circulations of authorisations can occur. Around the assemblage with Julie, August and Tim, this is exactly what can be identified. They trust Pete and the technology. They are interested in both Lego Robolab, and in satisfying their teacher’s expectations. And they are entangled in a circulation of authorisation that makes them, their teacher and the educational material look competent.

In his experiment, Harlow, the monkey and the term docility produce another type of assemblage - one of domestication. The monkey cannot resist and, as in our case, neither can Ida. Of course she could get up and leave the classroom, but within the boundaries of the system ‘education’ in which she is entangled, resistance isn’t possible in this specific situation.

This raises questions about when an arrangement of authorisations is turned into an arrangement of domestications, and when a docile arrangement is transformed into a arrangement with availabilities. And furthermore, whether it is imaginable or possible to have situations where docile relations and authorisations coincide.

Harlow and his monkey give us an important hint about the enforceability of authorisations. It seems as if authorisations cannot be forced, because when they are, they are turned into domestications and relations made of power.
Table 3: Differences between domestications and authorisations

<table>
<thead>
<tr>
<th>Authorisations</th>
<th>Domestications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availabilities exists</td>
<td>Availabilities do not exists</td>
</tr>
<tr>
<td>One who sets the expectations is the one who authorises</td>
<td>One who sets the expectations is the one who domesticates</td>
</tr>
<tr>
<td>Relations are based on voluntary commitment and co-constitution</td>
<td>Relations are forced into being by docile systems (The monkey and Ida) by some entities exercising power</td>
</tr>
<tr>
<td>Trust and interest are present</td>
<td>Trust and interest are not present</td>
</tr>
<tr>
<td>Circulations of authorisations occur</td>
<td>Circulations of authorisations do not occur</td>
</tr>
</tbody>
</table>

In table 2 above I have presented information about the two different types of relations, domestications and authorisations. To examine their differences I will use the empirical examples of the rhesus monkey and Ida’s obstruction, to elaborate the contents of the table on docile relations, and the example with Julie, August and Tim, to explain what is known so far about relations of authorisation.

I will explain the information gained on authorisations first. The teacher is setting the expectations of the children becoming good constructers, and making it available for the children to relate to the expectation by distributing the manual. The manual, boxes, hands handling the material. Trust and interest are making it available for the children to become good constructers, and making it possible for all the entities in the circulation of authorisation to look competent.

In matters of domestication, availabilities do not exist or are very limited. Both in the example with Ida, and of the monkey, expectations are set; fixed groups are constructed, baby monkeys die when separated from their mother, the availabilities are restricted to one. The Rhesus monkey has only one availability; to die in despair. Ida has one availability only if she wants to stay in the lecture; to accept her working group affiliation.

The dramatic comparison of a dead monkey with Ida’s dismissal of her request will need an explanation. As mentioned above, the monkey is locked in a box and cannot escape, whereas Ida, in theory can always get up and leave the room or go to the school principal or call her parents on her mobile. The situation Ida has accepted to be in, by her presence in the Multiroom, visible in the alignment of the floor and her sitting body is, as already explained, a voluntary commitment, which makes it into an assemblage of authority. Yet when deciding what group to be a part of the situation changes. Ida cannot chose which group to connect to, and in both of the situations with Ida and the monkey it can be said, as in row four in the
model above, that relations are forced into being by some entities exercising domestication. And through the identification of this relation two other things become visible.

First, domesticating relations seem to be able to be exercised together with the assemblage of authorisations. The domestication of Ida is coexisting with the circulations of authorisations; the teacher is authorising the children to listen, and the children by listening are authorising the teacher to speak, as shown in chapter 5. Or as described in this chapter, the teacher is authorising the children to become good constructors, the children authorising the Lego bricks to be good bricks... etc. It is in relations to this arrangement that the boundaries of the authorisations are activated by Ida’s request. Secondly, because of the ability to activate the boundaries of authorising relations, it becomes empirically evident that authorisations and authority not are the same. To see this we need to return to Bateson and his definition of authority which we left in a bracket two sections ago.

The introduction of docile arrangements helps me answer whether the brackets around Bateson’s notion of authority should be left permanently. Contrasted with docile systems, Bateson’s definition gives us a necessary and important feature - one of orientation. Rosenthal’s students, as well as Julie, August and Tim are all, for one reason or another, interested in doing what is proposed to them, whereas the Rhesus monkey and Ida are not interested. On the other hand Despret still places Rosenthal as an authority (Despret, 2004a, p. 127). Is she giving Professor Rosenthal authority, producing the relations between him and his students as one made of authority for pragmatic reasons, as a way to start the analysis and to draw the lines for the actor-networks and their assemblages to encounter in her work? And could Rosenthal’s juxtaposition with authority, captured in the ‘Rosenthal is authority’, be described differently entering the analysis in another place? I think this is so! What we initially may be inclined to coin as an authority is actually a result of apparently stabilised networks or a result of achieved stability over time. Authority is never stable or given. It is always made up in practice, despite how unconscious we are about the process, which is one of the advantages of the concept; circulations of authorisations since it captures authority as a process. Yet important to note is that Professor Rosenthal is made an authority through assemblages made over 40 years ago. The actors making up Rosenthal as an authority (the professor title, physical punishment still a part of the school system, use of surnames etc.) differs from the one making up Pete as one. Pete relates to the network of computers in school, and a school system that cherishes the individuality of every child. The teacher’s propositions as optional were not an issue at the time of Rosenthal (Holm, 2008; Juelskjer, 2009; Metz, 2006; Mullooly & Varenne, 2006). The network making Rosenthal into an authority was presumably stabilised to a greater extent than the
ones mobilised around Pete today, which makes Despret claim of the professor as an authority understandable. The difference between authorisations as a process and authority as stabilized circulations of authorisations will be elaborated further at the end of the following chapter where the relation between authorisations, authority and domestication will be considered again.

**Conclusion - authority circulates with knowledge trust and interest**

Chapter 5 helped me to expand the problem investigated by making visible the advantage of examining how Lego Robolab affects the authorisation processes of the classroom, as well as examining how the authorisation processes of the classroom affected Lego Robolab. This chapter has kept this focus and discovered that expectations, knowledge, trust and interest are vital actors to explore when understanding how authority circulates in computer enhanced classrooms.

In this chapter I started by introducing Despret’s notion of authority as an addition to Bateson’s definition. Drawing on Despret, I have brought to light that the one, whether human or nonhumans, that sets the expectations, is the one who/which authorises a certain reality to be produced. In this case Pete sets the expectations by aligning his knowledge, the children, Lego Robolab and the manual. It is discovered that knowledge and expectations are interlinked since the knowledge of the children, Lego Robolab and the manual is making it available for Pete to construct expectations of children that they follow the procedure and build a robot car.

The situation changes radically when all the children, boxes with bricks, manuals, and computers are distributed. The manual becomes a central actor linked to the assemblage of teacher expectations since following the manual creates cars alike that can be programmed to do certain tasks. Emotions of trust and interest are shown as crucial to identify in the relational assemblage to make authority circulate. ‘Circulations of authorisation’ is devised as an empirically inspired analytical concept that can capture the movable, circulating capability that Despret’s interlinking of authorisations and expectations introduces. Towards the end of the chapter the distinction has been made between an immanent a-synchronic dimension of authority (Bateson) and a circular movable aspect (Despret) and these have been discussed in relation to the terms docility and availability. Despret fixes the relation between Professor Rosenthal and his students as one of authority. The fixing is done as a way to analytically set boundaries for her analysis, and can also be experienced as a result of an analysis. Chapters 5 and 6 therefore help me to conclude that authority must always be explored empirically, as emergent accomplishments, constructed in time and connected to specific situations. Authority is never non-situated, and can take up different shapes as effects of teachers, children’s and technologies that are intertwined in practice. As a result, I will use the term authorisa-
tions or authorising instead of authority, because these terms signify movement and authorisations captures the process of authorising. Authorisations or authorising indicate the achievement of bringing an authority into being. \(^{54}\)

The analytical dimensions of knowledge, trust and interest have been identified as important actors to be present in order to make the circulations of authorisation happen. The dimension of domestication has been used to identify when authorisations turn into domestications, and the outlined principle of adding analytical dimension to follow up in the following chapters has already been challenged by the way I consciously ‘forget’ the dimension of bodies found in chapter 5. The following chapter offers bodies being enacted radically differently than the bodies’ enactments of Julie, August and Tim while building their robot car. The bodies of chapter 7 creates a sharp contrast to the standing-bodies or the walking-for-the-missing-brick-bodies, which made me decide to escape the predicted structure of the chapters and leave the discussion of the bodies performed until the next chapter. Furthermore ‘expectations’ have been important to include already in this chapter, since the argument interlinking authority, trust and interest, as well as the argument for circulations of authorisations could not be made without discussing expectations. Expectations will be discussed in greater detail in the following chapter.

Finally it has been identified that the circulations of authorisation I have investigated in this chapter have unfolded an attractive situation, seen from a teacher’s perspective; The children are doing what they are supposed to do, and every actor involved in the circulation ends up looking competent.

The next chapter will investigate examples where the teacher’s expectation of becoming good constructors are not met, and by that it becomes evident that there are other types of expectations that co-exist with the expectation of becoming good constructors. If the link between the one setting the expectations and the one who authorises is to be taken seriously, then this means that other authorisations also take place. This is what we are about to explore in chapter 7.

\(^{54}\) Latour has similar considerations on time, space and agency, and writes that they are better addressed and described as temporalization, spatialization and actantialization or, timing, spacing and acting (Latour, 1997).
Chapter 5 has highlighted authorisations as effects of sociomaterial arrangements. Specific devices, boxes, beamers, computers, manuals and bricks act together with humans, emotions and symbolic orders such as numbers, to establish Pete as the one who authorises. Yet not all entities link to this assemblage of ‘Pete-the-one-who-authorises’ when authority is distributed to the seven manuals handed to the working groups. In fact other networks of arrangements do either not at all, or only periodically relate to the assemblage of manual and teacher. The following three chapters in different ways describe such examples.

Chapter 7 analyses three different assemblages in which the manual is absent, and where the teacher expectation of the children becoming good constructers is only peripheral to the empirical examples discussed. I will describe a situation where a song mutates from being a ‘song sung’ into a performed song where body movements are coordinated to visualise the lyrics of the song, where two children are acting as a cameraman and a reporter, and finally a situation where two children are drawing with an application on the computer. In these descriptions it becomes clear that another expectation other than that of becoming good constructors is present in the Multirroom, and this is the expectation of engagement. It is identified that the technologies (computers, Lego Robolab, video camera) that part the teaching situation liberates the children’s bodies (and partially the agenda of the lesson). The three examples are entangled with one another; which is apparent when I present them in the following sections. However, I separate them into the three situations above when I describe them in detail because they each illustrate, in different ways, how the expectations of engagement and bodily freedom are enacted. Two topological metaphors, network and fluidity, suggested by the STS researchers Law, Mol and Sørensen will be used to identify the different entanglements of engagement.

Towards the end of the chapter the dimension of domestication becomes central when one of the assemblages is discussed. This leads to a discussion about availabilities, expectations and authorisations, where the differences between these terms are examined.
Camera performances and peripheral connection to teacher expectations

The week after class 5Y had their Robolab week, class 5X start theirs with a similar introduction to the Lego Robolab system, again done by the teacher Pete. The following example derives from class 5X’s second working day: Karen, another teacher, is present this day. Working groups have been set up the day before, materials and groups are distributed around the computer room and the Multiroom. Again, the Lego Robolab session is recorded by an unmanned video camera. The class has been working for half an hour, and the teacher in charge of the lesson and myself are physically absent. The camera is recording the activities in the computer room. Some children are standing alongside the working table, building their robot cars. Others are sitting in front of the computers. The tables are filled with boxes of bricks and manuals. The camera captures (among others things) the performance of two pupils, Viola and Kamilla, on tape.

The following descriptions of the snapshots are separated into three parts, each one following the other sequentially. Between the first two is a 16 minute break, and one minute separates sequences two and three.

1.
Viola is sitting on a chair in the back of the room looking into the computer screen. She takes up a computer car from the white box in front of her. The girls next to her hums the first two bars of the pop song ‘I Believe I can fly’ by R. Kelly, from the movie ‘Titanic’ (1997).

55 The term snapshot is borrowed from Mol (Mol, 2002). Snapshot is adequate, because it is exactly what it is, a snap shot of what is present in the classroom. This is not a positivistic statement in the sense that what is highlighted here is not reality per se, but the way I frame the data I am entangled with. In response to how I then justify the selection of my snapshots I have at least two strategies to choose between. One is to use more energy, and pages in justifying my choices, so others can unravel my analytical steps. The other is to accept that this is a condition for all research, and instead of using energy and written pages on self reflection and positioning, the pages and energy is used to enrich the descriptions of the snapshots. The measure of success changes accordingly. It is not that my choices necessarily are completely transparent, but that my descriptions are linked to and circulated in the practices that I address. As already explained in part I, at the start of chapter 4, I direct myself towards the latter strategy. When I write about the three snapshots in the following section, they are sometime called snapshots, and at others just referred to as example 1, 2 and 3, as also indicated in each description.

56 His performance name is R. Kelly, and his full name Robert Sylvester Kelly, see also http://en.wikipedia.org/wiki/R._Kelly
2.
The camera moves. Some mumbling is recorded, followed by a girl saying that this Lego Robolab lesson rocks! The door to the corridor opens, and the camera is moved by one of the children to capture the two girls entering the room. Viola’s voice is recognizable behind the camera. She shouts to Kamilla and Alice that they are being filmed as they enter the room. The girls start to dance and sign while they are moving closer to the camera, ending up mimicking a kiss in front of the lens, and then move behind the camera. Standing behind the camera, Viola asks Kamilla and Alice to do something on the floor, and hums the first two bars of ‘I Believe I can fly’. Kamilla and Alice jump in front of the camera and start to dance and sing the Titanic song in front of the camera. They stop singing after the refrain, and Kamilla tells Viola that it is her turn, but she declines.
3.
Viola is sitting on a chair at the end of the computer room with her face directed towards the computer screen. She turns around on her chair, sees the camera while she gets up, and walks towards it. When she is passing the camera she sings ‘I Believe I can fly’. None of the girls are visible or audible in 30 seconds, when the camera moves and Kamilla's voice can be heard. She asks Viola to make an interview with her, and walks to the front of the computer room. Viola moves the camera, to capture Kamilla, and Kamilla finds a 10 cm black Lego brick in one of the boxes, and places it in her left hand.

*Picture 10: Kamilla reporting*

With her ‘microphone’ ready to record her voice, she tilts her head slightly to her right and walks in the direction of the camera. Her voice changes and she uses high tones pronouncing every word clearly. Looking directly into the camera she explains that we are going to visit somebody who is drawing. Viola turns the camera to follows Kamilla’s body moving towards one of the stationary computers on the left, where two girls are sitting with a drawing application opened on the computer. Kamilla asks them what they are drawing, and asks them to speak out loud and clear. The girls turn around and look for a short moment directly into the lens before they turn their back against the camera and towards the computer screen again. The girls respond by mumbling something unidentifiable.
Kamilla turns around and explains that the girls were ‘simply drawing’ while she walks towards the camera and stops behind it. The camera is being lifted and Kamilla’s voice announces that ‘we’ will now go over to the girls. The camera is roughly moved forward 20 centimetres before it is put on the floor and Viola’s voice can be recognized. ‘We are not allowed to lift the camera’ she says, and the camera is placed on the floor. Kamilla’s fingers holding the Lego brick becomes visible in front of the camera lens, and she uses the brick to point at the girls while explaining what is visible.

Picture 11: Kamilla point at the girls with her microphone

Kamilla asks the girls to turn around and smile at the camera. The second time she asks the girls they turn around and wave briefly to the camera.

The door beside the computers opens and Karen, the teacher, enters the room. She addresses Viola and Kamilla immediately, and tells them to leave the camera. The girls are turning the camera 90 degrees to bring it into its initial position, and walks away from it. (Video recording the 5th of April 2006, tape 1, time 25:33)

All the girls’ enactments are linked to the general introduction the class received the day before, and we can therefore presume that one set of expectations is already present here. With 5X and 5Y having had a similar introduction, the teachers here also authorise the children to become good constructors: The expectation of a connection between the manual and the children is already made explicit in the
introduction, and in the distribution of children, manual, boxes and materials. It is in this room, where the expectations of the children relating to the manual are in the process of becoming good constructers, that the girls perform their actions.

I wrote in the introduction to the chapter that none of the girls relate to the manual. Readers would probably agree that the manual is not a prominent actor in the descriptions above. Yet being in a room where the teacher expectations of the production of good constructers is prominent makes it sensible to examine the girls’ relation to these expectations first.

To become good constructors it does, as described in chapter 6, draw bricks, sensors, computers, trust, teachers and children into one assemblage, and I will now address the question of whether or not the girls relate to this assemblage. In the first snapshot, Viola is sitting on her chair haphazardly fumbling with the robot car that her group built yesterday. Relations are here made between her and the teacher’s expectations, through the Lego Robolab car, and she is sitting in front of one of the computers. She is, in other words, relating to what is made available, in a way the teachers had authorised her to do.

The second snapshot, where the children dance and sing in front of the camera, seems to be completely disconnected from the authorisation processes and expectations present in the first snapshot. I will continue to the third snapshot before returning to this, because the way in which the third snapshot is peripherally linked to the teacher expectations raises the question about the connectedness of the girls who are dancing with other activities in the classroom.

What happens at the start of the third snapshot can be marked as a shift. First Viola looks at the computer screen and after a while she turns her body around on the chair and her angle of vision changes. She sees the camera (or the camera and some children behind it) and gets up. She starts to walk towards the camera and stops behind it. The camera, Viola and possibly also other classmates are relating, and the camera-girl relation is making other acts available. Viola, by relating herself to the camera, is disconnecting herself from the assemblage of the manual, the teachers, the expectations of the children becoming good constructers.

It is not clear in my data how the connection between the camera and the girls is taking shape in the second example. I cannot see if it is Viola who places herself behind the camera, and if so, when she does it. But a similar ways of connecting – eyes landing on the unmanned camera, eyes seeing other children standing behind the camera – can be imagined.
The circulation of authorisations around the camera is obviously different from the one that is produced around the manual and Julie, August and Tom in chapter 6. A good way to describe these differences would be to identify the different expectations in play. The question concerning what kinds of expectations are entangled in the camera-girl relations will be investigated in the following pages.

**Identifying other expectations - children trust technology to liberate their bodies**

The manual placed on the table actualizes a connection for some of the children, as we saw in chapter 6, but it does not take long for Kamilla and Viola to identify other availabilities. They relate to the camera in snapshot two, and with a black Lego brick and the video camera in snapshot three. Apparently they do not feel obliged to become good constructors as the teacher authorises them to be. One explanation of their actions could be that they do not see the teacher as an authority. Another is that other, more fluid expectations co-exist with the ones bound to the assemblage of teachers, manuals and Lego bricks. Hesitating to decide what is at stake here, I will look for other expectations that might authorise the girls’ actions, and to do that, I will return to Despret, Rosenthal, his students and the rats one more time.

There is a tension in Despret’s story about the rats that is absent in my material. Rosenthal’s students are told that the rats are bright rats, which unwarily puts them in a dilemma. If science is defined as a process of revealing pre-existing reality, then how, Despret asks, can the students simultaneously trust their rats and their professor. Rosenthal expected the students to discover that there was, in fact, no difference among the rats. In such a case his (pre-existing) world would have been discovered. What happens though, gives rise to new types of realities where ordinary rats turn bright and where students propose new realities into being.

In my material there are no such hidden expectations on the teacher’s side. The teacher Karen, in charge of this lesson, unlike Rosenthal, does not have some secret expectations for the children to fulfil or discover (for instance, to prove the manual incorrect). However Karen does have an expectation that is unarticulated to the children. She expects the children to be engaged whenever computers are involved in teaching activities, as her quotation below reveals:

> Well, many of the students are motivated from the start as long as computers are involved one way or the other.

*Interview with Karen, teacher, the 27th of April 2006, p. 3*
Karen’s expectations of engagement is also visible in the way she constantly, on her way around the two rooms, directs children back to their working groups or asks the children what they are doing if they are fluttering around. Karen is not alone with her expectation of engaged children. Other teachers interviewed state similar expectations:

I would actually say that that’s the beauty about the media [the computer], because it is always good. [...] It always catches them [the students]. There is something about it - the computers can do something that we can’t.

Interview with Pete, 01.05.06, p. 3

And the expectation of engagement does not stop there. The engagement born with computers in classrooms is entangled and related to a vast number of actor-networks that in different ways add to and intersect with the activities of this particular setting. In addition, words such as inclusion, technological knowledge, differentiated teaching are crafted into the actor-network of the legislative text of primary and secondary schools in Denmark, dictating that ICT shall be part of every subject area at every class level of the school (Gertz, 2008). Researchers within the field of computer enhanced teaching, in different ways have highlighted the potentials of ICT related teaching, pupil engagement being one of them (Gee, Shaffer, Squire, & Halverson, 2004; Holm Sørensen, 2006; Shaffer, 2006). We see that, apart from the two quotations given above, the literature mentioned here also supports the view that the very presence of technologies in the classroom entails an unarticulated expectation of engagement. In the example analysed in the previous chapter, I showed how faith and trust are crucial elements in the actor-network if the circulations of authorisations are to take place. The children have faith in Pete’s propositions, and can therefore fulfil his expectations. This knowledge raises the questions of faith and trust here. Who do these girls actually believe in? Who do they put their faith in, or what do they trust? The quotation below from Emma, one of the other children from Karen’s class, might give us a hint:

Robolab is more fun than ordinary lessons, because we are not just seated, we can move around.

Field note of conversation with Emma, pupil in 5th grade, the 23rd of March, 2006

Emma tells that the ability to move around is important. The children trust their experience, telling them that their bodies are freer when they are participating in technology enhanced teaching. The ability for bodies to move is for Emma experienced as one of the benefits of Lego Robolab lessons. The freedom to move is not
only mentioned by Emma, but is brought up several times in my conversations with the children during their Lego Robolab week, as well as in the follow up interviews with them.

Maybe the students trust the technology to break the structure of schooling and to liberate their bodies? Clearly the bodily rotation of the student Samuel, discussed in chapter 5, shows that he is enjoying the loosened constraints that arise in the combination of absent chairs and the teacher’s eyes directed towards activities at the other end of the room. Moving forward on his knees and lying on the floor would not be possible for Samuel in an ordinary classroom setting - a chair that would constrain his body to a fixed position illustrates this point. Samuel’s body is showing us what Emma’s quotation articulates: The children are experiencing other forms of bodily propositions, when computers are part of the teaching.

When the children have a session where computers are used, they normally move to the Multiroom, computer rooms, to corridors with laptops, or to the school library, which interlink alternative physical spaces with the use of computers. The children’s bodies are moved and pushed in different ways in these locations, which also promotes the enactment of the expectation of bodies to be articulated differently when placed in settings other than the ordinary classrooms. The children, in other words, trust technology to form other bodily patterns to relate to when computers are engaged in classroom activities.

Returning to the fifth grade class, the distribution of materials and bodies aligned with a few scattered chairs makes other ways of using Lego Robolab, classmates, floor, and camera available and increasingly attractive to relate to. The teacher’s interaction with working-groups or with one child at a time decreases her ability to see what all the children are doing in the two rooms. It is in this situation that Kamilla and Viola are playing at cameraman and reporter, and dancing in front of the lens. These form the assemblages that I will describe in detail in the next sections.

What the camera is making available

The British sociologist, John Law differentiates between three forms of presence (Law, 2004). This is done to make visible that absent matters have immediate effect. Law distinguishes between manifest presence, manifest absence and absence as otherness. ‘Manifest presence’ shall be understood as what is made present in a given situation; here the camera and the girls are present. ‘Manifest absence’ goes with presence, so to make present is also to make absent, Law tells us. An aeroplane can be said to be absent here, yet an aeroplane does not qualify as a manifest absence, because it isn’t normally related to the present. Technology enhanced
teaching in public schools is very seldom filled with aeroplanes. On the other hand
the teacher and I are manifest absence, when Kamilla and Viola are playing cam-
eraman and reporter, because our manifest absence is needed for the present to
unfold. The aeroplane is related to the third categorisation. ‘Otherness’, or absence,
goes with presence as well, but it disappears. Perhaps it is ‘othered’ due to the lack
of interest, for example it does not matter that aeroplanes are absent, because they
normally are so. Or things may be othered because of routine, - most studies, for
instance, do not give non-humans agency. But something could also be made absent
because of what is made present and manifest absent, and these manifest ab-
sent/present-ness could not be sustained unless it is othered (Law, 2004, p. 83-85).
An example of this could be the suppression of critical voices within computer en-
hanced teaching (Cuban, 1986, 2001, 2003; Squire, 2005), that more or less
strongly proclaims that ICT should be left out of the schools because the benefits of
its presence is overrated. Working with these types of indexations helps me to iden-
tify what can coexist and what cannot.

With these forms of presence in mind I will return to example three again. The
manifest present camera is relating to a video tape, set up to record the surround-
ings and the rolling tape in the camera links to two different manifest absences;
recording in general and the teacher and me, which produces different expectations.

Recordings first: Rolling tape expects action – something to record. It also produces
the idea that someone is behind and others are in front of the lens. So when Kamilla
and Viola are relating to the camera, they are not only relating to a camera, but the
expectations of this type of object in this type of situation into manifest presence is
brought as an effect of this assemblage, by recording dancers as in the second ex-
ample, and when playing cameraman and reporter in the third.

The camera is also relating to the manifest absence of me and the teacher. The
teacher is manifest – if the teacher was not part of this arrangement, there would be
no technology enhanced teaching taking place. And the teacher is absent because, if
the opposite was the case, it would be highly likely that the girls would be stopped
what they were doing, as is done when Karen enters the room at the end of the
third description.

I am manifest because I am making an alignment of children and camera possible –
if I wasn’t engaged in this research project an unmanned rolling camera placed in
this Lego Robolab session would have been highly unlikely. The manifest of me is,
so to say, supplying the camera, and I am needed to make the present enactment
possible. The absence of me is, however, also needed. If I was standing behind the
camera, it would be unlikely that the children would perform so extrovertly. The
materiality of the camera and tape, aligned with the record bottom pushed down, and the absence of me and the teacher, is not only making the children and the camera available to each other, but is also making a tension of my manifest absence, as described below.

It is in the entanglement of different manifest absences (filming in general, me and the teacher) and manifest presences (the girls and the camera) that the girls’ performance is produced. Placing the camera in the classroom, with tape rolling, I am expecting to get something to take home with me. And recording cameras activate expectations of action – tapes are rolling when things are happening. The absence of me makes it available to the children to perform their idea of action – the idea they suspect rolling cameras in general want. So the presence of the camera and the Lego bricks that supplies the microphone, the manifest absence of me and manifest absences of what rolling cameras want, are in other words making Kamilla and Viola as Cameraman and Reporter available. The mutually generating nature of the situation might be even clearer if the situation is imagined slightly differently.

What if we imagined the video camera without a tape and without the record button pushed down? What if we withdraw the tape? An empty camera would surely produce another situation. Lots of the excitement is bound to the recording because the rolling tape brings an audience to the performance. The girls know that, sooner or later, I will watch the tape, since a serious researcher is expected to do that.

What if we lifted the camera out of the situation? Playing news reporting could be imagined without the camera. The black Lego brick could work as a microphone anyway. But would it have been found in the box with 500 other bricks? And would it have mattered? Hardly, the black Lego brick are becoming the microphone in the relation to the camera, as the roles of a cameraman and reporter are imagined in relation to the camera. The camera makes the performance available to the girls and also defines the extent of the performance area.

The girl’s performance should also not be seen as a single act. Eight minutes later Viola and another classmate are ‘flying’ in front of the camera, singing artist R. Kelly’s ‘I believe I can fly’ again.
And it is not only the girls that are exploring what the camera and the recording is making available, as we see:

I have tried to highlight the heterogenic entities mutual work in the construction of the cameraman and reporter, yet one actor is notably powerful, and that is the camera. It important to clarify that although the camera is a very central actor, it is misleading to assume that the camera is making the assemblages, as a deterministic interpretation might do. All the actors relating in these very specific moments make the enactments of the cameraman and reporter, the girls who are singing, and the close-up of the boy’s face. The assemblages are not done solely by the camera. Of
course the camera is constructed with a technique making it capable of printing the boy’s facial expression onto tape, yet in order to do that both, I and the teacher still need to be manifest absent, the recording space in front of the camera needs to be free, and the idea of relating to the camera must have been made available to him, maybe by watching other classmates using it. Therefore an assemblage of heterogenic entities is identifiable here as well.

The deterministic idea that the camera brings cameraman and reporter into existence might also gain strength from other characteristics shared between the entangled entities, and that is the relative stability of the entities making up this assemblage. This awareness might be explored further if we move this relational analysis towards a topological one. In my online dictionary topology is defined as ‘the study of geometrical properties and spatial relations which remain unaffected by smooth changes in shape or size of figures, or the way in which constituent parts are interrelated or arranged’. This is however not a sufficient description for the topologies Law, Mol and Sørensen work with, and nor for the descriptions I am about to present. Mol, Law, Sørensen and others have taken this mathematical notion of topology and turned it into a very special way of approaching the relational analysis. Law writes:

Topology is a branch of mathematics which explores the characteristic of objects in space. So how does this work? A non-mathematical answer is that topologists think about spatiality by asking questions about the continuity of shapes: the properties that the latter retain while they are also being deformed. In topology, for instance, a shape is said to hold its form while it is being squeezed, bent or stretched out – but only as long as it is not broken or torn. If it is broken or torn, then it changes.

(Law, 2002, p. 94)

Topology concerns itself with spatiality, and in particular with the attributes of the spatial which secure continuity for objects as they are displaced through a space. The important point here is that spatiality is not given. It is not fixed, a part of the order of things. Instead it comes in various forms.

(Law, 1999, p. 6)

The two quotations teach us that a topological approach is concerned with spatiality and the continuity, deformation and, consequently, also the boundaries of shapes. The second quotation enlarges on the dynamic encounter of topological

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approaches. Spatiality is not given, as Law highlights – it comes various forms. This is exciting since the stability or the homeomorfic identification, not of what a situation or a thing is, but of the spatial form of an assemblage might indicate companionship with distanced spatial and temporal forms. - An assemblage making up 'camera man and reporter' might indicate that relations among entities is connected in a way that it produces the same topological pattern as a live report on television as in the Robolab session with Viola and Kamilla.

Within the STS literature four spatial metaphors, network, regional, fluid and fire, are suggested by the Dutch anthropologist and STS researcher Marianne de Laet, Mol, Law, the British psychologist and STS researcher Vicky Singleton and Sørensen, to create a spatial sensitivity towards the different ways relational assemblages are brought into being (de Laet & Mol, 2000; Law & Singleton, 2005; Sørensen, 2007b), and to capture these relatively stable 'patterns of relations' as Sørensen calls them (Sørensen, 2007a, 2009). One of the topological metaphors introduced is network, and this metaphor seems to encompass the way entities relate in the assemblage cameraman and reporter and is therefore brought into the analysis here.

**The network of cameraman and reporter**

The network metaphor can be used to describe the commonsense view of an object which corresponds with Latour's notion of immutable mobiles as things that moves around, but hold their form (Latour, 1990). It does that because it fills up a geographical space, but also because 'it holds its shape in some relational and possibly functional manner' (Law & Singleton, 2005, p. 335).58 What the network metaphor and the notion of immutable mobiles gives us is the awareness that even objects in an Euclidian sense are thus not solid objects but are only temporarily, for the moment, in stable networks. A lot of effort is needed to maintain these stable networks. There are a lot of objects in and around schools that can be seen through the network metaphor or as immutable mobiles. Examples are buildings, lecture structures, and the school system itself.

In the assemblage of cameraman and reporter the stability is, for instance, present in the way that relations are made to the stable idea of the structure of an interview, and the relation to the camera that records. If, for instance, the camera did not film,
or Kamilla and Viola’s idea of an interview was not the same, then the stability of the relations would dissolve and turn into something else. Such a change in relations would change the whole assemblage and would empirically exemplify a central feature of the network metaphor. If the relations making up this assemblage change, then the assemblage changes as well. Cameraman and reporter are immutable, this is the way to perform it; camera, cameraman, interviewer, microphone, and someone to interview are the minimum needed, as well as the relations between the entities being performed in a specific way; a man behind the camera, one in front etc. And cameraman and reporter are mobile in the sense that these entities, performed with this stability to one another, are as recognisable here as they are in the news on television, or elsewhere.

**The fluidity of the pop song performance**

I have described how the assemblage of the cameraman and reporter is brought into being as an entanglement between manifest absences of the teacher and me, expectations of camera-action stories, the presence of children and the video recorder. Another repeatedly enacted assemblage that has been mentioned but not yet investigated, is the one generated by the song ‘I believe I can fly’. What is remarkable about this assemblage is that it only exists in relation to the expectations of bodily liberation brought into the classroom with the presence of computer technologies. Whereas the cameraman and reporter assemblage relates to physical entities such as the camera and the black Lego stick, this assemblage lives and mutates in relation to the children’s body movements and verbal expressions. This, I will argue, produces an assemblage of a much more fluid nature.

The first time we meet the song is when it is hummed in the first snapshot of the girl next to Viola. How the song is made available to that girl is left unarticulated. Maybe she had recently seen the movie ‘Titanic’ that made the song travel well in Euro-American regions, or maybe she heard the song on the morning radio.\(^59\) What I can say something about is how the song travels. The song sung by the girl next to Viola in snapshot one is making something available to her. When she invites Kamilla and Alice to do something in front of the camera in example two, she hums the first two bars of the song and is making it available to Kamilla and Alice to unfold. The song is created as an assemblage and lives through the frequency of its

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\(^{59}\) These answers still leave some fuzziness about entrances, and ‘the song enters’ is not that satisfactory an answer, but the answer is quite a pragmatic consequence of research, because it is enabling descriptions coherent enough to travel. Researchers constantly cut in networks. And I have made cuts here. I have not followed these children prior to, or after their Robolab week. I have not been with them in the morning, in the evening, and cannot identify when the song is actualized for the first time.
repetition. At the start of the third example Viola sings it again, and the song is performed with the microphone and the dance of the girl flying a little later again, as visualized in the previous section.

The difference in the two arrangements of the cameraman and reporter and the pop song performance rests in the networks they draw. Recording and reporting from somewhere is practically crafted with the for-the-time-being stable technology of the camera. As described earlier, I cannot say whether the song arises because the girl next to Viola recently saw the movie, because the girl’s mobile phone is set up with it as a ringtone, or if she just heard somebody humming it on her way to class. But what I can describe is how the presence of the two first bars of the song is making it available to Viola who, by humming it when inciting Kamilla and Alice to act in front of the camera, is making it available for them to sing.

The song is manifest present in the three examples, while expectations about cameras are manifest absent to the situation. Furthermore cameras are enacted repeatedly with physical materiality while the song has a seemingly more fluid nature.

Thus how do I understand and qualify this fluidity? Marianne de Leat and Anne-marie Mol in an article about a bush pump in Zimbabwe gives an example of what they call a fluid technology (de Laet & Mol, 2000), and this will allow me to describe more accurately the relations drawn in this assemblage. In the above article the fluidity lies in the capacity that the object has of being both mutable and mobile. It flows like water and adjusts to the relational landscape it meets. The Bush pump helps the inhabitants in different villages in Zimbabwe to produce clean water, and the object wanders from village too village. It is used in different geographical locations and at different times and the object itself changes shape as the local people repair the pump when necessary with whatever is at hand to keep it going. The mechanics of the water pump change and also the practices that produce its success, de Laet and Mol explain (de Laet & Mol, 2000, p. 247-248). So what we have here is not a stable set of relations that make up the pump, but rather a fluid set of relations, because the sustainability of the pump depends upon the fluid adaptability it possesses. Fluid objects should, therefore, be understood as a set of relations that gradually shift and adapt (Law & Singleton, 2005, p. 339). Fluid objects flow and change gradually bit by bit, and the changes cannot be abrupt because otherwise the object would disappear. This is a contradiction in itself, thus holding an important thought. Fluid objects are things that both change and yet stay the same. Fluid objects are dependent on change because their sustainability is dependent upon their fluid adaptability. Fluid objects can therefore be seen as a set of relations that gradually shift and adapt, rather than as objects that hold themselves rigid.
The song enacted here can be described using the fluid metaphor. The pop song performance can be seen as both mutable and mobile. The song moves in and out of different assemblages and presents itself (mutates) slightly differently each time. We can identify the song for the first time in the first empirical example, where a girl hums it next to Viola. From here Viola relates to the song and brings it to meet a new assemblage of actors – exactly the same as in the bush pump example where other villages takes over the bush pump. Relating to the song’s audibility, by singing it briefly when filming Alice and Kamilla, she is making way for a continuous flow of the object. Kamilla and Alice are relating to the song and are by that adapting the song as a part of their performance (example two). Viola’s humming of the song at the start of the third snapshot is making the song available and present as a fluid availability. Shortly after the cameraman and reporter action is stopped by the teacher Karen, the song is taken up by the two girls that entangle the song with visualizations of a person flying, as illustrated in the previous section.

In the data available, I have just identified the song’s mobility in its continual flow from where it is sung the first time, until it is accommodated by the girls dancing. And the object mutates from being hummed, into being enacted to the beat of a dance, into being performed as an alignment of the lyrics with body movements.

To view the song’s performances by the fluid metaphor also helps to explain why the song is recognisable, just like the bush pump, but also why it is hard to give a singular clear description of it. The fluidity causes the song not to be stable. The fluid metaphor also helps me to be more precise about the survival of the song. I mentioned above that the repetition of the song is an indicator of its survival. A more adequate description would be to state that its sustainability relies upon its adaptability to the different relational assemblages it meet.

**Patterns of relations**

In this chapter I have identified that other expectations co-exist with the one partaking of the assemblage of teacher intentions and manual: Whenever technologies are present in the classroom, the children expect their bodies to be offered other ‘patterns of relations’. Patterns of relations is a concept borrowed from Sørensen (Sørensen, 2005, 2007a, 2009). Sørensen argues that the identifications of relations do not singly produce the specificity of an object. The specificity of an object is made by the way entities relate. The same entities can create different assemblages and different objects, if they are related differently. Such a situation will be described in chapter 9 (by making a comparison with an assemblage described in chapter 8). In the two assemblages investigated so far in this chapter, the entities are different and relate to each other differently and, following the logic of Sørensen’s approach, this produces different patterns of relations as well.
These different patterns of relations are visible in the two assemblages identified and described as the cameraman and reporter and the pop song performance.

<table>
<thead>
<tr>
<th>Assemblages</th>
<th>Cameraman and Reporter</th>
<th>Pop song performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metaphor</td>
<td>Network</td>
<td>Fluid</td>
</tr>
<tr>
<td>Relations made among entities</td>
<td>Stable relations</td>
<td>Moveable relations</td>
</tr>
</tbody>
</table>

Table 4: Gather information of the two different assemblages identified

As expressed in the table above the assemblage of the cameraman and reporter rely on relations made to objects that hold their shape. In this assemblage the girls related to the camera, to each other, to a black Lego brick, to the form of an interview – all entities that hold ‘for-the-time-being’ stable actor-networks. And it is exactly because these entities relate that the form of an interview the girls relate to is the same, the black brick imagined as a microphone, and the research camera handled as a TV camera – that cameraman and reporter can be enacted.

In the assemblage of the pop song performance, the girls enjoy the bodily liberation that goes with computer enhanced teaching, but without relating to any (here) stable objects, computers, bricks or manuals. The fluidity of this assemblage helps to explain how this is possible. The song does mutate over time, as explained in the prior section. Its adaptability and fluidity allow it to travel over or travel through other assemblages. It is not bound to present itself in a specific form, as the cameraman and reporter do when relating to the standardised model of an interview.

A third example is still awaiting analysis and is not forgotten; that is the one with the children drawing at the computer. Before I start my description of that, I will return to the notions of manifest, manifest absence and otherness as presented by John Law, and question the usefulness of these terms.

**Manifest absence/manifest presence revisited**

The notions of manifest present, manifest absent and otherness enabled the descriptions of the cameraman and reporter to unfold. Yet working with the concept of availabilities, and the introduction of two of the topological metaphors, it seems less clear what the absence/present logic has to offer now. With this acknowledgement, perhaps the obvious thing to do would be to omit the passage that uses Law’s vocabulary, and rewrite the sections with the knowledge gained through the other concepts. However the recognition of redundancy in the concepts at play has helped me realise an important difference in Law and Despret’s thinking, and presenting

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60 Computers, bricks and manual are here performed stable, but other situations could be imagined where this was not the case – computer break down, bricks disappearing etc.
this insight here will serve as a step towards the following clarification of the differences between availabilities, expectations and authorisations. For these reasons the use of the concepts of absence/presence remains in the text.

What I have done in the earlier sections of this chapter is to combine the ideas of the two thinkers. Law’s three concepts; manifest present, manifest absent, and otherness has helped me to identify that the absence of some things and the presence of others make certain things available, and I have combined Law’s absence/presence logic with Despret’s notion of availability in the examples I have presented. This creates the idea that availabilities are to be found in immediately present availabilities (manifest presence) and that more generalized, distanced associations (manifest absences) can be integrated into assemblages in the present time. The advantage of this logic is that we can decide what and who of the present actors in a given situation can act, and that absent things matters. The disadvantage of this description is that it produces an imaginary of spatial and temporal distances as a way to identify different sorts of relations, - some are immediately present and others are working at a distance, which produces the vocabulary of an inside availabilities and an outside availability, that might be inexpedient.

I will re-introduce Despret’s legacy of the twelfth camel which was explained in chapter 4, and suggest that the indexation of manifest presence, manifest absence and otherness, can be seen as the twelfth camel: The terms have enabled me to describe that the absence of me (and the teacher) helps the availability of playing cameraman and reporter to become real. The absent/present logic enabled me to see how absences are folded into the present, and it has exactly been this folding that made me question whether Despret’s making available could produce this insight without the presence of Law’s absence/presence logic. The latter makes me aware of the importance of the differences between Despret’s and Law’s scientific philosophical positions. I will aim to account for this in the following section.

The actuality and virtuality of a cup

John Law suggests that the problem of the inclusion/exclusion dichotomy is eased when approached from a poststructuralist tripartition into presence, absence and otherness (Law, 2004), whereas Despret’s scientific philosophical affiliations are aligned with Latour’s. Latour’s explanation is far more pragmatic than Law’s. Latour borrows the Deleuzian concepts of the virtual and the actual, where the actual is considered the actor-network, and the virtual as possible, yet unrealised connections (Deleuze & Guattari, 2005; Latour, 2004a, 2005a). With this interpretation, it does not matter if something is manifest present, manifest absent or ‘othered’. What is not present is a possible connection that is not yet actualised. This view corresponds fairly well with Despret’s notion of availability. Availabilities exist, yet
availabilities cannot be present as connections are actualised, since then they stop being availabilities (virtualities) and turn into actualities (actualisations). And it does not matter whether the availabilities are considered to be ‘just in front of you’ or as absent as in an idea of the form of an interview. As long as the availabilities are not connected to they remain virtual, and when connected to they becomes actualities – and as such become part of different actor-networks.\(^{61}\)

If we combine Despret’s notion of availability and the Deleuzian notion of the virtual/actual, then we might gain more insight into what availabilities are present in these empirical situations given here, and through that be able to identify differences between availabilities, expectations and authorisations.

I will start with a simple example: The cup standing besides my computer is making it available to me to drink from it. The cup is present here and now, which tells us something about availabilities. Availabilities need to be available. If there is no cup with tea beside the computer, then it is made available to me to walk to the kitchen and get a cup of tea from there. Yet the idea of a cup is available for me to relate to. If I know the concept of a cup, then this concept is as available to me as the physical one in front of me. Consequently availabilities do not make divisions between material and immaterial availabilities (although I am well aware that a cup in front of me and the concept of a cup enact different availabilities when related to).

Let me return to the cup in front of me. I write that the cup is making it available for me to drink from it. When suggesting what to do with the cup - drinking out of it – then we combine availability with expectation. When writing that the cup makes it available for me to drink from it, then expectation is already an effect of the present assemblage, and it makes me expect certain things to happen when I connect myself to it. The vast amount of possibilities made available through the presence of my cup (I can drink from it, I can throw it in the air and catch it, I can drop it on the floor) is given a boundary by the expectation present. There are certain availabilities more appropriate to relate to than others when the expectation – a cup is made to drink from – is to be satisfied.

I identified immediacy related to availability. Expectations on the other hand relate to actor-networks that go before and exceed presence. For instance expectations of the cup being able to support tea drinking are built into the way it is designed, and is thus confining the possibilities present. And if I want to hold the identity as a

\(^{61}\) Important to note here is that Deleuze concept of virtualities has nothing to do with the virtual/real divide put into circulation within computer theory and the field of interaction design. The first should be understood as elaborated above in the main text, whether the latter relates to the more or less clearly articulated divide between the digital and the analogue. See also: (K. M. Leander & MCKim, 2003)
competent tea drinker, then it is implausible that I would throw the cup on the floor or use it as a pencil holder. The cup is, in other words, expecting me to drink from it, and by that it is producing me as a competent tea drinker. Thus expectations do not determine my act. I could still throw the cup on the floor. Expectations are in this sense to be considered as resources and not as fixed goal to be obtained. The American anthropologist Lucy Suchman in her book ‘Human-Machine Reconfiguration’ nicely describes this point and shows that plans are best considered as resources for action, rather than determining action itself (Suchman, 2007).

When taking the cup and drinking from it, relations change. The cup becomes a part of my actor-network, and the availability is turned into an actualization. By grabbing the cup and lifting it to my mouth, I am not only making availabilities into actualities. I am also aligning myself with the expectations of the cup (or the expectations of the actor-networks of the cup). In this example relating to an expected availability makes the addition of the cup to my actor-network into an actor which I hardly notice, just as the children in chapter 5 hardly noticed that gender and numbering were added to them. But if I relate to one of the many imaginable availabilities that goes beyond the borders of opportunity that the expectations highlight, if I throw the cup on the floor for instance, or spill the content of the cup into my laptop, then the addition of the cup to my actor-network becomes notable: Such actuality would set new expectations and through that make other availabilities more plausible to relate to, such as to clean up the pottery from the floor, or to go to the IT support unit with my wet computer.

To sum up, availability has been identified as something immediate, where the absent theme of an interview is considered as immediate as the camera. When availabilities are related to they become actual, and by this act new availabilities are exposed. Expectations, on the other hand, encounter preceding actor-networks. The cup is inscribed to be drinkable, and with past experiences with cups as drinkable, expectations set out incentives to relate to certain availabilities instead of others if I want a drink of my tea and satisfy present expectations.

With some insight gained on the difference between availabilities and expectations, I will now turn my attention to authorisations. Authorisations are very like expectations. It would be understandable and even appropriate to exchange expectations with authorisations and say that the cup authorises me to drink from it.

So identifying differences is not immediately obvious. I will therefore look at the networks making up these concepts since it appears that expectations and authorisations draw rather different actor-networks.
Authorisations first: I have attempted to put the term authority aside, but it appears to manoeuvre its way into the descriptions again. Authorisations are connected with its stabilised form, authority. Authority is, as explained at the end of chapter 6, performed as singularities that authorise or are authorised, which is exactly why I wanted to use the concept of authorisations instead. But some of this interpretation maintains the concept of authorisations. When we are authorised to (do) something, then we are also believed capable of doing it. Trust is interwoven – the cup believes me to be able to drink from it – or to be exact, the actor-networks of the cup (enrolling among others designers, producers, distributors) believe me capable of drinking from it. This tells me that authorisations might share with expectations the inclusion of preceding networks, but its entanglement with the emotions of trust and belief makes authorisations more oriented towards the present than the past. In spite of the difference in orientation between expectations (past) and authorisations (present), they both share the ability to point out some availabilities to pursue rather than others. And this exchangeability of expectations and authorisations also explains why Despret is capable of interlinking expectations and authorisations, by stating that the one who sets the expectations is the one who authorises (Despret, 2004a, p. 120).

With this insight about the three terms I will look at the classroom again. The situation is obviously increasing radically in complexity than when I was analysing just me and a cup. In the classroom, several different entities are simultaneously made available, expecting, and authorising. And a combination of Despret and Deleuze has made clear that the availabilities change the very second that an availability is actualized. When bodies are moving, they are made available to stop. When the camera is recording, it is made available to stop action, and when the children are linking to the manual it becomes available to break that connection, as well as it also is made available to relate to the next instruction in the manual. Interpreted like this, availability does not tell us why, or how, something is related to, but the terms do help us gain insight into the virtual landscape of availabilities in the classrooms.

The insight gained on the difference and similarity between the three terms is collected in the following table:
<table>
<thead>
<tr>
<th>Relation to the present</th>
<th>Availability</th>
<th>Expectation</th>
<th>Authorisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choice of action</td>
<td>Available to relate to is guided by the authorisations, or expectations</td>
<td>Expectations point out reasonable authorisations to initiate on behalf of past experiences</td>
<td>Authorisations point out availabilities to relate to according to the expected goal to achieve</td>
</tr>
<tr>
<td>Time</td>
<td>Referring to possible enactments (future)</td>
<td>Referring to the past</td>
<td>Referring to the present</td>
</tr>
</tbody>
</table>

Table 5: A view on the differences between availability, expectations and authorisations

Circulations of authorisations revisited

The assemblage in which the camera partakes clearly illustrates that the presence of the camera is making it available for the children to relate to it. Using Deleuze’s concepts virtual/actual it is clear that when the girls link to the camera for the first time then they are actualising virtuality. The cameraman and reporter can thus be seen to be what is made real, out of some of the things made possible. The girls could have been relating to other possibilities as, for example, to the manual, but they chose not to do so.

Let us examine the expectations that Kamilla and Viola are relating to. At the start of the chapter I have argued that the presence of technology makes the children expect the presence of other patterns of relations. Linked to this expectation they relate to one another: Kamilla is asking Viola to film her interviewing. Here the expectations for their interaction is set. The form of an interview was available in Kamilla’s actor-network. The realisation of the form of an interview as a present actor makes certain availabilities more attractive to relate to than others. The black Lego brick, with a dash of imagination, looks like a microphone, and thus becomes an availability that fits within the boundaries of availabilities highlighted as ‘good to attend to’ or ‘right’ when realising an interview. Remembering the connection between authorisation and authority this also means that with this expectation given, the girls also decide what authorises their action.

In the previous sections, I explained that when we are relating to these availabilities they turn into actuality, which produces new availabilities. However the example of Viola and Kamilla differs from the one with the cup. When I have emptied the cup and I have my mouth full of tea, then - mouth filled with tea, cup at mouth -
is making it available to me to put the cup down again. Applied to the theme cameraman and reporter, it seems there is only one option; when the cameraman and reporter have changed from virtual to actual; it is made available for it to end. With this logic it becomes important to examine when the theme cameraman and reporter comes into existence, and secondly, when expectations are fulfilled. Let me look at the example again.

The absence of me and the teacher, and the presence of Kamilla, the camera, the black Lego stick and Viola are making it available to perform an interview. Kamilla is orally suggesting it to Viola, which makes it real, and with that, a new expectation arises. It is made available, and ‘fitting’ in relation to the expectation of an interview for Kamilla to say something, and when doing so, new availabilities becomes visible. She is expected to create some kind of story line relating to the schema of an interview. The girls at the computer are making it available to her to create a little reportage about them and say that; ‘we are about to see somebody who is drawing.’ The actualising of virtualities pointed out by the expectation continues until the girls are interrupted, which I will return to below. Before that I will attempt to answer the questions: When is the cameraman and reporter assemblage actualised? Why do the actualisation and its continuation appear to coexist?

Firstly fulfilment: The assemblage of cameraman and reporter is first fulfilled when it is stopped by Karen. Then it is reality, then I can reconstruct the story of children playing with my camera, and everybody watching the video would (probably) agree with me, that this is what is happening when viewing the video from the moment Kamilla suggests an interview until Karen stops them. The retrospective perspective is important here, and is underpinned by Latour who states that:

> If you realize a potential, nothing really happens, since “everything was already there in potentia.” If you actualize virtualities, it is only retrospectively, because of the radically new event of the actual occasion, that the real can be seen as what has emerged out of what was possible.

(Latour, 2005b, p. 235)

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62 I will not change example in the middle of this unravelling but mention that the latter question gets somehow clearer when the expectations of the children becoming good constructers as discussed in chapter 6 are kept in mind during the presentation of the argument.

63 It is important here is to mention that the description of the circulation of authorisation and what is made actual, captured on tape, suggest a timely interpretation that follows what the tape poses. Yet we cannot know when the camera and the potentiality it holds is discovered. Realising the availability does not make cameraman and reporter become actual. Relating to the camera, the black Lego brick and to the form of an interview is what makes it actual.
Our retrospective construction of the real or actual can also be explained if we look at this empirical example slightly differently. If the girls and the camera continued for hours, the interview was dropped, and the majority of the girls performance would be characterized as a dance, then we would retrospectively tag the assemblage cameraman and reporter differently. So cameraman and reporter are not made real before the emergence of what is made actual. Expectations point in a certain direction and fulfilment is emerging from the attachment to availabilities.

Let me go back to the example: Kamilla states that Viola is going to conduct an interview with her. Several things are at this point available to the two girls. What happens is that Viola and the camera relate, and Kamilla and a black Lego brick relate. Actualising these availabilities is an indication of an acceptance of Kamilla’s propositions.\(^{64}\) The knowledge of the form of an interview that Viola and Kamilla are committing themselves to might provide an insight into the circulations of authorisations. With this knowledge then circulations of authorisations are not only a constant actualisation of virtualities. Here, circulations of authorisations can be described as a process that is initiated by the expectation that it is set out to actualise. Kamilla and Viola are, through their actions, enacting cameraman and reporter by connecting to availabilities that help them actualise exactly that expectation.

Becoming a good constructor as discussed in chapter 6 can be similarly described. It is not relating to the manual and the bricks (or solely the bricks as I shall describe in the next chapter), that moves the children into becoming good constructers. It is them relating to an expectation and a continuous process of actualising virtualities that make the children appear as good constructers. And, as argued in chapter 6, successful circulations of authorisations make everybody look competent. The example of the cameraman and reporter in this chapter also illustrates that the circulations of authorisations work as positive spirals: The closer the entities are entangled in cooperation causes them to satisfy an expectation and this in turn entails that the expectation is more competently performed. The camera, Kamilla and Viola are competently performing cameraman and reporter as long as the teacher Karen does not relate to the assemblage, in the same way that Julie, August, Tim, teacher, manual and bricks are competently enacting good constructers.

Let me follow up on the following questions before we proceed: When are expectations set and when are they satisfied, and how can the seemingly coexistence of certain expectations and their actualizations be described?

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\(^{64}\) The same have been identified in chapter 5 where the children’s acceptance of the teacher’s propositions can be seen in the way they are accepting the bodily alignment with the floor.
Expectations are set when present actors relate to the expectation by their performance. For example Kamilla and Viola perform by walking behind the camera and grabbing a Lego brick, or the children’s acceptance of the teacher’s expectations of them becoming good constructors by relating to the manual. Thus satisfying expectations entails a constant process of actualizing availabilities - every time a virtuality is turned into an actuality, then new virtualities or availabilities arise. Satisfying the expectation guides which availability to relate to. The teacher’s distribution of the manual is making it available for the children to relate to it, and when following it there is a constant interplay of actualizing availabilities. The building instruction can be used as a simple example. On page 25 in the manual there is a building instruction. Actualising the first guidance is making the next one available. In this example satisfied expectations are also fairly easy to identify. When Julie, August and Tim hold a built robot car in their hands, expectations are fulfilled and new expectations are made available for them to fulfil. So circulations of authorisations are the process of fulfilling expectations. The teacher’s expectations or authorisations also stay virtual until the highlighted availabilities is linked to and the procedure to follow is actualised. This tells us that the expectation guiding the choice of availabilities coexist with the many (larger or smaller) availabilities that have to stay virtual until other expectations are accepted.

The example of Kamilla and Viola can be described in the same terms. There is an acceptance and agreement that an interview is to be done, which makes the circulation of authorisation point out availabilities to actualize in order to fulfil the expectations of cameraman and reporter. The end of it, however, is not that clear cut. Something else is revealed here. The girl’s expectations are being put to an end by Karen, which indicates that certain expectations rule over others, or that certain circulations of authorisations can shut others down.

**Domestication**

I have moved from a simple example with a cup, towards more complex situations in the classroom. As I have mentioned several times, Despret suggested that the one setting the expectations is the one authorising. In this chapter I have identified the same interchangeability in the use of these two concepts, expectations and authorisations, as well as I have pointed out that the concepts draw different actor-networks, and in particular I have pointed out the relation of authorisations to the term authority, and that its enactments in practice as well as linguistically, prevent authorisation and expectations from being exact synonyms of each other.

I will now direct my attention to the relations between different circulations of authorisations. What happens when different authorisations – becoming a good constructor and becoming cameraman and reporter - suggests different, conflicting
actualities? It is clear that the teacher Karen puts an end to the assemblage of relations making cameraman and reporter. I do not have empirical data to see whether the flow of the pop song performance is blocked but it is my belief that some of the mutations of the song event would be stopped just like the camera assemblage, whilst others which do not compromise the circulations of authorisations that are relating to the teachers expectations, would not be shutdown. For example where the two first bars of the song is hummed. Yet to gain more insight into the relation between different expectations and assemblages I will now focus on the dimension of domestication and the dimension of bodies.

Let us look at the teacher Karen’s actions. When she tells Kamilla and Viola to stop acting in front of the camera, Karen is exercising domestication. She can do that because she is stabilised as a legitimate authority. In chapter 5 I concluded that the stabilisation of authority can only be maintained as stable by a large amount of ordering processes that also engage the emotions of trust and interest. When Karen opens the door and sees what Viola and Kamilla are doing, she is not making things available to Kamilla and Viola. She is telling the children to stop, and is demonstrating her ability to give orders. I will argue that bodies and body movements perform a central role in this act. The first thing Karen sees when she opens the door as she comes into the room is Kamilla and Viola standing in the middle of the room one in front of, and one behind, the camera. Bodies positioned in Euclidian space function as fast indicators for Karen that Kamilla and Viola’s enactments are not connected to teacher expectations. Body positions can also help to explain why the girls are stopped from playing with the camera, but the children drawing on the computer instead of engaging with the Lego Robolab interface, are left unnoticed. Enacted bodies will be the last dimension to be investigated in this chapter, and the third example will show how computer enhanced teaching can perform bodily liberation.

**Bodies & technological magnetism**

I will now discuss the girls who are drawing and trace what is called technological magnetism (or technologies ability to engage and excite) within the literature of computer enhanced learning (Egenfeldt-Nielsen, 2005; Gee et al., 2004; Jones, 2002; Resnick, 2006; Shaffer, 2006).

‘They are simply just drawing’ Kamilla said on her way back from the two children sitting in front of one of the stationary computers. Let us find out what constitutes the actor-network here; what is made available, what is immediate to the children

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65 Karen like Pete is stabilised as an authority prior to this example, see chapter 5 for a detailed description of that process.
drawing? They enjoy a bodily emancipation – for instance no one asks them to stay on their chairs. They are free to move between the two rooms, as long as they do it quietly with no sudden moves, and it is preferable to move near the tables with bricks. Yet moving around isn’t what they relate themselves to. In front of them is a computer with a drawing programme opened.

This class in general is familiar with computers (interviews with children and their teachers confirm this), they are use to play with the computers – or rather, they are use to using different applications on the computer in their spare time. Here, the two girls have opened a drawing application, and by so doing silently relate to something other than the Lego Robolab interface. This tells me that the relation between the girls and the computer liberates them in another way besides the bodily release.

Technology offers a vast amount of other availabilities only a few clicks away. They could have opened a browser; they could have opened an online game, their Facebook profile, or MySpace page. The possibilities are many, and this experience matters. The girls know that computer enhanced teaching does not only make the availability of different body positions and the potential of an increased bodily movement available, the digital material makes available other things as well. Making these other digital materials available produces an assemblage of connections made between the children, the computer, online/offline content, and body positions that resemble bodies as they are performed when interacting with Lego Robolab’s programming interface. Body positions are here becoming important because it makes the activities look right from a teacher’s perspective, and both wrong and right ways to meet the expectations of engagement can therefore be said to be produced.

**Wrong and right ways to meet the expectations of engagement**

All three assemblages described in this chapter; cameraman and reporter, pop song performance assemblage, and the girls who are drawing, enact engagement one way or another. Or all three assemblages bring engagement as an effect. Yet the different teacher’s responses to the assemblages show that there exist right and wrong ways of meeting the unarticulated expectations of engagement, seen from the teacher. When Karen enters the room Kamilla and Viola’s doings are immediately stopped.

The children by the computer are left alone, and we are left with guesses to suggest what would have happened if a teacher had met the pop song performance in its different mutations.
None of the assemblages relate to the Lego Robolab application, to the manual or (to more than one) Lego brick. It is difficult to satisfy teacher expectations of becoming ‘good constructors’ without relating to any of these actors. Yet the children drawing at the computer are not addressed by the teacher, and by that are authorised to continue what they are doing. Fulfilling the teachers expectations produces 1) bodies that are standing at the boxes building, 2) bodies sitting in front of the computer programming, 3) bodies walking to ask assistance from the teacher or a class mate, or 4) bodies walking to find a missing bricks in another box with Lego bricks. The bodies of Julie, Tim and August in chapter 6 are examples of this. The children drawing’ bodies match the children following the teacher expectations of becoming good constructers, and are therefore left unnoticed.

What about Kamilla and Viola? They are surely also engaged, but it is easily identifiable that their bodily emancipations actualised in their movements do not match the way bodies are performed when expectations of being good performers are being actualised, captured in the four bodily availabilities mentioned above. There is no bodily connection to any of the entities making up ‘good constructers’. The physical space the girls inhabit match exactly the assemblage of cameraman and reporter they are enacting, and not the one the teachers wish them to enact.

In all three assemblages, seen from the expectations of the teacher, the relations to the materials are made in wrong ways. The children drawing relate to the wrong application on the computer, and Kamilla and Viola relate wrongly by grabbing only one brick instead of building with them, and the girls are wrongly singing instead of building. The wrongness does not stop there though for the cameraman and reporter. Viola and Kamilla’s faulty relations to materials are linked with wrong body movements – too wild and too noisy, together with relations made to forbidden material – the camera. In contrast the children who are drawing are continuously puzzling, with a constrained bodily activity that aligns the picture of an engaged children, in matching bodies performed when following the teacher expectations. Thus the wrongness seems to be mostly present in the song example since the only thing linking the assemblage of the pop song performance, with the teacher’s agenda is the expectation of engagement.

None of the three assemblages is in relation to the expectations of being good constructers. The teacher setup and the given introduction are practically the same in the two classes. The camera is part of both situations and both classes are asked to follow the manual, yet authorisations are only circulating in Pete’s example, making all parts of the network look competent – which from the teacher’s position is an attractive situation. Creating a situation where these situations do not occur would take actors like computers, cameras and other electronic equipment out of the class-
room. So what is the lesson to be learned from these descriptions? That it is to be expected that children do not relate to teacher expectations? Well yes, the availability of small handwritten notes changing hand under tables in an ordinary classroom is always a possibility. But the change in media, from paper and pen to camera and computers, makes the numbers of different ways of relating to the material noticeably increase. This, in conjunction with the different material arrangement when using digital learning materials that decentralise authority and minimise the possibility for the teacher to supervise all activities, makes the general possibility for local expectations to come into existence increase. This results in freer body movements, such as we have seen it be the case in the cameraman and reporter assemblage, and the more fluid assemblage of the pop song performance.

**Conclusion - other expectations make other authorisations available**

Teachers are expecting the children to become good constructors and to be engaged. The expectations of engagement have been studied through three different assemblages in this chapter; the pop song performance, the cameraman and reporter, and the children drawing. Each assemblage has produced insights into the authorisations. I have discovered when describing the pop song performance that other teacher expectations are present, that of engaged children, and that children expect their bodies to be liberated while participating in the lesson. The relational analysis is related to the topological metaphors; fluids and network developed within the field of STS, since it is possible through these metaphors to capture that the ways (the same) entities relate to each other produce radically different things.

The second assemblage made up of Viola, Kamilla, camera and a black Lego brick is opened up analytically by the vocabulary of absences and presences, since it is obvious that the absence of me and the teacher matters in relation to what is enacted. The logic is, however, thankfully returned, because it promotes the insight that something always is suppressed or not available and this stabilises reality far more than the monistic description of reality that Despret, Latour, Deleuze would allow. Despret’s availability is hereafter linked with Deleuze notion of the actual and the virtual to express what exists. With these logics in play it is identified that availability corresponds with virtuality, and that actualisation of virtuality produces actuality or what is real, which again makes new virtualities arise.

Authorisations and expectations are related to this logic, and it appears that the interchangeability among the two terms (as suggested by Despret) does not make them equal. Differences occur since the two concepts draw different semiotic actor-networks. Authority is reintroduced as it helps to explain that authorisations are oriented towards the present – I authorise you to become a good constructor, while expectations, on the other hand, are related to the past, the teacher can set expecta-
tions since she knows the children are capable of certain things. In the Kamilla Viola example this means that when Viola relates to the camera and Kamilla to the Lego brick, then they set the expectations of cameraman and reporter, and they authorise themselves to become just that. The circulation of authorisations is pointing out availabilities to relate to, to fulfil the expectations. This produces three important points about authorisations. First, it is possible to have coexisting expectations. Secondly, that circulation of authorisations can be described as a process of fulfilling expectations. And thirdly that circulation of authorisations can coexist. Viola and Kamilla’s circulations of authorisations co-exist with the circulations initiated by the teacher Karen’s expectations up to the point when Karen interrupts the girls activities. Then, by the use of her stabilised authority and her ability to domesticate relations things change.

The third assemblage described in this chapter is the children drawing. The children drawing interlink body movements and circulations of authorisations. Karen can immediately interfere with Viola and Kamilla’s activity because the ways their bodies are enacted do not match the ways bodies are performed when becoming good constructers. The children drawing however bodily resemble such bodies, and are therefore left unnoticed.

The coexistence of different authorisations have been identified in this chapter but not sufficiently explored. The following chapter will provide a more detailed exploration of this topic.
8. AUTHORISATIONS MULTIPLY - A PASTA FORK AND A FAST CAR

The subject of chapter 8 is a description of the multiplicity of Lego Robolab and the coexistence of several different assemblages with different circulations of authorisations. In the former chapter I have presented three empirical examples where the children did not encounter the manual or the teacher in their activities. It illuminated that other, unarticulated teacher expectations partly legitimize some of the children’s activities. This chapter follows the boy Bertil’s changed affiliations to three different assemblages: One where the relation between Bertil and the Lego bricks is prominent, one where the manual is central, and one where the relation between the children, bricks and computer is important.

The different constellations in the three arrangements affect who and what is given the possibility to authorise. In this case then the relation between Bertil and the Lego bricks suggest that the changes in authority figures are promoted (and promotes) relational changes within a relatively stable repertoire of different human and nonhuman entities. The descriptions points out two things: That authority is not only sociomaterial but is always in a developing process, and that there is always changes between who or what has authority.

I will also discuss one of the questions raised in chapter 7. In interviews conducted after the observations, the teachers align expectations of the lessons with the outcomes of the lessons. However the idea of Lego Robolab and what Lego Robolab is making available to teachers and to children does not align, it is not the same. This asymmetry is discussed by introducing the Mol’s notion of multiple ontologies, and it is suggested that understanding Lego Robolab as a multiple object might be helpful in understanding the variations and discrepancies in the handling of Lego Robolab.

Assemblages with different enactments of Lego Robolab seem to co-exist and this makes it important to engage with descriptions that capture the relations made between assemblages. The chapter follows Bertil’s movements, first where he is in a situation where he is authorized to act by the Lego bricks, second where he is authorized by the manual, and finally where he becomes the one who authorises himself. The focus will be on the transitions between the different arrangements where through different expectations and different circulations of authorisations exist. Identifying the relations between the different assemblages is done with the
The chapter concludes by suggesting Lego Robolab as a multiple object, and that the coexistence of different assemblages is interlinked with different patterns of relations and to the temporal dimension of the coexisting assemblages.

**Lego Robolab authorising**

The example I am about to analyse is another situation where a child departs from the expected procedure. The children in 5Z have been given an introduction to the system and the class has been arranged in working groups. The materials, computers, manuals, and boxes are also distributed.

One of the fifth graders, Bertil, looks briefly at the manual and puts it aside. He starts to explore the contents of the boxes. Omar, his working partner, does not mind and participates in the examination of the bricks. Bertil takes one of the engines, some Lego bricks and an on/off switch. He is leaning over the table and starts to build. After a while he raises his head, smiles and demonstrates his invention to Omar – an electronic pasta fork.

The fork is 25 cm long, ending at a 15 cm shaft from where Bertil can start and stop the rotation of the fork head. He runs around to the other working groups and shows his fork. Some of his fellow peers laugh, and a boy across the room shouts that he wants to see the pasta fork as well.

*(Field notes from the 19th of April and video recording from the same period, tape 2, time 05:00)*
Let me start this analysis with an imaginary procured in the connections between the example above and the quotation below. The quotation is from Vinciane Despret, and has already been presented once in chapter 4, part I. Despret’s empirical cases are situated within the field of experimental psychology where she unfolds relations between animals and researchers. In the quotation below by replacing scientist with teacher, apparatus with Lego Robolab and animals with children it gives a fertile ground for making a different interpretation of the empirical example of the Pasta Fork assemblage I discuss here. The suggested alternative word is placed in italics, just behind the word that it could exchange.

The contrast between a scientist (teacher) who relies on the availability of both apparatus (manual) and the animal (Lego Robolab), and the scientist (teacher) that requires docility this scientist (teacher) being himself docile to the perceived prerequisites of science (teaching) may be translated along another contrast: The contrast between the manner of addressing oneself to the system, on the one hand as a care-taker, as somebody interested in its possible becoming, and on the other hand as a judge or a master. In the first case the animal (Lego bricks) are what articulates the system, in the other, it is the system that articulates the animal (Lego bricks), which just have to show how it (they) obey laws.

(Despret, 2004a, p. 124)

The combination of propositions from the quotation above together with the example just presented opens up new ways of looking at the configurations of children, material and teacher. Initially I will focus on the relation between Lego Robolab and Bertil, and the other relations will be added to the explorations later in the chapter.

The teacher’s double ambition of the expectation of creating good constructers and engaged children opens the possibility for liberated exploration, as highlighted in the previous chapter. But this, I will argue, does not solely explain Bertil’s engagement here. Something different is taking place which we might see when we allow ourselves to imagine the situation in different ways. Suppose we suggest that the Lego bricks are what articulates the system here, and not the other way around. I will follow this interpretation to see what it can produce.

The box with Lego equipment and Bertil are relating. Looking at the lines of availability, then Bertil is addressing himself to the situation as one being interested in possible becomings. It is clear that the presence of the Lego Bricks makes Bertil work differently – he is not initially relating to the manual, he does not take any
notice of the computers but he leans forward and investigates the content of the boxes. Presumably this is partly possible because the relation between Bertil and Lego bricks is not a new one (as a group interview in which Bertil participates also confirms). Bertil has been relating to Lego bricks before, at home, which makes prior experiences present. These prior experiences partake of the assemblage of Bertil, bricks, teacher expectations and peers, which produce and materialise new ways to articulate the relation of Lego-bricks-and-Bertil. Bertil normally just builds with the bricks but this box offers an impressive collection of specialized bits and pieces, almost demanding a liberated use. I will suggest that Lego Robolab authorises Bertil to build freely with the material, and that this authorisation is possible through the alignment of several things, namely: prior building experiences, Bertil, teachers out of sight, the content of the Lego boxes, and a working group member who cooperates with Bertil.

Lego Robolab’s authorisation of Bertil is returned with trust. Bertil trusts the bricks to be constructable. He builds a pasta fork, and when finished he shows his creation to the other children. Remembering the concept ‘circulation of authorisation’ then it can be said that the circulations continue. Bertil, with this activity, is authorising his classmates to be good fellows who acknowledge his invention. And in the same movement his peers authorise Bertil to be a good inventor himself and, at the same time, they authorise the bricks in the boxes to be ‘good bricks’. A circulation of authorisations is made and this time it is anchored, and/or initiated by Lego Robolab.

The argument that the Lego bricks are the one authorising is yet still not satisfactory. It sounds as if Bertil is drawn to the bricks. I even have an interview which supports this. What would the descriptions have been like if I had not conducted an interview? Who am I then to determine what Bertil expects? I will try to illuminate the argument that Lego Robolab authorises Bertil to relate to the bricks differently by remembering and using the insight gained in previous chapters on authorisations and expectations.

In chapter 6 it was identified that for authorizations to circulate the emotions of trust and interest need to be present. It was identified that expectations and trust are interlinked with past enactments, and that in order to be maintained trust in the stability in the entities performances needs to be encompassed (for instance by the teacher). In this line of thought then Bertil has expectations of the Lego Robolab, based on his former experiences of using the Lego bricks. He therefore believes that Lego Robolab can be used in liberated ways. The shortcoming of this view is that we are fairly quickly locked into an analytical position of assuming what people rightly, wrongly or passively believe in, and at the same time an inner/outer and
I/you dichotomy is activated. Bertil is not necessarily ‘drawn’ to the Lego boxes. What I can see is just what he is doing; he looks into the boxes, he takes some of the Lego bricks and starts to build. Bertil is making something with the bricks and is in that act making himself available to the event Bertil-with-the-pasta fork. So the act of making - the event - is making Bertil available and giving him expectations. It is this belief that actually makes the pasta fork available to him. Intentionality and expectation, in other words, do not here belong to the human species – they are created as effects of relations between humans and nonhumans.

Returning to the description of the Lego boxes as the authorising figure with this and the previous insight in mind, can I then say that Lego Robolab is authorising, or would I more rightly conclude that the boxes are not doing it alone? If I choose the first position then the argument that places intentionality in the relations among entities is weakened and something is ‘put into’ Lego Robolab. If I choose the latter then the argument for Lego Robolab as the one authorising is weakened. A third possible answer might emerge as a mix of the two positions. Lego Robolab authorises Bertil to build the Pasta fork and this is done in relation to other entities. Instead of taking the view that design is something that imposes order on practice I will use Sørensen’s view on design as being something that is engaging with practice in order to enrich the point of view of Lego Robolab as being an authority in a network that is a co-constitutive movement (Sørensen, 2006).

**Design engaging with practice**

Sørensen’s interest in design processes in relations to design itself arises from a question about whether fixed standardised design brings about rigid practices and whether open, more fluid practices brings about flexible designs. In order to answer this Sørensen returns to the design process, where she explains that it is impossible to design anything without an imaginary of what sort of practice the design is going to engage with. In these imagined practices we see certain users and situations of use, and by that, other imaginaries are intentionally or unintentionally excluded. ‘Design is never just about making a technology but always also about designing practices, whether intentionally or not’ (Sørensen, 2006, p. 149). This procedural view on design gives things a political dimension as Sørensen, in line with other STS researchers, concludes (Law, 2004; Law & Singleton, 2005; Mol, 2002). The design is so to say stabilized with a certain intentionality. However this does not mean that the articulations – the doings of Lego Robolab – are also stabilized. The concrete realizations are often proven to be more subtle and complex than the designers intentions (Sørensen, 2006, p. 161). Sørensen blurs the borders between designers and users by making it clear that both teachers and designer’s make the design practices, although we tend to understand that it is the teachers, job to be the one developing the practice whilst the designers job is to create the learning technolo-
gies. She writes; ‘just as designers implicitly design practices as well as technologies, so do teachers implicitly design technologies when planning the practice of the class. (Sørensen, 2006, p. 146). The teachers in Bertil’s class could have chosen to design the lesson otherwise. They could have chosen not to introduce the manual, and then the technology Lego Robolab would have been completely different. They could also have chosen, as some teachers did (interview with Paul) to add extra assignments to those written in the manual, which would again change the technology.

Sørensen’s view on design as a process is useful to keep in mind as we look at Lego Robolab as a co-constitutive movement between the Bertil-Robolab relation, and his prior experiences with Lego bricks. And if, at the same time, we accept that the design making ability is not just restricted to the designers and the teachers then I will suggest that children-with-technologies might have the same design making ability. This leaves us with (at least) two arguments to pursue: Lego Robolab as an authority in relation to other authorities in the classroom, and Bertil himself as a designer of practice.

**Different versions of Lego Robolab**

I will join Bertil again:

When Bertil is walking around to show his classmates his electronic pasta fork, he sees where following the manual is taking the other working groups. Returning to his place he takes the manual and finds the building instructions p. 25. Omar and Bertil start to build again, this time relating to the manual. The manual shows how to build a car with one engine. Omar and Bertil use two engines and they also build in bigger wheels.

The groups are given an assignment. They are going to programme their car to drive for two, four, six and eight seconds and measure how far the car can drive according to these time measures. Bertil and Omar are also programming their car, but not according to the time measures suggested. After a while the teacher asks all the groups to programme their cars to drive the distance of 123 centimetres, without testing it first. The working group’s calculate and programme their car to drive the amount of time they presume fits with the assigned distance, while Pete measures the distance on the floor and mark it with white tape. When all the groups are ready, the cars are lined up and, on the signal from the teacher, they are set off. Omar’ and Bertil’s car is faster than any other car and continues to drive way beyond the 123 cm mark.
The groups return to their workspaces, and five of the other boys immediately approach Bertil and Omar to figure out how they can tune their cars, and Bertil offers to help them. *(Field notes from the 19th of April and video recording of the same period tape 2, time: 5.00)*

In this and the previous field note excerpts I have described Bertil and Lego Robolab in different configurations; from the-Lego-boxes-and-Bertil and Bertil-and-a-pasta-fork, to the-manual-and-Bertil, and ending with Bertil-and-the-fast-robot-car. These different assemblages are interwoven differently with the dimensions of bodies, emotions and domestication, and the examples illustrates the great variety of ways that the Lego Robolab participates in the interplay between the child(ren) and the teacher’s agenda. Questions arise about how we can make proper descriptions of these differences.

**Multiplicity**

The notion of multiplicity that is put into play by STS researchers seems useful to introduce here. Sørensen writes:

> While it is widely accepted that people may exercise different politics with one and the same thing, a thing itself is generally understood as singular, as only one. Turning to a symmetrical approach that describe humans and things in the same term makes it just as possible that things have a multiple politics as it is possible people do.

*(Sørensen, 2006, p. 156)*
Sørensen’s incentive to talk about multiple objects is political. She asks us why we aren’t allowing objects multiplicity in the same way as we take it for granted that our handling of objects allows. To think Lego Robolab as a multiple object has already been implied through the learning platform’s ability to be presented with or without different elements of the material. Yet the difference has so far been presented as a brick system itself, where the parts of the system can be either related to or not – as it is also the case with the manual. However the notion of multiplicity goes further than that: The multiplicity of objects has methodological consequences. Annemarie Mol’s work in her book ‘The Body Multiple’ (2002), can be used to illustrate this. Mol is studying how the disease atherosclerosis is done in practice, and introduces multiplicity as a necessary consequence of her research practice. She writes:

If we no longer presume “disease” to be a universal object hidden under the body’s skin, but make the praxiographic shift to studying bodies and diseases while they are being enacted in the daily hospital practice, multiplication follows. In practice a disease is no longer one.

(Mol, 2002, p. 83)

Mol’s multiplicity arises from an ethnographic empirical ambition to study practices, from which her concept ‘praxiograph’ is also coined.\(^66\) If objects are multiple in practice, as Mol and Sørensen suggests, then a multiplicity of ontology follows as well. We might talk about one body, one Lego Robolab system, but they are multiple in different assemblages – different ontologies.\(^67\)

Several questions arise from this. To start with we need to get closer to the multiplication of objects. If multiple objects and multiple ontologies exist together what are the relations between them? Furthermore, what will it mean to engage with multiple objects and multiple accounts? For instance, both with a multiple object and with multiple ontology questions arise about how singular impressions of coherent objects and realms can be enacted by manifoldness or fragmentation.

Let me start at the beginning of the question. In what way is Lego Robolab a multiple object? Not only is the design changeable according to the elements of the learning platform (manual, bricks, computer) that are related in the specific moments, but if the notion of multiplicity is to be taken seriously, then the multiplicity of

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\(^{66}\) See also chapter 4.

\(^{67}\) Some objects do thus multiply easier then others. The black board for instance does not multiply as easily as the computer which, in principle, is the gateway to a whole library of opportunities. Science is another good example where a inertia in the willingness to make findings multiply is more common than the opposite case. See also the discussion on accuracy and articulation in chapter 4.
Lego Robolab never just counts as part of the learning system the teachers bring with them to the classroom. Then the answer is to be found in the enactment of Lego Robolab in practice. Does this mean then that there are as many assemblages of Lego Robolab as there are actor-network constellations present in the classroom? Mol’s well cited quotation ‘more then one but less then many’ (Mol, 2002, p. 55) hints that this is not the case. Turning to the field notes excerpts presented in this chapter also does not support a view of Lego Robolab as infinitely multiplying. Assemblages cluster. And there are at least three different assemblages identifiable here: Bertil and the pasta fork, children with the manual, and boys tuning their cars.

I will identify the multiplicity through the dimensions of bodies, emotions and domestications, and by that describe how the circulations of authorizations are done differently in the three assemblages. Furthermore, the way in which entities relate in the different assemblages can be said to form preferential patterns of relations that can be understood by the topological metaphors introduced in chapter 7.

Bertil and the pasta fork

I have already identified the emotions present in the assemblage where Bertil and the Lego Robolab system produce the pasta fork. Bertil builds with the bricks which are making it available to him to build the pasta fork. The circulations of authorisations are identifiable here; Bertil trusts the bricks, and the bricks trust Bertil. Yet other entities and effects of relations are identifiable in this enactment of being in relation to the Lego Robolab system. Let me look at body movements. Using the expectations identified in chapter 7 then Bertil’s body looks engaged. He is standing at the high table and builds with the Lego bricks. The teacher must to go directly to Bertil to see what he is doing, and by that identify that he is not following the manual and building a robot car. By not knowing that Bertil is building a pasta fork the teacher has no reason to interfere. The enacted bodies aligned with the bodies enacted in the assemblage where children follow the manual, and Bertil and the pasta fork is thus easily overlooked by the teacher.

The enactment of Lego Robolab which Bertil is engaging with when the fork is produced only relates to bricks and sensors which do something to it. The spatial metaphor of fluidity presented in the previous chapter as something that floats through the relational landscape and adapts to what it meets on the way, might bring an insight about the way Bertil and the bricks are relating to each other (de Laet & Mol, 2000; Law, 2002; Law & Singleton, 2005). The Pasta fork is not just there, like the procedure in the manual. It evolves gradually, and it can do that because Bertil’s standing at the boxes with bricks and his body match the bodies of children doing what the teacher expects them to do.
As a recapitulation of the assemblage of the pasta fork, it can be said that the enactment of Lego Robolab can be identified as an assemblage that includes Bertil, Lego Robolab in form of bricks and sensors, the emotions of trust and interest, and enacted bodies that fit those of children that are engaged in becoming of good constructors. There is no domestication by other co-existing assemblages, and the relation between the present entities can be characterised as a fluid pattern of relation. The fluidity matters, as we shall see, since it is exactly the explorative nature with which Bertil handles the bricks that brings the Pasta fork into existence.

**Children with the manual**

There is another assemblage co-existing with the pasta fork arrangement and that is the one where the children follow the manual. The circulation of authorisation here looks like the one identified in chapter 6 where Pete authorises Julie, August and Tim to become good constructers. The bodies enacted fit the bodies that emerge from following the teacher’s expectations, and no domestication takes place. The material parts of Lego Robolab engaged here includes the bricks, sensors, computers and the manual. As identified already in chapter 6, the manual is a central actor, because authority is distributed into the procedure it contains. The agency the manual holds is also identifiable in its ability to mould the pattern of relations in a certain direction. The procedure written in the manual does not change. It cannot be combined in endless ways just as the Lego bricks can. Following the manual makes identical robot cars. Following the manual makes the relations between bricks, sensors, computers and children relatively more stable than the assemblage of Bertil, sensors and bricks, just described. The way entities relate can thus be said to have a network character, or more precisely, the manual can be seen as a network object - an immutable mobile - that moves around and holds its shape. With the manual in the centre of this assemblage the relations between entities obtain a network character as well, the bricks and sensors are linked to it in a specific order. The same bricks or wheels are selected in approximately the same stretch of time by the different working groups. With the manual, the mutual construction of things and human is obvious. When the children relate to the immutability in form of the procedure that the manual holds, then it matters how, and in what order, the rest of the Lego Robolab system is related to, something that is not important in assemblages where fluidity is the dominant way of relation. The connection between the manual and the children can thus be described as a networked pattern of relation.

**Tuning cars**

For a while Bertil and Omar take part in this network assemblage when they relate to the manual’s instructions. They build the bodywork of their car, find the wheel size according to the manual and add an engine. The fragility of the stability entailed in the network assemblage becomes visible when Bertil and Omar add an
extra engine to their car. This act signals a displacement. Bertil and Omar and their robot car are no longer a part of the assemblage of manual followers. And they no longer produce the specific enactment of Lego Robolab that this assemblage fabricates. They take part in a new assemblage, and two questions seem necessary to ask to vindicate this descriptive judgment. First, how does this assemblage come into being, and secondly in what way is this assemblage different?

I will answer the latter question first. Something different is at stake here. The boys are neither following the manual, as in the previous assemblage discussed, nor are they just building as when the pasta fork emerged. Bertil and Omar know what they want. They want to tune their car. The boys still avoid being domesticated into relating to the manual by replicating the pattern of relations present in the assemblage of the manual followers. And even when they demonstrate their fast car in front of the class and the teacher can see that they have diverged in their actions they are not domesticated to change their performance.

The network metaphor cannot be used to describe what is happening here for several reasons. The stability of networks is provided by actors that hold each other in place, and if one entity changes, or disappears, as here with the manual, then the whole actor network changes. I have in the previous section described how the teacher promotes stable relations among the entities by introducing the manual. And when engaged with the manual, the manual enforces that the children and material create similar connections. When Bertil and Omar are tuning their cars, there are not engaged with the manual. Their Lego Robolab - bricks, sensors and the computer – is not an immutable mobile that easily travels among the actors and holds the actors relations in shape. Yet their enactments do not develop smoothly, as for instance with a fluid pattern of relation when one brick relates to the next and a pasta fork is emerging from the process. Their interaction with the material can be said to stream from a stable idea.

There is another topological metaphor that might hold explanatory potential in developing the description here, and that is the one of fire (Law & Mol, 2001; Law & Singleton, 2005). Law and Mol describes the fire metaphor as:

[…] a metaphor for treating the continuity of shape as an effect of discontinuity. As with fluid constancy, movement rather than stasis is crucial. Without movement there is no consistency. The difference is that, whereas in fluidity constancy depends on the gradual change, in a topology of fire constancy is produced abrupt and in discontinuous movements. [...] Thus fire becomes a spatial formation alongside (and in interference with) Euclidian, network and fluid spaces. To say that there is a fire topology is
to say that there are stable shapes created in patterns of relations of con-
joined alterity[…].

(Law & Mol, 2001, p. 615-616)

The continuity and stability of the assemblage of car tuners, rest in the synchronisa-
tion of action: we tune the car. Bertil and Omar are not letting the selection of one Lego brick guide the next. They know their goal – a fast car – and a stable shape is created. Yet this goal is dependent on the absence of the manual and teachers, it is, to use Law and Mol’s words, dependent on the conjoined alterity of teacher agenda/manual and the car tuners. And it does not, as a way to domesticate the process, relate to the suggested order of enactments as the manual does. So the assemblage of relations enacting the car tuners can be said to hold an odd mix of the fluid and network metaphors - It holds a clear goal; we want to build a fast car as with the network metaphor, together with a non determined process; we have no clear idea of how to do it as with fluidity. This shows in what way the fire meta-
phor is developed alongside (and is interfering with) the other metaphors, as Law and Mol stress above.

Having identified what differentiates the car tuners from the two other assemblages identified, I will seek to answer how the assemblage of car tuners comes into exis-
tence. Using the fire metaphor, the explanation seems fairly straight forward. Follow-
ing the manual cannot remain, when entities change or drop out of the rela-
tional grid, so in the same moment that the children break the connection to the manual, something else happens. The same can be said with Bertil’s previous en-
actment of the pasta fork, and the girl humming ‘I believe I can fly’, but in both of these two cases no clear goal exists. Things evolve gradually in these examples , but with the car tuners something different occurs, according to the view of Law and Mol. Here the relational break from the manual is done with determination and with cooperation between Bertil and Omar, and we can identify that the disruption occurs when the idea of building a fast car arises.

The final thing I will discuss about this arrangement is the dimension of domestica-
tion. All the other working groups have programmed their cars to drive 123 centi-
metres, and Bertil and Omar joins with their tuned car that drives much faster and far beyond the 123 cm. Both teachers and children note this, but Bertil and Omar are not asked to stop their performance, as we saw with the girls and the camera. Back in their place they are left to demonstrate their car to the boys that gather around them. The lesson is almost ending, and I suggest that the time of this event is important, which will be taken into account in the following section where I will
describe the relations between the three different assemblages that correspond with three different circulations of authorisations. Table 6 below presents the insights gathered from the three different assemblages discussed in this chapter.

<table>
<thead>
<tr>
<th>Assemblage name</th>
<th>The Pasta Fork</th>
<th>Following the manual</th>
<th>Car tuners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entities present</td>
<td>Children, teacher, Lego Robolab without the manual</td>
<td>Children, teacher, Lego Robolab with the manual</td>
<td>Children, Lego Robolab without the manual</td>
</tr>
<tr>
<td>The assemblage meets the teacher expectations</td>
<td>- of engaged children</td>
<td>- of engaged children - of becoming good constructors</td>
<td>- of engaged children - of ending-lesson-children</td>
</tr>
<tr>
<td>Children’s body movements</td>
<td>Fits the patterns of movement of engaged children</td>
<td>Fits the patterns of movement of engaged children</td>
<td>Fits the patterns of movement of engaged children</td>
</tr>
<tr>
<td>Domestication</td>
<td>No domestication</td>
<td>No domestication</td>
<td>No domestication</td>
</tr>
<tr>
<td>Spatial Topology</td>
<td>Fluid Mutable mobile</td>
<td>Network Immutable mobile or Regional Immutable Immobile</td>
<td>Fire Mutable immobile</td>
</tr>
<tr>
<td>Product produced by the assemblage</td>
<td>A Pasta fork</td>
<td>Cars alike</td>
<td>Fast cars</td>
</tr>
<tr>
<td>Goal/process</td>
<td>No clear goal/no clear process</td>
<td>No clear goal/ Clear process or Clear goal/Clear process</td>
<td>Clear goal/no clear process</td>
</tr>
<tr>
<td>Expectation and authorisation</td>
<td>Lego Robolab</td>
<td>Teacher/manual</td>
<td>Bertil and Omar</td>
</tr>
</tbody>
</table>

Table 6: Summarizes the three different authorising assemblages discussed in this chapter

The first line in the table expresses the name used for the assemblage discussed. The second line shows the entities present apart from knowledge, interest and trust which are part of them all. Third line notes the elements in play of the Lego Robolab system, while line four and five note what teacher expectations the assemblage meets and what type of bodies are enacted through the assemblage. Line six shows whether the activity is domesticated or not by the teacher, and the spatial topology identified in the descriptions is noted in line seven. Line eight holds the product produced, line nine the way goals and the process is enacted, and finally line ten presents who is capable of setting the expectations of the activity and, by that, establishes a circulation of authorisation.
In the comparison of descriptive attachments to the different assemblages it becomes clear that sometimes order is not as complete as it seems. I have indicated this by the insecurity places in the second row, line seven. I question whether the manual followers are most adequately are described through a network topology or a regional topology. – A question that is triggered by the way process and goal is enacted when following the manual. Here I describe the process as clear, - written in the manual, and the goal as clear – build a robot car by following the manual, which would correspond to an immutable immobile – clear goal, clear process, which are the characteristics used to describe the regional metaphor. One of the characteristics of the regional is that it precisely identified through its homogeneity within its boarders (Law & Mol, 2001; Sørensen, 2009). This description is not as accurate as letting a network of hybrid entities describe the topology of the assemblage of manual followers, and I will leave the network metaphor as the most fitting topological description of the assemblage. Yet the insecurity carries an important message, one of letting the ‘impure’ forms exist and be visible in the descriptions. This might make us sensible to the existence of other topological forms in addition to the four mentioned here.

The coexistence of different assemblages

So far I have identified three different assemblages which relate to three different enactments of Lego Robolab. I will now seek to answer what it will mean to engage with multiple objects and multiple accounts. I will start by examining the relation between the different assemblages.

The assemblages can be visualized in the diagram below, where each square in the figure indicates one of the three described assemblages mentioned in table 6. The visualization of the assemblages is layered but this does not reflect any hierarchical position of one practice being more important than another. The letters A, B and C are added to assist in the following descriptions.

Figure 9: Multiple assemblages
The hanging-together-ness of Lego Robolab

Investigating the relations between the assemblages according to the different Bertil-material configurations I will return to the practices Mol describes (Mol, 2002). Mol’s analytical object, the disease arteriosclerosis, is enacted in various different settings. The distance in time and space are important actors enabling the multiplication of arteriosclerosis. The patient enters the examination room prior to an operation, and the operating theatre is a quite different spatial setting than, for instance, the rehabilitation room. Arteriosclerosis can be said to be performed asynchronously in time. This activates questions of coordination. How do the different versions of arteriosclerosis hang together, how is this achieved and how do the different versions relate? Mol answers these questions empirically by showing how one version of arteriosclerosis can win over another, and how this addition of versions is a powerful way of performing singularity, how a composed picture emerges at different times, or how one version of the disease is transformed into another. All these are different ways that versions of arteriosclerosis coordinate, and it is through these coordinations that the impression of ‘hanging-together-ness is performed.

Mol’s argument for multiple ontologies is socio-materially supported: The versions of arteriosclerosis relating the frozen limb which a pathologist brings out of the freezer to examine with the version of a doctor meeting with a patient in the consultation room differ. What I am doing here is taking Mol’s multiplication ideas and adding them to a single, physical location - the Multiroom. The analytical incentive is the same, i.e. objects are done in multiple in practice, but I do not have the advantage of rather different sociomaterial practices distributed in time and space to support my argument of multiplicity. In my case the spatial dimensions coincide and the temporal displacement is minimal, and it becomes important to capture the details of the different heterogeneous arrangements. The differences between the three assemblages have been identified in the previous descriptions, and presented in table 6 above. Relations among the assemblages, therefore, become interesting to describe and examine in order to answer the question about how the assemblages do or do not hang together. This will be the last question to be discussed in this chapter.

The making of multiple assemblages and changes of authority figures

In Mol’s example among the doctors, patient, tables and chairs in the clinic one version of arteriosclerosis is enacted; with pathologist in the laboratory among microscopes and freezers others are performed. None of the practices are given up because none of the socio-material authority configurations are abandoned.
Transferring the notion of multiple practices into the same location makes it interesting to see the different authorities in relation to one another. Here I describe this in more detail.

By aligning assemblage A (pasta fork) and B (following the manual) as visualised in figure 9 some clearly distinct differences becomes visible. The version of Robolab with the manual and the version without it are not the same, and the Lego boxes as being an authority or the teacher as being the authority through the manual are not the same either. Bertil is showing his peers his pasta fork, and in that act he discovers what the manual is making available to his fellows. Bertil is returning and relates to the manual. Using Mol’s explanations of performed coherence of objects, then Bertil is coordinating his action with another assemblage. Does that mean that he equates assemblage A with assemblage B? In fact two things happen. He is relating to a different enactment of Lego Robolab, the enactment where the manual is a prominent entity in the assemblage, and he is not relating to the Lego bricks as the ones authorising him to act, because here the manual/teacher is doing that. Does this coordination with the authority of another assemblage then dissolve assemblage A? Well maybe the interesting question here is not whether an assemblage is dissolved or not, but if the coordination is affecting anything. The question might therefore be phrased differently. What would it take to be identified as another assemblage? It seems as if intention is important. If the one who authorises action no longer affects acting entities, then the assemblage transforms and is added to another assemblage. The boxes with bricks still hold the potentiality, virtuality, availability of being an authority again. The boxes are, so to say, making assemblage A available. Thus as shown in chapter 5, authority is not done in isolation – something and somebody needs to relate to the availabilities to make an assemblage and authority rise. Assemblage A is dissolved, yet something is added to Bertil. He is a different actor than if he had started by relating to assemblage B. The word added is used rather than translated because Bertil’s experience from assemblage A is not disappearing or translated into something else, it is becoming a part of Bertil’s actor-network. The presence of Bertil’s experience in assemblage A is becoming apparent, because the experience is being actualized when Bertil later meets the boxes with bricks again.

Bertil is relating to the manual in assemblage B. The manual is however not continuing to be the authority for Bertil. Bertil’s recent experience with a very fluid relation to Lego Robolab in assemblage A does not align with the stabilized structures in assemblage B. His liberated way of addressing and transforming the manual’s instructions does not fit in with the action repertoire of assemblage B. His experiences from assemblage A makes other actors available to him. He has been working freely once before and he can do it again. Bertil improvises and a break is
identified. Bertil adds to the manual’s instructions, by putting an extra engine and bigger wheels on his robot car. Knowing that the network pattern of relations needs stability in order to exist, then these additions are enough to identify a new assemblage. Showing the rest of the class his car translates the teacher authority into Bertil being an authority. The other boys want to build a car like Bertil, and by teaching them, he is authorising them to do so. Bertil is making himself available to the other boys by showing them how to tune their cars. And in this act he also authorises them to become good builders of fast cars. Assemblage C (the car tuners) is formed.

To sum up, it can be said that the two assemblages A and B are rather different but their co-existence seems unproblematic. Assemblage B holding the teachers’ expectations and guidance procedure is not challenged by what Bertil is doing in a corner of the classroom. In fact the relational landscape of A can be said to be dependent upon B. Think of the bush pump. The relational landscape needs something to be fluid in relation to it. Here the bricks are provided, bodies appear to be engaged bodies, and from this point Bertil and the bricks can relate to each other in fluid ways. The rupture between A and B is thus far less of a displacement than between B and C. Rather it literally seems to flow out of the situation.

At least one important question remains. How does it come about that Bertil and Omar are allowed to perform authority? When all the robot cars are set off in the competition it is observable that Bertil and Omar have an agenda of their own. And for them to continue be the ones authorising the other boys to tune their cars, the boys find an important ally in time. The lesson is almost ending and two minutes after the competition on the floor is finished, the teacher asks the children to pack the Lego Robolab equipment together. The car-tuners are allowed to exist because the teaching is about to end. Another goal in this particular place in time does not disturb the manual followers, and the car is not going to be used the following day when a new car is to be built enabling the children to work with some light sensors.

The hanging-together-ness can be summarized as being enacted through two different processes: The dissolution of assemblage A, and the transformation in the relation between B and C. Another important feature that adds to the impression of coherence is that Bertil, the Lego bricks and sensors are consistently present in the three assemblages.

It has also been identified that the co-existence of assemblages B and C is impossible because they both serve a different goal, yet the doubling of goals (becoming good constructers and becoming good car tuners) work through the alliances Bertil and Omar find in the factor of time.
Discussion - multiple objects and multiple assemblages

At the start of this chapter I quoted Despret when she writes about two different ways of addressing oneself to systems; as caretakers or as a master/judge (Despret, 2004a, p. 124). If expectations of good constructors and engaged children are put together with Despret forms of addressing systems, then we can posit that the expectations of the children becoming good constructors produces a master and judge function: Are you able to produce the Lego car or not. On the other hand expectations of engaged children make other ways of being with the material possible. Practice A and C are good examples of this. When we allow other assemblages (and questions) to be produced then we are also allowing the possibility of creating complex actors. Bertil can relate to the manual but by relating to it in multiple ways and in different ontological realms, he is offered other additions to his actor network than if he solely had followed the teacher’s propositions in assemblage B. Bertil is, so to say, addressing himself to the Lego system as interested in possible becomings. And he can do this because both assemblage A and C are aligned with the teacher’s interest in the possible becomings manifested in her expectation of engaged children.

Assemblages like A and C seem to be vital parts of computer enhanced teaching and possibly of any teaching, if we are not to synchronize behaviour into docile behaviour. But isn’t the effect of the teacher’s expectations of good constructors in fact doing just that, one could ask. This in fact is not so because the children have availabilities here, but in docile systems there are not other availabilities. The baby rhesus monkey reminds us of that (Despret, 2004a, p. 124). The teacher is (more or less consciously) letting possibilities live – there is always at least one other assemblage available to the children. The children are therefore voluntarily choosing to follow the teacher’s instructions by following the manual.

Conclusion - multiple coexisting authorities

Sometimes the different actor-networks line up, and sometimes they do not. Sometimes technology, the children’s idea, the teacher’s intentions, the time of day, the physical location line up and an assemblage of manual followers stabilizes for a while, but mostly they do not.

Law explains that problems such as these are normally dealt with in the same way as the matter of different perspectives (Law, 2004). In an epistemological frame not operating with multiple objects and where the ontological plane is imagined singular, perspectivism is often used to explain variation and differences. A way to overcome differences then is to get insight on each others perspectives - if we can just understand the children or teachers and their problems, then we can find solutions.
Integration of technology in schools has been thought of as a matter of different perspectives where the underlying assumption is that if different actors changed their perspective and ways of working with the technologies, then technology in schools would begin to be a successful endeavour. A brief look at how technologies have been introduced into the school system can show how this thinking has influenced the different actors involved with it throughout the last 20 years. The kind of thinking such as: if the teachers adopted the right approach, if they had the right technology, if we just had that kind of product etc. which all centre on the notion of an object as singular - one school – one technology or as here, one enactment of Lego Robolab (Jedeskog, 2005).

Mol takes an ontological approach and recommends that differences should not be understood epistemologically, as has just been presented, but ontologically. She writes:

> Philosophy used to approach knowledge in an epistemological way. It was interested in the preconditions for acquiring true knowledge. However, in the philosophical mode I engage in here, knowledge is not understood as a matter of references, but as one of manipulation. The driving question no longer is “how to find truth?” but “how are objects handled in practice?”

(Mol, 2002, p. 5)

This directs focus away from different perspectives of a single object towards different objects in different sets of relations and assemblages (Law & Singleton, 2005, p. 342). The movement towards comprehension and problem solving is hence quite different when working with multiple ontologies: If one ontology is added or translated into another, then alignment in interest, view and versions of an object would be due to a coordination/distribution process. If we look at the empirical examples again, then this approach firstly alters the idea that Lego Robolab is one object. The teacher has one idea of Lego Robolab, the children another, different assemblages have different possibilities for enactments of Lego Robolab, and I with my own Lego Robolab experiences and my scholar’s knowledge about technology in the classrooms, authority and STS literature all help to create one (but multiple) enactments of Lego Robolab. The different actors understand Lego Robolab differently. However the term multiple has a deeper implication. It is not just the understanding that differs. The different actors perform different objects, and are, so to say, helping different actors into being. This has been identified through the description of the pasta fork, manual followers and the car tuners. Secondly this multiple object can – together with other actors – create a set of coexisting assemblages. The matter of stabilizing the object(s) becomes therefore a matter of making these different assemblages with different ontologies, different handlings of the (multiple) object.
relate or converge. In this sense ‘Objects become ontologically complex, multiple and (in some cases) mutually exclusive’ (Law & Singleton, 2005, p. 342), as Law and Singleton teach us.

The movement of Bertil-with-different-enactments-of-Lego-Robolab, where the bricks and sensors are present in all of them, infuse a particular actor-network in its travel. And it is not only Bertil with different configurations of Lego Robolab that moves but also the one, or the thing, authorising is moving from the bricks over to the manual (as an intention by the teacher’s distribution) and to Bertil himself. Bear in mind that this motion of authority figure does not resemble the circulation of authorisation, though it might appear to be so. The circulation of authorisation, as described in chapter 5 and the start of this chapter, starts and ends (not necessarily synchronically in time) with the same actor having authority, and it relates to one stabilized enactment of Lego Robolab. The movement of authority figure we discover when following the different Bertil-with-Lego-Robolab configurations relate to different enactments of Lego Robolab along the way and makes it evident that many forms of authority coexist - Bertil is authorised by Lego Robolab when building the pasta fork, whilst the rest of the class is working uniformly, by following the teacher supported intentions in the manual. A question of inclusion or exclusion of authorities appears. Does the one form of authority then exclude the other? No, apparently not. Bertil is authorised to build the fork in the fluid networks he relates to, while the rest of the class follow the teacher’s instructions. A term suggested to describe these variations is the notion of multiplicity (Mol, 2002), and the differences between the three assemblages here is captured by the topological metaphors. The ‘hanging together-ness’ or coexistence has been discussed and here Bertil and the bricks and sensors are central actors, for the coherence of Lego Robolab, since they part all the different assemblages enacted.

Teacher authorisations have been challenged through the cameraman and reporter in chapter 7 and by the car tuners here in chapter 8. In both cases the teacher’s authority is not jeopardised thus for two different reasons. Karen asks the girls to end their activity and they align with her demand. Bertil and Omar find a strong ally in time, and they are left alone for the remainder of the lesson despite its incompatibility with the teacher agenda.

Chapter 8 has taught us that several authorities co-exist in the snapshots I have examined, and that this coexistence is explainable and understandable through the notion of multiple ontologies: The reality for Bertil and his version(s) of Lego Robolab differs from the Lego Robolab the teacher is in relation to. The assemblage of the teacher agenda and the Pasta fork thus marks two different realms existing.
together at the same time and in the same space, which also might explain why the teachers all report a successful teaching outcome; they do not fully see all the different enactments of authority and Lego Robolab in play.

Looking at the problem this thesis sets out to examine again – how does Lego Robolab affect the authorisation processes, then this chapter adds that Lego Robolab is not just one thing, a single object, but that several versions align with and affect different authorisation processes in the classroom.
PART III

In chapter 1 I gave myself the challenge of investigating the changes in authority configurations when Lego Robolab entered the classroom. In part III holding the conclusion I will sum up the answer given to this question in three different ways. First, keeping to the order of the chapters, I follow the gradual development of insights and questions raised concerning the authority processes of the classroom through the empirical examples described. Secondly I will introduce a new empirical example and through it show how the knowledge gained through the chapters helps to vindicate my other descriptions of the situation described. Thirdly I look specifically at the concept of authority and authorisation to sum up what this thesis contributes towards the understanding of the two concepts. As a closure to the chapter I present the Brazilian Anthropologist Eduardo Viveiros De Castro’s notion of the ‘smallest common multiple’ and suggest that it is to be taken literally in order that teachers may be able to reconcile the tensions engendered in computer based teaching.
9. CONCLUSION - REFLECTIONS ON IT TEACHING

This thesis starts with a question concerning the paradox that under existing law, on the one hand IT should be a part of every subject matter at every grade level, and on the other hand, despite massive investments of IT equipment in schools, there has been a stagnation in the use of digital learning materials. Pondering this question was transformed into a letter to a school in a suburb of Copenhagen asking for permission to observe IT based teaching, and an arrangement was made with a school to follow lessons where Lego Robolab was to be used. At the school my former pondering was turned into astonishment. Everybody - teachers and children - seemed satisfied with the IT teaching lessons even though few of the children were actually following the teacher’s agenda by following the instruction manual as directed. This surprise was used to create the focus for the thesis; authorisation processes when working with Lego Robolab. It also led to the decision to adopt ANT as the theoretical inspiration to describe and discuss the enactments of authority in the classroom since the presence of Lego Robolab clearly affected the teaching.

To look at computer enhanced teaching with ANT does something to the way authority is examined. ANT is concerned with the tracking and tracing of the assemblages made up of heterogenic human and non-human actors. It is these hybrid enactments of authority in the classroom that have been in focus in this thesis and which have positioned this study as an ontological one – one where the actor’s world building capacities are taken as being sound. The principle of symmetry has been used in the descriptive analysis of the thesis and together with the ontological orientation this has affected the way knowledge production is thought of in this thesis. Knowledge production has been described as additions and, moreover, it has been stated that the aim has been to make the additions as articulated as possible. I will, therefore, briefly outline now what has been added in the different chapters to what we already know about authority in IT based teaching, and what has been articulated in the work of this thesis.

**Insights gained on authority in computer enhanced classrooms**

Prior descriptions of computer based teaching and authority has taught us that authority is constructed through interaction and negotiation, and that authority can be deconstructed (Metz, 2006; Mullooly & Varenne, 2006; Pace & Hemmings, 2006; Stensaaas, 1999). This insight is brought to the empirical examples of this thesis and put in motion with the symmetrical and sociomaterial doctrine of ANT.
The analytical part of the thesis, chapter 5 opens with a rather ordinary situation. The teacher Pete is instructing the class in the features of Lego Robolab. The example produces the knowledge that the apparently human act of authorising and being an authority is heavily supported by nonhumans – the floor, the walls, orientations of the bodies, eye contact, the material choreography of Pete with the different Lego Robolab parts – are all actors that enable Pete to be an authority and to set the expectations for the lesson. In addition the translation of the group-of-children over gender-child to working-group, and the colour-on-cable-group, show how the ordering of the children is also highly material. Gender, numbering and colours on cables are used to exemplify the different nonhuman additions made to the children’s actor-network. These insights are developed in relation to a conventional, centralised teaching situation, and this suggests that teachers in ordinary classrooms might also possibly be part of such sociomaterial entanglements.

When the introduction to the Lego Robolab is finished, children, Lego Robolab and computers are distributed and the centralised teaching environment is turned into a decentralised one. This changed teaching situation enables me to ask what happens to the assemblages making up the teacher as an authority when the working groups are distributed to the different working stations in the Multiroom and computer room, and what happens when the children build robotic cars themselves. The chapters 6, 7 and 8, in different ways, provide answers to these questions.

At the start of chapter 6, using Despret’s ideas, expectations and authority are seen to be linked and this explains why the teacher authority is able to set the expectations for the lesson. The teachers expect the children to follow the manual and to become good constructors. Following the manual will produce identical cars. Julie, August and Tim demonstrate this, and by following their activities several other things are highlighted. A circulation of authorisations is identified: The teacher authorises the children to follow the manual and become good constructors, lifting the manual from the floor to the table the children authorise the manual to hold a proper set of instructions that will help them become good constructors. Through their activity of building cars the children authorise their teacher to be a competent teacher who gives his pupils manageable and meaningful assignments to fulfil as they meet his expectations. The circulation of authorisations is thus identified as going beyond humans. It includes the manual which authorises the boxes with Lego bricks to be a proper set of bricks enabling the manuals propositions to be fulfilled, and the Lego bricks authorise the manual to hold a sensible building description that enables the children to fulfil the teacher’s expectations. And it is discovered that to get the circulation going trust and interest are interwoven in the assemblage. The identification of these emotions is also used to distinguish between the notion of authority and the notion of authorisations. To be an authority trust is important.
In this empirical case – and presumably in most cases – trust is an emotion that draws networks beyond the present moment. Pete was trusted as a teacher who knew what he was doing yesterday and so is benefitting from this when juggling with the Lego Robolab material and distributing the learning material. Authority can be said to encompass circulations of authorisations of other times and places, which helps to determine Pete as an authority. It also teaches us that for authority to exist some sort of stability among actors needs to be present. Authorisations, on the other hand, include the movable aspects of the present circulations, and encompass the process of the making of an authority.

Who authorises whom is not only affected by the presence of trust but also by the interest that is enacted in the specific situations among, and by, the actors present. And as such trust and interest are both effects of different relations of an assemblage and thus does not ‘belong’ to the humans but is enacted in the relational grid of which they are a part. Chapters 5 and 6 therefore help me to conclude that authority must always be explored empirically. Authority is always situated, and takes up different shapes as effects of the how teachers, children and technologies are intertwined in practice.

Chapter 6 has unfolded an attractive situation, seen from a teacher’s perspective; the children are doing what they are supposed to do and every actor involved in the circulation ends up looking competent. Chapter 7 investigates examples where the teacher’s expectation of the children becoming good constructors are not met, and by that it becomes evident that there are other types of expectations that co-exist with the teacher’s expectation of the children becoming good constructors. This is shown through three different assemblages; the pop song performance, the cameraman and reporter, and the children drawing.

Each assemblage has produced an insight on the authorisations. Through the pop song performance it is discovered that the teacher’s expectation of engaged children is present in these lessons, although it is seen that there are other ways of participating in the lessons which still fulfil (some of) the teacher’s expectations. This is the case with all the three assemblages described in chapter 7, yet the way in which a very similar group of actors relate to one another produces very different results and this suggests a more topologically oriented approach would be useful. Therefore the topological spatial metaphors developed by STS researchers are adopted as part of the descriptions. The pop song performance is described through the fluid metaphor since it develops in relation to the relational landscape it meets, and it has been explained how the song travels from being hummed, into singing and dancing and ends as a performed act where the children sing and act out the lyrics of the song.
The next assemblage; cameraman and reporter is described through the network metaphor and it is discovered through this description that the interchangeability among authorisations and expectations (as suggested by Despret) does not make these concepts equal. Differences occur since the two concepts draw different semiotic actor-networks. Authorisations are oriented towards the present – I authorise you to become a good constructor, or as with the cameraman and reporter – I authorise you to make an interview, while expectations, on the other hand, are related to the past. The teacher can set expectations of the children becoming good constructors because she knows the children to be capable of certain things, and she has gained experience of the product prior to the event, and Viola and Kamilla already know the form of an interview. Three things can be learnt from this: 1) expectations coexist 2) that circulation of authorisations can be described as a process of fulfilling expectations, 3) and that Viola and Kamilla’s circulations of authorisations coexists with the circulations initiated by the teacher Karen’s expectations up until the point that Karen interrupts and stops the girls’ activity.

The third assemblage of the children drawing interlinks body movements and circulations of authorisations. The bodies of the girls drawing at the computer match the enacted bodies of the children when building and programming robot cars and therefore it is easier for the teacher to overlook what these girls are doing. Whereas in the previous example the teacher could not miss noticing Viola and Kamilla’s bodies placed in the middle of the room and it is this that makes Karen realize that interruption is appropriate.

The last arrangements of authorisations described in chapter 8 enlarge on a situation that illustrates different assemblages with different circulations of authorisation coexisting. This leads to the discovery that to make a proper description of Lego Robolab it must be seen as a multiple object. Arrangements that follow the movement of Bertil-with-different-enactments-of-Lego-Robolab is described and in all of them the bricks and sensors are present. Here authorising is moving from the bricks over to the manual (as an intention by the teacher’s distribution) and to Bertil himself, which makes it evident that many forms of authority co-exist, and a question of inclusion or exclusion of authorities appears. Apparently Bertil building a pasta fork or tuning a car can co-exist with the teacher agenda. With this knowledge gained co-existence will be further discussed after I present below a brief summary of the knowledge gained on the different assemblages of authority.

Different enactments of authority

I have described several assemblages of authority in chapter 6-8, which I have summed up in the following table:
<table>
<thead>
<tr>
<th>Name of the assemblage</th>
<th>Chapter for description</th>
<th>Entities relating in the circulation of authorisation</th>
<th>Components related to in Lego Robolab</th>
<th>The assemblage meets the teacher expectations</th>
<th>Children’s body movements</th>
<th>Domestication of the children</th>
<th>Spatial Topology</th>
<th>Product produced by the assemblage</th>
<th>Goal/process</th>
<th>Authority setting the expectations and circulation of authorisation going</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Teacher, children, manual and Lego Robolab</td>
<td>Bricks Sensors Computer Manual</td>
<td>- of engaged children - of becoming good constructors</td>
<td>Fits the patterns of movement of engaged children</td>
<td>No domestication</td>
<td>Network Immutable mobile or Regional Immutable immobile</td>
<td>Cars alike</td>
<td>No clear goal/ Clear process or Clear goal/ Clear process</td>
<td>Teacher/ manual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Children Camera Robot car</td>
<td>Robot car</td>
<td>- of engaged children - of engaged children</td>
<td>Does not fit the patterns of movement of engaged children</td>
<td>No domestication</td>
<td>Fluid Mutable mobile</td>
<td>A song circulating</td>
<td>No clear goal/ Clear process or Clear goal/ Clear process</td>
<td>The song Viola and Kamilla</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Children Camera Lego brick and the form of an interview</td>
<td>One black Lego brick</td>
<td>- of engaged children</td>
<td>Does not fit the patterns of movement of engaged children</td>
<td>Ends with a domestication</td>
<td>Network Immutable mobile or Regional Immutable immobile</td>
<td>An interview</td>
<td>No clear goal/ Clear process or Clear goal/ Clear process</td>
<td>The drawing programme Lego Robolab</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Children computer</td>
<td>Computer</td>
<td>- of engaged children</td>
<td>Fits the patterns of movement of engaged children</td>
<td>No domestication</td>
<td>Fluid Mutable mobile</td>
<td>Drawing on the computer</td>
<td>No clear goal/ Clear process or Clear goal/ Clear process</td>
<td>Lego Robolab Bertil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Child, teacher, Lego Robolab</td>
<td>Bricks Sensors Computer</td>
<td>- of engaged children</td>
<td>Fits the patterns of movement of engaged children</td>
<td>No domestication</td>
<td>Fire Mutable immobile</td>
<td>A Pasta fork</td>
<td>Clear goal/ no clear process</td>
<td>An authority collective of children</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Children, Lego Robolab, a game</td>
<td>Bricks Sensors Computer</td>
<td>- of engaged children</td>
<td>Fits the patterns of movement of engaged children</td>
<td></td>
<td></td>
<td>A battling game</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7: An overview of all the authorisation assemblages described in the thesis. The last row expresses information on an assemblage that will be described in the following section.
The first row of the table gives the name of the assemblage as it has emerged through the descriptions of it. The second row informs in which chapter the assemblages are described. The third shows us what entities are relating in the circulation of authorisation. The fourth describes the parts of Lego Robolab in play in the version of Lego Robolab, it is related to. The fifth row identifies which of the teacher expectations the children are relating to, and the sixth row tells us whether or not the children's movement relate to the movements of engaged children. The seventh row tells whether or not the children are domesticated in their enactments and the eighth line expresses the way the actors relate by relating the pattern of relations to the topological metaphors. Row number nine informs us what kind of product the arrangements produces, and row ten reflects how the goal and process is managed. Finally the table ends with row eleven which reports who/what are capable of setting the expectations of the activity – and by that also reflects who can be considered the stabilised authority of the assemblage.

From this schematic overview some tendencies across the different authority configurations becomes identifiable. It seems as if some types of authority configurations can co-existence with the teacher’s agenda of following the manual more easily than others. As an example let us look at Bertil and the pasta fork. The pasta fork assemblage is identified as a having a fluid pattern of relations, meaning that there is no clear goal and no clear process involved - Bertil and the material relate fluently and therefore cannot jeopardise the goal set by the teacher in the way an enacted diverging goal would do. Another fluid assemblage is identified - the one with the pop song performance. No clear goals are set here either, yet the bodies enacted do not resemble bodies performed by children becoming good constructors, and presumably, therefore, the teacher would stop the singing activities when noticed, just as Viola and Camilla are stopped when playing cameraman and reporter. A third assemblage is marked as fluid. That is the children drawing. The data accessible to me here is sparse. I cannot identify whether the children are actually having a clear plan with their activity (regional and fire), or as suggested in the scheme, whether they have a fluid relation to the computer and drawing programme. What I can see is that the children enact engaged bodies that resemble the ones of the manual followers and therefore they are left alone or not noticed. All the three fluid assemblages; the pasta fork, the pop song performance and the children drawing exist together with the teacher assemblage, and at the same time it is identified that the pop song performance enacts bodies that do not fit the teachers agenda and that this assemblage is the only one that is domesticated. Through this it is notable that to keep a fluid assemblage coexisting with the teacher agenda it is as important to enact rightly engaged bodies as it is to maintain a fluid goal and a fluid process.
Other assemblages have goals in conflict with the teacher’s assemblage of manual followers, and the car tuners are one example. This assemblage differs from the others in the sense that the teacher here is aware of the diverging goals that exist, yet Bertil is not domesticated into following the manual. I have explained in chapter 8 that Bertil finds an important ally in time because the children are shortly to pack away all the equipment ready for the lunch break, and this allows the teacher to accept the car tuning activities, which also marks an identification of a situation where two authorisation processes with explicit diverging goals exist and are noticed by the teacher. The aim here is not to reintroduce the normative indignation I had in the beginning of my study, but what I am seeking here is uncovering patterns of the coexisting authorisations. Other availabilities are always present in these settings where computer technologies are used; it is therefore interesting to identify the positive examples of unproblematic coexistence of different circulations of authority, and the borders or boundaries which allow for such a co-existence.

In one of the classes I visited at the school I have identified another example where diverging goals among teachers and children are noticed by a teacher. I will briefly introduce it here for two main reasons: 1) it allows me to demonstrate the knowledge gathered in chapter 5-8 that enables me to understand what is happening in the example a little better than I could have done without the insights produced by this thesis, 2) it allows me to reveal and qualify the discussion which seeks patterns of (in)compatibility between different authority configurations.

**The battling cars game**

The different Bertil-with-material configurations taught us that authority figures multiply and can co-exist in different versions in the same classroom. Until now examples have been given where the relations between the different authority figures have not jeopardised the teacher. This, together with the two reasons mentioned above, vindicate the decision to bring one last empirical example as part of the final discussion of the thesis and describe an example where some children are, like Bertil, becoming the ones who authorise. To discuss how and in what way the different authorisation practices seem to co-exist and relate an evaluation by the teacher on the last day of the Lego Robolab week is brought into play.

We are meeting 5Y again on the last day that they are working with Lego Robolab. Karen, the teacher in charge, has moved the working groups using laptops to an ordinary classroom and the description below starts at the end of the fourth Lego Robolab session that day.
The three groups in the classroom have been working with an assignment on page 9 of the manual where they are to put light sensors on their robot car, preventing it from falling off a table. Otto and Victor find an extra engine. Karen enters the room and the boys ask her if it is ok to add an extra engine. Karen replies by enquiring if they have made the assignment in the manual, and leaves the room again. The boys start to add functional and aesthetic additions to their robot car. Another working group; Anton, Mark and Louise start to do the same.

I leave the room for ten minutes, and when I return a game has started. The two groups of children are programming their cars to drive as fast as possible, and build the cars as robust, stable and challenging as possible. When ready the groups place their creations on the floor, and on a signal to go they synchronically press the release buttons.
The cars bump together accompanied by cheering from the two groups. Eventually one of the cars falls over, or an engine stops and the two groups collect their cars. Karen enters the room again and states that there is too much playing around. The groups return to the table and as soon as the teacher leaves the room again the battling game continues. *(Field notes from the 6th of April, supplied with audio recordings from the same period, tape 2, time: 1.02)*

Going through the described example with the knowledge gained on authority and authorisations throughout chapters 5-8, I will try to explain why these children are allowed to continue their actions, and why the teacher’s attempt to domesticate the situation fails.

Let us find the authority(ies) here. Remembering that the one who is setting the expectations is the one who authorises, it becomes important to look at the circulations of building and battling. The groups build their cars and bring their creations to the floor. After a battle, the next challenge is set and the groups return to the table and prepare the cars to meet the next challenge. Expectations are here created in the relation between the ‘history’ of battles, current battle and the children’s inventiveness. The expectation stabilizes through language when the children agree on the next challenge. Authority can thus be allocated to an *authority collective* of battles and children, where the children in negotiation with the enactment of the material and with each other, set the next challenge – the next expectation.

Knowledge, trust and interest are also identified here. The children know the content of the boxes, since this is the last Lego Robolab lesson in their Lego Robolab week. They trust the bricks’ build-ability, and interest is surely present as seen in the way challenges set, material and the children are intensely entangled when I return to the classroom and meet cheering children and their showy cars.

Some of the process here resembles the assemblage identified when Bertil authorises his peers to become good car tuners, yet this practice is stronger, more populated. The pattern of relation in this assemblage can be described through the fire metaphor. The children know what they are doing while playing the game. They have a clear goal. The process – how to prepare a battling car – is more diffuse. The children are not told by the manual how to build their car, they have to experiment and be innovative to win the next battling round. Fork lift trucks are invented and levers are added as tools to turn over or push aside their competitor’s car (see the pictures below the at the field note excerpt).
Remembering that fire exists as, and on behalf of, fluid and networked patterns of relations (see chapter 8), it seems important to note that this fire assemblage is fuelled by a more fluid relational pattern. Victor and Otto are building without goal at the beginning of the field note excerpt. The Lego bricks are making it available to them to fluidly explore the possibilities of the material. Inventive cars emerge, which inspires Anton, Mark and Louise to build inventively as well. What triggers the game itself is left to guess, since I leave the room and when I return the game is already in progress. What we can see is that a clear goal – battling to win, is agreed upon by the two groups - a goal that is hard to merge into a joint goal with the manual followers. Yet it would suit the argument for the fire metaphor if I had empirical material to describe the arousal of interest and the relation made by the other group to the building and gaming assemblage. What I can suggest with the imaginary of the fire metaphor at hand, is that the idea to participate arises spontaneously. To explain the fire metaphor Law and Mol use the imaginary of a bush fire; bushes (immutable) on the plain which suddenly burst into fire (mutable). The bush fires ignite themselves due to the high temperatures of the plain (Law & Mol, 2001). Perhaps the ‘high temperatures’ of the class room might join the children in lighting the fire spontaneously at their group tables as, almost concurrently, they create inventive car decorations and tune their cars to drive as persistently and fast as possible. But I cannot know this.

Karen addresses the children playing with the cars two times without effect. What explains this? If we recall Julie, August and Tim and the circulation of authorisation that makes the manual a central actor (chapter 6), then a particular feature becomes apparent in the overview above and that is the number of allies a certain circulation of authorisation draws upon. In the case of the manual followers several entities are working in the same direction. Let us play with the idea that the amount of allies that a circulation has is important.\footnote{Which also is a well cherished point in ‘classic ANT’, see also (Latour, 1996, 1999; Latour & Woolgar, 1986 (1979))} If this is the case then part of what makes the teacher, material and children look competent in the effort of becoming good constructors is precisely that the alignments of the availabilities related to, point in the same direction.

What do the children of the battling cars align with? They are two groups, meaning that a larger number of children are engaged in the activity. They engage with one of the more articulated versions of Lego Robolab, meaning that they do not use only one brick, as Viola and Camilla do in the interview, or bricks and engine as
Bertil does when he builds his Pasta fork. They engage with a version of Lego Robolab, that includes bricks, engines and computers. They invent a game that aligns the children’s focus; this is what we are doing.

Karen seeks to change this by drawing on authority made up of the prior stabilisations of herself as the authority. In contrast to this situation it is relatively easy for Karen to domesticate the cameraman and reporter since only one brick, and wrong bodies in front of the camera do not make a strong network of allies for the children. Here Karen does not succeed in changing the groups behaviour, and she uses an event taking place on the last day of the Lego Robolab week to legitimize a soft approach to the collective authority the children have been able to create.

Distribution and coordination

I present here an evaluation done with class 5Y in a lesson on the last day of their Lego Robolab week, where Otto and Karen reflect on the specific event of the battling cars game. The class is sitting at the group tables in their classroom while Karen, from the blackboard, is starting an evaluation of the Lego Robolab week. She asks every child to consider and mention a good experience from the Lego Robolab week together with a suggestion of any improvements that could be made to these activities.

Karen: All right we will go over to Otto.

Otto: I also thought it was fun with the building, but there was some hassle with the groups. And then I thought it was fun when we were allowed to build, when Victor and I built a robot on our own.

Karen: Where you could build a robot on your own in the end or?

Otto: Yes.

Karen: What was it the competition was all about when you were making your own robots? I don’t think everybody knows that.

Otto: It was about wrecking the other cars, it was about toppling them.

Karen: That meant that the robot should have a lot of strength, so it could push the other, was that what it was about?

Victor (interrupting): Yes! And with a little stick that just could lift the other car up.
Karen: Ok, so you missed making up your own challenges?

Otto: Yes.

Karen: Ok good.

(Dictaphone recording from the 7th of April 2006, time: 06:21)

The connection between the field note excerpt from the classroom and the dialogue above makes it possible for me to reveal issues about coordination and distribution of the different assemblages. I have already described how the two assemblages are irreconcilable and I will now attempt to describe what, nevertheless, enables the teacher to be, or become, an authority.

First of all, by including the children in the evaluation the teacher highlights another authority collective as interesting. The children are authorising themselves, and by inviting the children to describe their activities, the teacher legitimizes those actions. How is that possible without the teacher losing authority? A possible explanation is that by recognizing the battling game Karen makes explicit her implicit expectations of children being engaged whenever computers are used. She also legitimizes other ways of relating to Lego Robolab as being risk-free of challenging her authority in that moment because, since the lesson is over, all the groups cannot start to build on their own; none of the other children can be inspired to copy the battling game. Furthermore the teacher is redefined as an authority by acknowledging the actions of the children engaged with the battling cars and recognising their game as valuable here in the evaluation. Karen’s dialogue with Otto and Victor is a way to coordinating the two authority assemblages.

I gave two reasons for presenting this last empirical description. One was to illustrate how the knowledge gained in this thesis helps to look at situations in the classroom in other ways than just assuming that children are misbehaving, which I have done in the last sections. The other reason was my desire to find patterns for the successful alignment of the two irreconcilable assemblages. It appears that the different authority figures can co-exist exactly because they are not coordinated instantly, but are first aligned in the evaluation made by the teacher the day after the Lego Robolab workshop. To be able to explain this we need to understand the enactments in the classroom differently. I will enlarge on this in the following section.

Co-existing versions without tension?

The co-existence of different assemblages having dissimilar authorities circulating seems scarcely to be a challenge for the teacher when fluid assemblages co-exist, as with the assemblage of the teacher guided manual followers where the network
metaphor is dominant. As I have briefly discussed, this is not the case when camera-
eman and reporter or the two fire assemblages co-exist with the teacher’s agenda
because they have diverging goals. Herein the inconsistency in the choice of relating
the cameraman and reporter to the network metaphor becomes obvious. I mention
in chapter 8 table 6, that the network assemblage of the manual followers also
shares topology with the fourth metaphor mentioned by Law and Mol and that is
the one called regional, which is characterised as an immutable immobile. This
might also be the case with the cameraman and reporter assemblage. The description
of the arrangement of following the manual and the cameraman and reporter
matches the network metaphor best, yet when comparing the assemblages of au-
thority between the chapters this way, then it is the regional tendency of the assem-
blage that comes into play. Considered this way, then the topological sameness in
the assemblages of cameraman and reporter (network/regional), car tuning (fire)
and the battling cars (fire) is that both fire and regional are immobile. And it is
what this immobility of the assemblages produces that I will focus on in the follow-
ing.

In the descriptions in part II and in table 7 in this chapter I have described three
such immobile assemblages; cameraman and reporter (network/regional), car tuners
(fire) and the battling game (fire) coexisting with the assemblage of the manual
followers (network/regional). Yet only the cameraman and reporter are domesti-
cated.

If we look at other differences between the assemblages in table 7, this domestica-
tion might be because the enactment of engaged bodies do not align with the bodies
enacted while following the manual, as already mentioned, yet another reason
might be that the arrangement making cameraman and reporter available is not as
tightly knotted together as the one bringing car tuners and the battling game into
existence. Remembering the explanation of a strong assemblage given by Latour in
chapter 4, where stability and strong assemblage is achieved through netting, lacing,
weaving and twisting of ties, a heterogeneity among actants, and a careful plaiting
in of weak ties (Latour, 1996, p. 2), 69 then there is something very well coordinated
among the relations made between the battling game children, the rhythm of the
game and the small acts of picking and choosing of bricks. When put together these
make up an assemblage so strong that the teacher’s domestication attempt fails to
‘win’ over the children from gaming. The cameraman and reporter, in comparison,

69 Latour uses the word network instead of assemblage, and I could have stuck to that. Yet the change in
the sentence above from network to assemblage is merely done for practical matters – it is easier to
follow the argument that I am making when I do not intermix Latour’s notions of networks, that for
him can cover all spatial formations, and Law’s (and others) metaphorical refinement of a chosen num-
ber of topological descriptions that I draw on here.
is in a network of relations, where the version of Lego Robolab related to is there but only weakly in the form of the one brick which they use as a microphone. Although there are allies to be made through an inventive use of Lego Robolab, as seen for instance with the assemblages of pasta fork, the car tuners and the battling game, the cameraman and reporter assemblage cannot draw on such an alliance. The reason for this might be that the immutable form they relate to is an interview. An interview, as described before, engages a very specific set of actants; an interviewer, a camera man, a camera and a microphone, which leaves very little room for further allies to matter in this situation. In contrast, in the battling game assemblage, for example, the particular game form invented is strong because the number of human actors joining has not reached its limit, as long as newcomers respect the immutable structure which is held in check by a few, simple rules of the game. This might explain why the assemblage of the cameraman and reporter is stopped and, contradictorily, this other assemblage in play co-exists with teacher expectations.

The assemblage of car tuners and the battling game share another feature. We see that Bertil is becoming fairly articulated in his relation to Lego Robolab, through his movement through three different assemblages and ending with the car tuners, and we experience the children in the classroom creatively inventing a game to play. These activities are not teachers intend but they are valuable activities and remind us that the teachers could have chosen other ways to be with the Lego Robolab material. This might provide a possible lead to a way that the teachers may find acceptable and comfortable to live with in the IT classroom as it could assist in reducing the tension of IT teaching. As I elaborate on this point in the next section I will also put forward my contribution to the field of STS research which has been developed through this thesis.

Multiplicity in one physical location

In her study of arteriosclerosis Mol has shown us how the disease multiplies over and across different physical settings. In chapter 8 I have shown that the enactment of a multiple object does not need this separation in time and space to multiply. Multiplication of objects can take place in a single location, which can be considered an addition to Mol’s detailed descriptions of arteriosclerosis enactments multiplying in several different locations. I have shown how Lego Robolab makes something very different available to the children and the teachers, and I have argued

---

70 The number of allies to an interview would obviously increase if the immutable form of an interview was enacted in a live reportage for a national news channel. In such cases the technical alliances would massively have overruled the little camera placed in the classroom, a sound engineer would be present, as well as other technical functions would be filled out by humans or non humans. Yet the form of an interview stays immutable.
that these differences cannot be captured through the notions of perspectivism, but is better accounted for by a multiple ontological approach. With a multiple ontological oriented attitude to the thinking of authority circulations in computer enhanced teaching environments, a series of questions still exist concerning the handling of this multiplicity and the different compilations of availabilities to different actors in the classroom.

How can we, for instance, acknowledge the inventiveness of Bertil and the children battling without this happening retrospectively – as with Karen and Otto in the evaluation, or because the timing is right because it is ‘time to end the lesson’ – as with Bertil and his tuned car?

The school I visited has all the possibilities available for IT teaching, with functional hardware, good digital learning platforms and extra teachers present. The lessons I have examined have actually been attempted to structure the children’s behaviour by making them follow the manual, but still the majority of the children follow other possibilities than the one offered by the manual. This suggests the idea that perhaps it would be better if we stopped this type of teaching. However I do not think that eradication of this type of teaching would be a wise next step. But the awareness that these environments are rather difficult to control might pose a useful point of departure for further investigations within the field of IT teaching. The following section will point out the contribution this thesis makes to the field of computer enhanced teaching by recapturing the insights produced on authority and authorisations in educational situations that are using digital learning platforms. I then consider what implications these insights might have for further research.

**Concluding remarks on authority and authorisations**

At the start of this thesis I ask how Lego Robolab affects the authority of the classroom, and I can now answer that Lego Robolab does not affect anything in itself, it is the net of relations – the topologies that arises - that change and affect the authority.

Through the chapters I have learned that; authority is a sociomaterial achievement, and that to be an authority is an effect of repeated circulations of authorisations. The circulations of authorisations express the process of authorising and that it requires that something or someone sets the expectation (based on knowledge) (chapter 5) and that trust and interest are enrolled to make the authorisations circulate (chapter 6).
I have learned that authority is a multiple phenomena (chapter 7), and that authorisation can be initiated by technologies, children and teachers (chapter 8). The multiplicity has the effect that different authorisations can coexist at the same time, and by this the findings of this thesis may be generalized.

A broader spectrum the descriptions of the thesis shows that technologies make other activities available to the children, and that these other availabilities occasionally can turn into other circulations of authorisation which become a challenge to the teachers.

Through the thesis I have explained how different relational arrangements of authority have been in play which have affected the teachers differently, and through that I have made empirically evident Stensaas’ point about the deconstruction of teachers roles i.e. that consciously and willingly or unconsciously and unknowingly deconstruction of the teacher role is what happens. And my descriptions add to this. It is not only the teacher’s role that changes. The teachers actively have to relate to other types of materials and find new allies among them. The description of the cables rescuing Pete as authority when he divides the children (chapter 5) or the relation between the manual and Lego Robolab being an important ally in the distribution of authority among the distributed children and materials (chapter 6-8), are examples of such alliances. For teachers to become confident with the new material alliances will take time, just as it took time to make the blackboard and chalk into faithful allies in conventional teaching.71 The teachers must therefore continue the process of sensitising themselves to this type of teaching in a way that makes room for many more articulations between the extremes of success and failure. I will return to this in the following section.

It is seen as an advantage if the teachers are aware that the divergence from the teacher’s agenda is unavoidable in this type (and presumably every) form of teaching. Notes changing hand under tables in a classroom is also an aberration from the teacher’s agenda – yet it is a temporal concurrency and a spatially limited deviation, and this makes these situations less visible and challenging to the teacher. Whereas the spatial and temporal oscillations in the decentralised teaching in the type of settings described in this thesis make the divergencies more visible and more problematic.

71 Time that is encountered in at least 4 years of teacher education. And as well as experiencing this in the student role, during ten year of primary school and three years of secondary school, makes blackboard and chalk teaching is very well rehearsed in every teacher.
Smallest common multiple

A somewhat abstract tool for expanding thoughts about successful computer enhanced teaching lessons can be found in the notion of ‘the smallest common multiple’ as suggested by the Brazilian Anthropologist Eduardo Viveiros De Castro (Castro, 2005).

To seek the smallest common multiple is an ideal for Castro in his research. For him it is a way to enlarge the world, to create a constant curiosity that leaves room for surprises. Castro explains his intention this way:

The real in its universality is indifferent to representation: it is totally neutral. Inversely, point of view is subjective, representative, partial, incomplete, limited. Proceeding from this dichotomy all that would remain for anthropology to do would be to compare and reconcile points of view in order to find their greatest common denominator: elementary structures, a universal grammar, the symbolic, Oedipus. Following the arithmetical allegory, I prefer instead to seek the smallest common multiple: That which allows the multiplication of things rather than dividing them in order to find what they have in common, and which would necessarily be poorer than what we find in any given culture.

(Castro, 2005, p 138-139)

Castro tells us that if we compare cultures in order to find what they have in common, we will end up with poorer accounts of a world by omitting what produces the world’s specificity. Castro lets the world be multiple and, by this, makes articulations possible.

Seeking the greatest common denominator tends to obliterate articulations. In contrast, if we believe that the cultures are not necessarily compatible then the smallest common multiple marks a good starting point for exchange across cultures, since it creates a possible passage of understanding where the differences between the cultures are at their smallest.

The notion of the smallest common multiple is here used as an inspiration and taken literally - as a tool for understanding the radically different world around us in general, and in the classroom in particular. To explain this I will briefly go back to Mol’s multiple arteriosclerosis. Mol explains to us how versions are coordinated, distributed, or included to make relations between the different ontological realms possible, yet no standardised tool is given to identify these passages of exchange that makes the disease and its body hang together in spite of its fragmentation.
Castro offers a way to identify these exchanges with his idea of the smallest common multiple. The world is not one for Castro – it is multiple. And acknowledging this - a multiple word(s) or multiple ontologies as what is given (in contrast to an universal one) – then the combination of the three words – smallest, common and multiple, elegantly allows the smallest common of two (or more) worlds to offer a place of identification and, at the same time, allows differences to be recognised through the presence of the multiple world. If we look with this concept at the classrooms and the different assemblages of authorisation that are available, then a search for the smallest common multiple between what the teachers, children and Lego Robolab\textsuperscript{72} see as availabilitys, might give us a more articulated idea of the reality(ies) teachers and children navigate in this types of teaching. I will return to this after considering a passage in Castro’s own study about how the idea of the smallest common multiple is identified.

Castro gives an example of the way relations can be understood differently when writing about his anthropological study of the Amerindians in Amazons. Because the two cultures have different approaches to the notion of relations by making ‘relations’ into the smallest common multiple a passage of understanding between western and Amerindians thinking is created. Through the presentation of this Castro gives another valuable hint about handling the tension between different versions (or worlds) present in the classroom.

In a western world view a social relation is constituted by what we have in common – it is thus through communities of regularities that we relate and communicate. The Amerindians, Castro explains, have a completely different way of considering relations. To them it is not due to what we have in common that we are able communicate; it is because we are different from one another, and it is because we are interested in relations to something other than ourselves that we communicate (Castro, 2005, p. 140). Differences are also to be found in the way humanity is enacted. For us in the western world what we have in common with a jaguar or a crocodile is animality – everything is defined by the principle non-human.

The Amerindians contrasts this: For them everything is human, and furthermore every species sees itself as human. Castro explains it this way:

\begin{quote}
We see jaguars as wild beasts, as ferocious. Jaguars, on the other hand, see themselves as human but they don’t see us as human. They see us as peccaries, because they eat us. Peccaries, on the other hand, don’t see us
\end{quote}

\textsuperscript{72}Lego Robolab seen as a string of humans and non-humans taking a.o. materials, distribution systems, designers into account.
as humans either. Because we eat them, they see themselves as humans and us as jaguars. So each species sees itself as human and the other species as non-human: either as pray or as predators, depending on each entities position in the food chain.

(Castro, 2005, p. 141)

With jaguars and peccaries onboard I will relate to the classroom again. Castro’s attempt to find the smallest common multiple, shares Latour, Law, Mol and others criticism towards perspectivism. One of the important reasons for this scepticism is that when looking at the Amerindians through perspectivism it makes the question of what interpretation is ‘right’ increasingly apparent. Tolerating other views on the common world is only sustainable to a certain degree beyond which the dominate view can no longer tolerate other views.73

Seen this way then perspectivism can only allow limited explanatory space to the events of the classroom. If Lego Robolab, for instance, is imagined as a coherent object of one world, then we will fairly quickly produce the argument that the teacher ought to be able to control the situation and should not tolerate any other behaviour. Adopting such a view would mean that computer based teaching would remain at an unproductive and unattractive stage. Let me expand upon this:

What would happen if the teacher saw the children as species – as jaguars or peccaries that sees things and thinks radically differently? With the world made up of a more dynamic system of multiple ontologies, as Castro, Latour, Law, Mol and other ANT researchers subscribe to, then there are possibly endless other worlds enacting other understandings of the situations within the classroom. Seen in this way, then teachers cannot put an end to the multiplicity of the classroom. What needs to emerge is an acceptance that coherence is not made by locking out variations. Then the next step would be to identify the smallest common multiplicity between variants present in order to make a productive and creative classroom atmosphere.

Such an identification – such a passage of things, relations, moments - that are both common to, and yet different in, different worlds present in the classroom can be said to be found in the notion of expectations of engagement enacting different authorities as identified both with the teachers, children and Lego Robolab. Recognising that these three types of expectations are produced in three very different realms might help to invent ways to make these differences useful. Teachers expect

73 Thanks to Casper Bruun Jensen, from the IT University of Copenhagen for making this point clear to me at the Danish STS study group meeting on the 17th of March 2009.
engagement since their experiences tells them that the children are always engaged when computers are part of the teaching. The children’s excitement, thus, does not flow from the suggested content of the lesson but is brought into existence in relation to these loosely teacher controlled environments and by the freer bodies they are able to perform during these lessons. Lego Robolab’s expectations of engagement are built into the system’s varied and flexible possible usages, yet these potential usages will never come into full play if the passages of interchange between children and teachers are not found. To advocate thinking in terms of jaguars and peccaries might seem to be rather odd and too distanced a thing to do – exactly because the general metaphysic of western thinking believes in universalism. A more gentle way to work with this insight could be simply to recognise that we cannot know if the children share our world view. Or we could allow ourselves not to know what emerges and exists, to accept living with uncertainty and become like the ‘noses’ that need to learn to be affected by this type of teaching. This would be potentially more useful than expecting to be familiar with the children, the materials and the relations to both in these settings.

To sum up - the argument, peppered with Castroian spices, would state that teachers and children see the things present in the lesson differently. Therefore the first step is for the different species (primarily the teachers) to accept this; that different possibilities exist. The second step is for them to recognise that the coordination between (and the ability to coordinate) the different versions are a process of finding the smallest common multiple between the different world views represented. Progress will then be possible after this is established.

Closure

Seeing the multiplicities in the current work has been well supported by the topological thinking, which has been used to vindicate authority as a multiple phenomenon and Lego Robolab as a multiple thing. The smallest common multiple can thus be a way to gain a better understanding of the different existing ontological realms within the classroom, and to identify different, possible, tangential connecting points between the different realities.

According to this insight then imposing further regulations to the classrooms cannot be seen as a step in the right direction. However, an expansion of the frame within which IT teaching may be judged to be successful, where it might encompass more experimental assemblages created in the classroom, could be considered as progress. On the level of legislation it would be an advantage to take the multiplicity into account, and adopt a less prescriptive approach to the opportunities for learning in these environments, which is inherent in the governmental argument for
the massive financial investment in IT. We have by no means a standardised idea of the way a school textbook can enact in a learning process, so why do we think we can have that when technology is being used?

The acceptance of the multiplicity present in computer based teaching and the suggested liberations of codes for success in this form of teaching suggest at least two rather concrete continuations of this research. Firstly, more studies of these authoritative multiple situations would be useful in order to identify their passages of coordination. Secondly a continued sensitivity towards, and exploration of the topological vocabulary would be advantageous since it seems to be a very productive method to articulate changes and movement in agential, spatial and temporal dimensions in the situations studied. With these few reflections on possible and exciting future research, I will bring closure to this work by stating that this thesis has tried to retain humbleness towards what is in advance of the empirical investigation, and has found a sociomaterial approach to authority which offers ways to re-articulate and re-specify the enactments of authority in computer based teaching. It has opened the way for new and productive sociomaterial reinterpretations of the well-described relation between teacher, learning material and children in computer based teaching.
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APPENDIX A

Excerpts from Lego Robolab instruction manual
Prøv selv!
— Stop motoren på et bestemt tidspunkt

2. Programme nettoppen til at køre fremad i et sekund.
3. Læg et målebånd på gulvet, og test, hvor langt robotten køre
   på et sekund. Gengiv testen tre gange, og beregn gennemsnitstangen.
4. Anbring en LEGO figur eller en anden genstand på gulvet ved siden
   af målebåndet i en afstand, der svarer til den, der blev tilbagekastet på
   et sekund.
5. Afprøv, om robotten kan den korrekte distance uden at vælte figuren
6. Gengiv punkt 3, 4 og 5 med 2, 4 og 6 sekunder, og beregn hver gang
   hvor langt robotten køre.

BEMÆRK: Det er en god gruppeopgave i klassen, hvor hver gruppe lever de samme forsøg og sammenligner deres
resultater. Hver gruppe lever en graf med tid og afstand og plotter deres resultater ind.
APPENDIX B

Letter to school participating in the project

Fredag d. 22. juli 2005

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Kære XXXXX

Jeg hørd Nana Benjamin og er i gang med en ph.d. ved Learning Lab Danmark, Danmarks Pedagogiske Universitet. Projektet fokuserer på hvordan man kan skabe en meningsfuld lærings situation i folkeskolen ved brug af læringspil. 1 Målet er, at give et bud på hvordan man mere systematisk kan udvikle læringspil. Projektet vil derfor opstille nogle designprincipper, der tager hensyn til didaktiske overvejelser, samtidigt med at spillelementer bibeholdes.

Designprincipperne vil komme til at bestå af forskellige parametre. Et eksempel på et parameter er genre, da det antages at nogle klasserom får mere ud af strategiorienterede læringspil, mens andre får mere ud af adventure genre. Et andet parameter er kontekst, hvor relationen mellem rum, computer og elev undersøges, da det antages at læringsudbyttet varierer i forhold til hvor mange elever der er sammen om en computer og i hvilket rum eleverne spiller. Ett tredje er parameter kognitiv strategi, da det antages at de forskellige motiverende incitementer, der leder eleven gennem læringspillets, så som frustration, succes og konkurrence, understøtter forskellige kognitive strategier.

Designprincipperne vil dels kunne anvendes i selve udviklingsprocessen, dels kunne bruges til at evaluere programmer vi allerede kender i dag.


Det er ikke afgjørende præcist hvilke læringspil I anvender. Andre programmer end de nævnte kan være lige så gode, så længde de kan karakteriseres som læringspil (se definition i noten). Hvis derimod ikke arbejder med læringspil på et af de nævnte klassetrin, så lad mig vide det og jeg vil arbejde for at skaffe et program fra Learning Lab Danmark eller Mikro Værkstedet, som kan blive stillet til rådighed under observationsperioden.

For at give jer en ide om sammenhængen til de andre dele af mit arbejde, har jeg vedhæftet et kort resume af min projektbeskrivelse. Og svare naturligvis meget gerne på uddybende spørgsmål. Forskningsprojektet løber fra juli 2005 til juli 2008.

Jeg håber jeres interesse er vakt og at I har lyst til, og ser mulighed for i, at jeg kan komme ud på netop jeres skole og foretage disse observationer. Jeg er på ferie til d. 22. august 2005 hvorafter jeg vil kontakte jer pr. telefon.

De bedste hilsner
Nana Benjamin

---

1 Læringspil definerer jeg som programmer der:
   1) kommer af læringspil
   2) anvendes på et specifikt rum
   3) er udviklet med et specifikt formål at skabe laring hos en given målgruppe.