

Enactments of Computational Empowerment

A master thesis by Johannes van den Heuvel

An exploration of computational empowerments enactment in the creation of the test subject of technology comprehension

Supervisor: Andreas Birkbak

Aalborg University Copenhagen

Techno-anthropology

10th semester

No. of characters. 151.154

No. of standard pages. 63

Table of content

1. Abstract.....	4
2. Introduction.....	5
3. A literal translation of <i>digital myndiggørelse</i>	8
4. Problem area.....	13
5. Problem statement	13
6. Analytical Framework	14
6.1. Techno-anthropology, STS and the Relation to Computational Empowerment.....	14
6.2. Introduction of ANT	15
6.3. ANT in my empirical field.	17
6.4. Introduction to post-ANT.....	19
6.5. Post-ANT as part of my empirical fieldwork.	21
7. Presentation of Methods	23
7.1. Collecting data to create a symmetric analysis	23
7.2. An internship as a method.	23
7.3. Semi-structured Interview	24
7.4. Conditions of my fieldwork.....	25
7.5. Coding and transcription.....	26
7.6. Document analysis.....	27
7.7. Presentation of the Informants	28
8. Analysis part one: Policymaking	29
8.1. Beginning with the minister.....	29
8.2. Expert committee.....	31
8.3. The recommendation	33
9. Partial conclusion part one: Policy makers.....	35
10. Analysis part two: The subject developers.....	36
10.1. The Manifestation of a prototype idea	36
10.2. The educational milestones	37
10.3. The curriculum and teaching guide.....	38
10.4. Subject development organization.....	39
10.5. Constituting computational empowerment.....	40

10.6.	Qualifications of subject developers	41
10.7.	Unfolding the ability/knowledge goals	42
10.8.	Double <i>black box</i>	45
11.	Partial conclusion part two: The subject developers	47
12.	Analysis part three: The practitioners	48
12.1.	Receival	48
12.2.	Goals.....	49
12.3.	Symphonic work	52
12.4.	Practice based understanding of computational empowerment	52
12.5.	Actualizing prototypes.....	53
13.	Partial conclusion part three: The practitioners.....	55
14.	Discussion.....	56
14.1.	Translated or multiple epistemologies of computational empowerment	56
14.2.	The use of a partially existing object.....	57
15.	Conclusion	59
16.	References	60

1. Abstract

Dette projekt begynder med en kort introduktion af forsøgsfaget og de rammer som tekforsøget indeholder. Dette går over i en bogstavelig oversættelse af digital myndiggørelse til begrebet computational empowerment, der er baseret på international litteratur. Derfra præsenterer jeg min problemstilling: *What is computational empowerment?*

Før jeg forklarer den analytiske ramme for Aktør-netværksteori og Post aktør-netværksteori, og hvordan den vedrører dette projektet. Jeg følger op på dette kapitel med en beskrivelse af min metode til dataindsamling og refleksioner over de anvendte metoder. Derefter begynder jeg med de tre analysekapitler, med fokus på tre forskellige grupper, der gør brug af og har en forståelse af digital myndiggørelse. Jeg udforsker en gruppe, der er kategoriseret som politik-udviklere, der inkluderer den tidligere minister Merete Riisager og det udvalg, der har defineret grundlaget for teknologiforståelse. Jeg følger op ved at udforske fagudviklernes arbejde med at skabe prototyper baseret på information modtaget fra Uddannelsesministeriet. Det sidste analysekapitel er fokuseret på skolepersonalerne, og deres forståelse af digital myndiggørelse.

Gennem de tre analyser baseret på politiske beslutningstagere, fagudviklere og uddannelsesmæssige personlige, konkluderer jeg, at der findes mindst fire former for digital myndiggørelse. De fire udformes som værende 1) en holistisk kritisk reflekterende gevinst, 2) et færdighedsområde snarere end en abstrakt forståelse. 3) en indsigt i digitale artefakter, som andre skaber og forståelse for den kontekst, artefaktet er i, i vores samfund. 4) i spektret mellem en "digital socialvidenskab", der kun reflekterer over teoretiske problemer til en digital myndiggørelse, der kan artikulere refleksioner og en kritik af teknologi baseret på input fra de andre kompetenceområder.

Med det sidste kapitel inden konklusionen understreger jeg behovet for at anerkende de flere vedtagelser, og hvordan alle disse fire vedtægter af digital myndiggørelse skal tages i betragtning i den følgende politiske beslutningsproces, hvor politiker skal overtage, i 2021.

2. Introduction

This project investigates *digital myndiggørelse* (computational empowerment) as a concept used in the limited area of *Teknologiforståelse*, which is a test school subjected that is to be carried out from 2019-2021 (skoletekno.dk 2019). In this project, I will refer to the test school subject (forsøgsfag) as technology comprehension (teknologiforståelse). The test school subject is developed to find out how to best strengthen an understanding of technology in pupils in the Danish primary school and how to best integrate technology comprehension in Danish primary school (Børne- og Undervisningsministeriet 2018). Through the rest of this project, when referring to subject, I am speaking of the test school subject.

A consortium consisting of all six university colleges (UC) in Denmark won the contract of creating this test subject. In order to determine the best way to integrate technology comprehension into the Danish primary schools, six testing-modules was developed. Half of the schools teach in technology comprehension integrated into their regular schedule and the other half has an independent subject called technology comprehension. This is further divided into three different age groups (skoletekno.dk 2019).

	As an independent school subject	Integrated into existing school subjects
1 st till 3 rd grade	Yes	Danish, Math, Nature/technology and Arts
4 th till 6 th grade	Yes	Danish, Math, Nature/technology and Craft and design
7 th till 9 th grade	Yes	Danish, Math, Nature/technology and social studies

This table is based on (skoletekno.dk 2019).

The test-subject of computational empowerment is developed through four competency areas: **Computational empowerment, digital design and design processes, computational thinking, and technological ability to act.** (Børne- og Undervisningsministeriet 2018)

In the description there is a balance between the four areas of competence, which is crucial in enriching each other and are each other's preconditions. Without computational thinking computational empowerment becomes hollow and superficial, and without computational empowerment and digital design, computational thinking and technological ability are detached from the application perspective, which is crucial for a critical approach to the construction of digital artifacts. (Undervisningsministeriet 2018a, 3, translated by me)

The four competency areas should complement each other, according to the Ministry of education.

I began my research into the world of technology comprehension on my ninth semester as an intern. I interned at the project management of the consortium, overseeing the production of subject matter provided to the schools who is a part of the test subject technology comprehension. The consortium is managed by consultant at *Københavns professionshøjskole* (KP) (Jørgensen 2019, 10).

One of the first assignment I had as an intern was to read a preliminary study of international advances in technology comprehension. As part of the preliminary study, there existed a call for a comprehensive study of *digital myndiggørelse* (Jørgensen 2019, 20). Instead of a systematic literature review, I have devoted a chapter on other literature on the subject, to investigate and qualify a translation of digital myndiggørelse (Computational empowerment).

This study investigate what computational empowerment is, when there exist numerous understandings from the beginning of the test subject. While I do not believe this is a study that answers the call of the preliminary study from Ramboll or dives into how to teach computational empowerment.

This report ignited something within me as I did not feel sure, in understanding what computational empowerment was, I began to question which enactments there existed. What started as a small spark, grew to a medium sized flame, as I were assigned with reading technology comprehension-related teaching material accessible for free on the internet. I was assigned this task, to gather and condense inspirational material to the subject developers producing teaching material to the schools. I located 95 ideas with some relevance to technology comprehension, From Ultrabit, EMU, FabLab, Teksperimentet and Telenor. Only a few of the free lesson plans involved anything resembling computational empowerment and they called it digital literacy. This is not me making this distinction, rather it is the distinction between the two Danish terms *digital myndiggørelse* and *digital dannelse* which is also discussed in the later chapter on literal translation of *digital myndiggørelse*. While the lesson plans, we in the project, produced were almost similar, we used computational empowerment rather than digital literacy. This notion made me believe there were something more to understand about computational empowerment. Through my field interactions I was thereby let into a small conflict, as not all I met in the consortium believed digital literacy and computational empowerment are to interchangeable things.

In this project, I will refer to the people working on creating useable content to this subject, as subject developers. In general most of the subject developers work at one of the six university colleges, as educators of teacher-students. The content the subject developers produce will hence fourth be called prototypes, as it does not live up to the general Danish understanding of what a lesson plan (undervisningsmiddel) is.

This project contains a literal translation of *digital myndiggørelse* into the term computational empowerment, based on international literature. From there I present my problem statement before I explain the analytical framework of Actor-network theory and Post actor-network theory and how it pertains to the project. I follow this chapter up with a description of my method of data collection and reflections on the methods used. I then begin on the three chapters of analysis, focusing on three different groups work with and enactments of computational empowerment. I explore a group

categorized as policymakers, which include the former Minister Merete Riisager and the expert committee that has defined the basis for the test subject of technology comprehension. I continue on exploring the subject developers work with creating prototypes, based on information received from the Ministry of Education. The last chapter of analysis is focused on the school personals, their enactments of computational empowerment and how they work with the prototypes they receive.

3. A literal translation of *digital myndiggørelse*.

With this project I would like to explore the relative understanding of *digital myndiggørelse*. In order to create a better and coherent reading experience, *digital myndiggørelse* needs to be translated into English, this also gives me the opportunity to dynamically incorporate other literature on the subject, as *digital myndiggørelse* is mainly a Danish concept (Jørgensen 2019, 13-14).

Digital myndiggørelse cover the ability to analytically and with reflection understand the importance of digital artifacts in everyday life and in a work-life context. Through qualified analyzes of digital artifacts, the embedded intentionality of the artifact and the use, the student is given the necessary basis for proactively being able to redesign digital artifacts and to assess the significance of the artifact for the individual, communities and society. (Undervisningsministeriet 2018a, 9, translated by me)

The Ministry of Education uses this definition of the term, and in the process of finding a fitting translation, I will compare any potential term to this definition. This is not an admission, that this definition should be the commonly used definition, rather I see it as a gauge to compare with.

There exist similar concepts in literature in English, which this chapter will dive into. The main reason for a thorough discussion on which term to use, in order to translate the concept of *digital myndiggørelse*, is its proximity to the Danish term *digital dannelse*. The term *digital dannelse* is often translated into digital literacy, which in itself is a term filled with conflicting interpretation. Digital literacy originates in its broader understanding with Paul Gilster from his book called "digital literacy" (Gilster 1997, Bawden 2008). Digital literacy emerges as a subcategory of literacy, concerned with the digital aspect. David Bawden describes this as a traditional view of literacy, wherein the world around has changed with the coming of a digital age, but the literacy aspect is still to deal with the surroundings through "*technologies and formats of the time*" (Bawden 2008, 18). With this definition of literacy, the digital aspect is thereby only a fraction of the literacy needed in general. Literacy is thereby something bigger than the interactions with one format, one way of digesting information or one way of creating understandings of the world. The digital aspects thereby limit the inputs and interactions of a person's literacy.

In Paul Glisters book the following is written:

"digital literacy is about mastering ideas, not keystrokes" (Bawden 2008, 18 (Gilster 1997)).

This somewhat aligns with my own understanding of *digital dannelse* and *digital myndiggørelse*. But as I see digital literacy as a fitting translation for *digital dannelse* rather than *digital myndiggørelse*. I also have an internal need to explain the holistic idea of *dannelse*. Glisters statement is not an obvious one, as some use *digital dannelse* as the ability to act with digital tools, such as email, the internet or digital media (Bagger 2018, 33-35). According to Bagger's approach to *digital dannelse*, the elderly reaches an aspect of digital literacy when they are able to comply with the Danish government requirements for

digital communication, furthermore digital literacy is to fulfill one's own digital needs and reflect on one's action to reach a goal online (Bagger 2018, 43).

The term digital literacy holds some of the same discussions and internal discussion as digital dannelsen, and therefore I will, in this project, use digital literacy as a translation. One of those internal discussions which is present both in digital dannelsen and digital literacy is the use of the term to cover the ability to handle, appropriate and process the multi-media inputs of a computer (Bawden 2008, 18. Bagger 2018, 35-36). Digital literacy thereby becomes the ability to act with computers, with actions that are informed by knowledge on computers abilities. This knowledge that informs actions is not a deeper understanding of hardware, rather it is an understanding of the interactions need as a common user of the technology.

At one point I also discussed the use of digital Bildung as a substitute translation. This would not satisfy my own need, to create a better reading experience as it would be a German word rather than a Danish. Through my reading of abstracts, I also found uses of digital Bildung as a generic term, covering all education regarding digital aspects (Bergner 2017, Heinen and Kerres 2017). Therefore I return to the term digital literacy, as I also need to explain why this term does not fit into an understanding of *digital myndiggørelse*.

Gilster summarizes ... in the book by suggesting that there are four core competencies of digital literacy: Internet searching, hypertext navigation, knowledge assembly, and content evaluation. This list however seems to miss out some of the issues quoted at various places as significant. (Bawden 2008, 20)

Some of the competencies needed in order to maneuver in the digital world and gain digital literacy, perhaps seems dated in the world we live in. This is mostly because of how basic building blocks the four core competencies of digital literacy are. If we look towards the elderly or the early experiences children have with computers, we still see these competencies being appropriate, as internet searching or hypertext navigation is needed tools to assemble knowledge (Bagger 2018, 35-37)

While finding a translation for *digital dannelsen* is important for this project as it is, in some instances compared to *digital myndiggørelse* and in others interviews the distinction is made very clear, as an underlying characteristic of the whole conversation. The search for an independent term that *digital myndiggørelse* can be translated into continues.

The next term I found interesting, was the term computational thinking, which originates from informatic (Michael E. Caspersen et al. 2018, 1). Both Ole Sejer Iversen and Michael E. Caspersen, who have written a report on computational thinking as part of IT-vest, were co-chairmen on the expert committee, writing a proposal for the content of the test subject to the Ministry (Børne- og Undervisningsministeriet 2018) This committee will be the focus of the first chapter of analysis.

The produced report could be seen as a "call to arms" for all, as they compared the lack of computational thinking-skills and informatic-skills to be equal to proletariats lack of reading and writing skills hundreds of years ago. Thereby stating the general need for an everyday understanding of

informatic (Michael E. Caspersen et al. 2018, 1). Michael E. Caspersen presents computational thinking as the fourth industrial revolution, the fourth scientific domain, the fourth universal language skill and the fourth basic learning skill (Michael E. Caspersen et al. 2018, vii-6). This might emphasize the importance of computational thinking, but it does not actually narrow the definition down to something tangible.

Computational thinking originates with Seymour Papert in 1980 but was popularized by Jeannette Wing. Wing defined computational thinking as such:

Computational Thinking is the thought processes involved in formulating a problem and expressing its solution(s) in a way that a computer can carry it out [without human interpretation]. ((Wing, 2006) Michael E. Caspersen et al. 2018, 10)

If I compare this statement with the following definition of *digital myndiggørelse* that the Danish Ministry of Education has provided, there are vast differences between the two concepts.

Computational thinking also exists as one of the other three competency areas of technology comprehension but is presented by Michael E. Caspersen as something more. It should be noted that the text I am referring to is written before he acted as co-chairman of the technology comprehension writing committee. Michael E. Caspersen represents an informatic approach to *digital myndiggørelse*, with his understanding of computational thinking. Because of the existence of computational thinking as a competency area, I cannot use this as a translation. Furthermore the Ministry of Education definition of *digital myndiggørelse* does not work as a fourth learning or language skill.

The former Minister Merete Riisager also creates a distance between informatic and the test subject I am limiting my scope to. I would not like to muddy the water by using a term related to informatic, because I have to make this distinction clear later on.

So far, my exploration has been for a term that could replace all of the concept of *digital myndiggørelse* while still maintaining some sort of neutrality as not to define the whole concept through the translation. By neutral, I mean a term that every group of actors can identify with and shape into their own image. This has brought me closer to the understanding of reflections and critical thinking as part of the term, but as the next step a reflection, on the translation of each word in *digital myndiggørelse*, is needed. I will initially dive into an understanding of the word digital.

Given how important digital technology has become to our lives it is useful to know what the word "digital" actual means. In technical terms it is used to refer to data in the form of discrete elements. Though it could refer to almost any system numerical, linguistic or otherwise used to describe phenomena in the discrete terms over the last 60 or so years, the word has become synonymous with the technology which has made much [...] possible, electronic digital binary computers (Gere 2009, 11)

Using this understanding of digital, it could be used as a synonym for computational as in *computational thinking*, as it is a generic understanding that limits the scope to all screen/machine

interactions. I would like to supplement the definition of digital by Gere, with another explanation on how to understand the term digital

The term digital will be defined as all that which can be ultimately reduced to binary code, but which produces a further proliferation of particularity and difference. (Horst and Miller 2013, 3)

Once again I show a definition based on binary code, which is enacted through computers. I lean towards the second explanation of digital, as it is simple and timeless. I thereby understand digital, as in *digital myndiggørelse*, through the spectacles of Horst and Miller. I also believe this understanding allows for a translation of digital, into a term such as computational.

With such a generic and general definition of digital, a lot more focus must go to understanding and translating *myndiggørelse*. *Myndiggørelse* is a verb originating from the term *myndig*, which translates to legally independent (Familieretshuset n.d.). Thereby is *myndiggørelse*, the process of obtaining qualification to maintain or become a part of a democratic society.

One of the most common translations of *myndiggørelse*, would be empowerment (Siim 2003). Empowerment is of course, in its own right, a theoretical term, but as it turns out, a theoretical term, which proves to be quite useful in this context.

Empowerment is defined as processes, that improve the underprivileged individuals and social groups ability to create and handle mental, material, social, cultural and symbolic relevant resources. Empowerment references both to the subjects experience, meaning the feeling of "doing a difference" in order to handle and changes one's life situation and to the actual realm of objective reality, which consists in the societal power-and resource distribution systems that affect the life chances of different groups at a given historical moment (Andersen 2003, 14, translated by me)

The empowerment term is here taken verbatim from a city planner perspective but fits my narrative. Empowerment could thereby be a good placeholder, as it both concerns the individual's perception of their abilities to act, and an outside scope of the positive consequences of the actions. This also brings us to the next term in this "tournament of definitions" *Digital empowerment*.

Digital empowerment connects the arbitrary term digital, almost only as a limitation to the scope of empowerment. Digital empowerment is used as a term describing processes where individuals move from only being on the receiving end of digital products, digital artifacts and digital activities as consumers or users (Mäkinen 2006, 382)

Digital empowerment is an enabling process, which proceeds like a spiral from the prerequisites to the improvements in skills and knowledge, and then to the consequences, which are empowering for the community and its members. The changes happening during this process are not just one-way improvements, but they reflect and influence each other's. The spiral of digital empowerment is dynamic and

changing because it keeps up with progress in the surrounding society (Mäkinen 2006, 391)

A school class can be seen as a community, Mäkinen uses digital empowerment as something happening through group interaction and as a holistic effort that lifts and empowers a community rather than an individual. This does not fit into the ideas of the definition and ambitions the Ministry of Education has for *digital myndiggørelse*, as there exist a focus on empowerment of individuals. But this also brings us full circle as we continue on with the term empowerment, we reintroduce the term computational and we connect it to one of the co-chairmen of the expert committee of the test subject, Ole Sejer Iversen. Sejer Iversen presents in his article "From Computational Thinking to Computational Empowerment: A 21st Century PD Agenda" the idea of computational empowerment as a reflective component in computational thinking (Iversen, Smith, and Dindler 2018, 1-2)

In this paper [...] We propose computational empowerment (CE) as a PD [participatory design] alternative, focusing on how children can build their understanding of technology and their agency in a digitized world (Iversen, Smith, and Dindler 2018, 1)

This term does not only give a fitting translation, that could correlate with the definition of the Ministry of Education, the article also relates it to digital literacies, as computational empowerment feeds into the individual's larger digital literacies. This thereby creates a clear hierarchy between the two terms which fits well into the written understanding, that so far has been presented. As this report explores the term *digital myndiggørelse* (**henceforth computational empowerment**) this hierarchy will be challenged or completely disregarded

4. Problem area

In this project I deal with the exploration of the multiplicity of computational empowerment. As I have already described, there exist a test subject which should find a way to strengthen technology comprehension among school pupils in Denmark. This test subject is new and consist of different disciplines. I argue that one of those disciplines, Computational empowerment is unstable and under development as an ongoing discipline alongside the test subject. This is not a problem in itself, but because the point of the test subject is to further develop on policymaking, I foresee a challenge. This challenge is to evaluate on an underdeveloped concept. I see this as a challenge because I fear, changes to the concept of computational empowerment, is seen as mistakes made in the field rather than renegotiations through new relations. I therefore make a point of investigate how each hand-off in this process has changed the concept of computational empowerment, to avoid any actors is singled out as scapegoats. This is done through a Post-Actor-network theory scope (Post-ANT) which will be expanded on later.

5. Problem statement

What is computational empowerment?

6. Analytical Framework

In this chapter I would like to explain how I create connections between Techno-anthropology, Actor-network theory (ANT) and Post Actor-network theory as analytic framework and Computational empowerment as a field of investigations. I begin with an explanation of techno-anthropology as a part of the studies of science, technology and society studies (STS). I continue with an introduction of ANT, where I introduce the concept of *Translation*, *Treason*, *Black boxes* and *Partially existing objects* as analytical concepts. I continue on to justify the use of the aforementioned analytical concepts in this project.

6.1. Techno-anthropology, STS and the Relation to Computational Empowerment

I will begin this theory chapter by dwelling on the role of a techno-anthropologist for just a moment. In an introduction to Techno-anthropology Torben Elgaard Jensen, one of the professors involved with the development of the field, writes

STS is about this problematic and productive relationship between science, technology and society. Quite obviously, this is an important problem to think about and to study. But it has to be done with skill and with care. The quality of the whole STS enterprise hinges on the sophistication with which we can conceptualize the relation between science, technology and society (Elgaard Jensen 2013: 3)

Techno-anthropology is directly linked to the studies of STS, so is computational empowerment as it builds on scientific developments from informatic, it directly include technology in its practices and lastly societal consequences are reflected on, by schoolchildren through the concept of computational empowerment.

The roll of a techno-anthropologist is to understand and seek answers in the relations between technology and humans. With technology comprehension and computational empowerment being so closely linked in content with the core of Techno-anthropology, I find it vital to investigate the collaborations between different professions and the creation of a subject that might contain the same values and ideas as my own profession.

This project will focus on what computational empowerment is, through the use of Actor-network theory (ANT). ANT is among others, an analytical framework under the umbrella term of STS (Bruun Jensen 2020, 516).

In the former chapter, I do a literature review focused on a literal translation of *digital myndiggørelse* (computational empowerment). In that chapter I referenced a quote from the Ministry of Educations that defines computational empowerment. In this quote there exist a focus on cross- or interdisciplinary work with the four competency areas. Before we continue on, to the next section I will explain the use of "literal" in the title of the former chapter. As part of the analytical toolbox of ANT, there exist a theoretical term called *translation*, to avoid confusion I therefore attach literal, when I talk of translation

between languages and not between actors. In the next chapter I will explain the term *translation*, as this term is used in this project to understand the unstable status of computational empowerment.

6.2. Introduction of ANT

My goal with exploring the concept of computational empowerment, is to unfold an understanding of the project that can explain the shifts in enactments as purposeful actions rather than careless mistakes. This is done through ANT and Post-ANT.

ANT do not have a preconceived understanding of agency stemming from human actors or non-human actors (Bruun Jensen 2020. 516-517). This is seen in the use of the term actors, as it covers all participants relevant for a network. As I study what computational empowerment is in the specific field of the technology comprehension test subject, I will also be met by an overlap in allies and different ways of enacting computational empowerment related to the different networks. This is also in part why I have split my analysis into three subchapters. These subchapters are both co-dependent and independent and should be read accordingly.

One of the main analytical tools I use is the ANT-concept of *Translation*. *Translation* is the process of reaching a common agreement (Callon 1986, 6).

Four 'moments' of translation are discerned in the attempts by these researchers to impose themselves and their definition of the situation on others (Callon 1986, 1)

The process of *translation* happens through four connected and overlapping moments. In this report the moments are found throughout, and a central explanation of the moments and their function is needed. *Translation* is focused on achieving change, but it comes at a cost. Vasilis Galis and Francis Lee have written an article on the excluding factors or treasonous factors of the *translation* process, as a critique of classic ANTs focus on strong network and strong actors (Galis and Lee 2014).

As part of my inclusion of Post-ANT reflection into this project, I also identify the four moments of exclusion (Galis and Lee 2014, 154). Underneath is a matrix that describes the two sides of the *translation/ treason* process.

Four moments of <i>Translation</i>	Four moments of <i>Treason</i>
<i>Problematization.</i> The process of identifying actors through a group defining problem. Potential allies appear through the need for alliances to reach the involved actors' goals (Callon 1986, 6-7).	<i>Distortion.</i> Be defining a problem, through problematization, agendas not included are thereby neglected. The problematization thereby creates an "other", which exist outside of the defining problem (Galis and Lee 2014, 159-160)
<i>Intressement.</i> this moment contains the actions that impose and stabilizes actors identified through the problematization moment (Callon	<i>Estrangement.</i> The "other" actors/agendas loose influence by being dissociated. Wherein the intressement stabilized identities related to a

1986, 8). The problem that was relevant for the actors, must be followed up by actions that stabilizes a follow-up on the potential network.	defining problem, the distortion is followed up by devices excluding the stabilized actors from the estranged actors (Galis and Lee 2014, 162).
Enrollment. is a moment of dividing and accepting roles among the actors, as a way of going from receiving an identity to accepting them as a role that through multilateral negotiations (Callon 1986, 10).	Rejection. This moment concerns the complete severing of association between enrolled actors and rejected actors <i>It is a matter of transforming a series of obstructions into an insurmountable barrier (Galis and Lee 2014, 165).</i>
Mobilization. The moment where the few can speak on behalf of the many actors. The actors come together in reaching their goals together, through various actions and thereby reaching goals not possible without alliances (Callon 1986, 14).	Disruption. The final term of <i>treason</i> concerns the consequences of the other agendas when an agenda is mobilized. Other agendas become invisible and destabilized (Galis and Lee 2014, 168-169).

The concept of *translation* is explained through Michel Callon's text on scallop domestication. In Callon's case, a set of researchers set out to cultivate scallops in St Brieuc Bay (Callon 1986, 5). While in Galis and Lee's case, we see the allocation of disable people as actors in the construction of Athen metro (Galis and Lee 2014, 154). While both vocabularies make sense to use in the *translation* process. I will use both terms simultaneously as the relation are not stabilized yet. The actors do not exist in stable networks though relations, as the *translation*/*treason* moments are not stable. The two terms are used as two sides of the same set of actions (Galis and Lee 2014, 154). To further investigate the complexity of computational empowerment, I will therefore investigate change to the concept of computational empowerment through both perspectives.

I see the development of computational empowerment as a *partially existing object* because computational empowerment exists as a concept under development (Bruun Jensen 2020, 519). As the test subject has gone through several rounds of production and testing out at primary schools, it cannot disappear, but it is not a concrete thing yet. The concept is not bound to any specific actor, human or non-human, in any stabilized sense (Bruun Jensen 2020: 519-521). I will develop the argument of the *partially existing object* through the analysis of gathered data.

A *partially existing objects* is the opposite of a black box (Bruun Jensen 2020, 519). The black box exists as part of the classic ANT toolbox in order to describe unquestionable constructs.

The word black box is used by cyberneticians whenever a piece of machinery or a set of commands is too complex. In its place they draw a little box about which they need to know nothing but its input and output [...] The impossible task of opening the black box is made feasible (if not easy) by moving in time and space until one finds the controversial topic on which scientists and engineers are busy at work. (Latour 1987: 2-3, 4)

The black box is not only a construct used as a replacement in machinery, it is also used in socio-technical context wherein networks have reached stabilized conditions. When a black box reaches a stability, it often becomes invisible in a daily context. In the field, computational empowerment, has not yet reached a point where in the content is obvious to everyone. Eventually computational empowerment might reach stabilization as a concept, through common agreement in definition, and become a black box. While ANT in general avoids duality, as it simplifies the world we live in, we here see two concepts which immediately appear as dualities. When networks either is a *black Box* or a *Partially existing object* it is important to note that being a partially existing object is not a stable construct and is therefore not able to act as a stabilized opposite to *black boxes*.

6.3. ANT in my empirical field.

ANT is not considered regular theory despite the name. I use it as an analytical toolkit, with preexisting vocabulary that helps describe the relations seen in the field.

So what is ANT? In 1999, Bruno Latour argued that, despite the name, it does not count as a theory. Certainly it is not predictive, and it does not offer social laws. But if it is not a theory, then what is it? One plausible response is that it is a tool-kit for thinking about and studying the social; more particularly, that it is a tool-kit for charting practices of association [...] Properly handled it is also a critical sensibility both analytically and politically. It becomes a way of energetically undoing otherwise hampering taken-for-granted assumptions: about the social and the natural; about the world; about politics... (Law and Singleton 2014; 3)

Through reading Law and Singleton paper on ANT and multiplicity, it becomes apparent that they expect theories to include some sort of social laws, that help explain behavior. While there does not exist predictions in the toolkit of ANT, there exist analytical principles. The most important analytical principle is that of ontology. In using ANT I also adopt the ontology based in practice and materiality. This means that worlds are internally defined in groupings called networks. In the practice of network, non-humane actors can have agency on their own (Bruun Jensen, Gad, and Winthereik 2013, 6-8). This analytical principle also means any analysis done with ANT should be generalized symmetric and exclude any preexisting understandings of the field, from the researcher (Bruun Jensen 2020: 516). By symmetric analysis, human actors and non-human actors are perceived as equal. This analytical point is to understand the more nuanced complexity of the reality, humans and technology constitutes together. The analytical point of human and non-human actors is also based in an understanding of

mutual constitution (Bruun Jensen 2020: 516). Endre Dányi explains actor-network theory through these two points

...relations may exist among all kinds of entities, humans and nonhumans alike; and ... the differences that appear as patterns of relations are never absolute, and therefore cannot be easily described as attributes of micro- or macro-phenomena (Dányi 2017, 1).

Through these two points of understanding ANT from Dányi and the description by Law and Singleton, I am thereby left with an understanding of ANT as a framework used to navigate an exploration of concrete relation between humane, non-humane or in our case *partially existing objects*.

As Actor-network theory grew over time, as an actor among academic scholars, a stabilization followed.

we should say that actor network theory has been a successful project. This may be right, but this success has been bought at a price (Law and Singleton 2014: 4)

For a framework, as ANT best can be described, this stabilization had negative consequences as relevant critique followed and ANT ended up being a stabilized black box, out of the control of the original developers of this framework. A framework that preaches complexity and have no predictive assumptions, should and could not be reduced to a commonality and have no universal usability (Gad and Bruun Jensen 2010: 57).

According to [John] Law, it is very hard to criticize, describe, and diagnose ANT without contributing to its fixation (Gad and Bruun Jensen 2010: 58).

I follow this quote by Gad and Bruun Jensen, that criticizing a concept thereby also enables the definition of this specific construct. ANT consist of many different tools, all usable in different situations or relevant in different contexts, by pointing at the toolbox rather than the individual tools something is lost in each tool's definition and the justification of its existence. If we for a moment allow for some form for fixation of traditional ANT, there two points Law characterizes ANT with.

ANT is a "ruthless appliance of semiotics," (Law 1999, p. 3). All things are what they are in relation to other things, not because of essential qualities. [...] Additionally, traditional ANT is about performativity: things are what they are because they are done that way by actors relating to other actors (Gad and Bruun Jensen 2010: 58).

The understanding of existing through relation also means that dualisms dissolves and the existence of actors outside the black or white picture of dualism. A good example of this, that already has been mentioned in this chapter is the *partially existing object* (Gad and Bruun Jensen 2010: 58, Bruun Jensen 2020: 519). The other point is on performativity. If actors, networks an actors-networks only exists through relations, the researcher runs the risk of writing off actors without allies, who still seek to influence a network. Seeking to improve on ANT, based on critique of valuing "stronger" actors over actors without allies, and to overcome the fixation previous success had brought with it the question of "what comes after ANT" was brought forth by Law and Hassard in *Actor Network Theory and After* (Gad and Bruun Jensen 2010: 55).

6.4. Introduction to post-ANT

The answer to the question above was to create and rebrand ANT. This is in part explained in the quote beneath, as the framework had to break free of the chains of conformity to maintain its focus on complexity.

As ANT teaches, one can never isolate pure concepts from the sociotechnical networks that shape them. For this reason, "improvement" is also a peculiar name for what ANT views as processes of ongoing transformation (Gad and Bruun Jensen 2010: 56).

ANT and Post-ANT exist as the same framework, the same actor-network, wherein neither is a method nor a theory. To follow up on the quote on contributing to fixating ANT in order to diagnose it, is also pertinent to note that fixation of ANT was not wished for by its developers. A framework that should reflect the complex constitution of networks through relation, should of course grow and change with the changes to relations. Post-ANT is hereby this growth of insight. One of the ways in which ANT grew, can be seen in the light of the following quote. Post-ANT texts contain needed reflection on the role of the researcher.

"post-ANT" is our abbreviation of a set of discussions within ANT; in other words, it is a shorthand for "reflexive" ANT texts (Law and Singleton 2014: 4).

The understanding of Post-ANT thereby also leaves room for reflection on the critique of valuing privileged actors, the understanding of multiple practiced and enacted realities. By this I have gathered that talk of after-ANT, Post-ANT and multiplicity is in-part created to avoid stabilizing any attempt at fixating ANT and inhibiting continuances exploration of complexity.

ANT has received notable critique, which also has led to the reflective aspect of Post-ANT. Among the critics there exist a feministic theoretical focus. I will focus on two points of critique on ANT, stemming from the feministic theoretical community

ANT has been challenged by feminists for focusing on privileged actors and for its blindness to other possible ways in which networks might develop—without control or force as primary mechanisms. Feminists have also noted that networks appear quite differently for marginalized actors living with multiple borders... For example, Susan Leigh Star describes a transsexual person at a time where he or she is waiting for an operation and does not fit the common heterosexual or homosexual networks but is nonetheless intensely confronted with them. She suggests that this example indicates limits to ANT's mode of description (Gad and Bruun Jensen 2010, 58-59).

Earlier in this chapter I have described *translation*, alongside *treason*, and connected these two analytical frameworks. This is done to best grasp this challenge of describing marginalized actors. IN the analysis, this point of describing marginalized actors does not shine through, as I deal with a *partially exiting object*, where networks are not stabilized yet. I therefore walk a line between partially marginalized agendas. I have not found truly marginalized groups in my research. By truly marginalized I mean actors that are clearly *rejected* from interacting and contributing to the enactment of

computational empowerment. But I will also agree with the feministic critic, as I also contribute to fixating which actors should influence the development of computational empowerment. I have limited my work to a single test subject, by the term computational empowerment is not bound to this area alone. By limiting my fieldwork, I may unknowingly have excluded actors.

The second point of critic to ANT in general, which has shaped the rebranding of ANT, is concerning generalized symmetry.

Most sociological theories include a concept of "otherness," which, among other things, handles the limits of theory itself: the fact that there are important conditions that are out of its scope. However, because of the notion of generalized symmetry, ANT can be criticized for wanting to explain everything, and therefore for not leaving space for any "other" (Gad and Bruun Jensen 2010, 59).

Where in exist the limitation of ANT. This critique is in-part handled but looking at the compasses to "other theories". If we stand our ground, in believing ANT is an analytical framework, there is much sense in comparing the analytical framework with a theory. Furthermore I will draw focus to the point in practice-based understanding of ontology. The researched subject is understood through the network. While this is of course difficult in a network impacted by a *partially existing object*.

A way Post-ANT has maintained, and rediscovered complexity is through a deep understanding of realities as being multiple through heterogeneous practices and enactment, and the understanding that realities are never an invention (Law and Singleton 2014: 12).

Post-ANT brings with its analytical principle of *Multiplicity*, this principle goes against the understanding of generalized symmetry, as a principle of a singular network. I have earlier referenced generalized symmetry as a main principle for all ANTs analytical principles. As part of the Post-ANT "update" this principle has also been updated with the principle of multiplicity.

She [Anne Marie Mol] strives to shed light on the practical and local means whereby different actors with different aims handles or enacts arteriosclerosis. She uses symmetry as a preparatory methodological arrangement in order not to commit to the understanding any specific actor has of a phenomenon, because, she tells us, such understanding is always generated as a consequence of ontological work and enactment of such phenomena. It is exactly this situation, characterized by a multiplicity of enactments that Mol is trying to elucidate. As in Latour and Callon's argument for generalized symmetry, we are therefore obliged to meticulously follow the efforts of involved actors to establish their relations in the networks of care practices. Mol identifies comparison as a particularly important mode of establishing relations and contrasts in health practice (Gad and Bruun Jensen 2010, 65).

The idea of leaving behind preconception as a researcher has not been dismissed but is met by reflection. ANT is no longer about following one network as its actors stabilizes around a commonly agreed upon black box. As part of multiplicity, several understandings or realities are enacted, at times in proximity of each other.

Furthermore Post-ANT has introduced the multiple, both as an understanding of ontology and as a method of writing (Gad and Bruun Jensen 2010: 70-71, Vikkelsø 2007: 303-305). I am therefore also dividing my chapter of analysis to three different realities of computational empowerment, based on the role each group take and steps they use to enact computational empowerment.

6.5. Post-ANT as part of my empirical fieldwork.

As I have previously presented, as part of the discussion on computational empowerment, there are many understandings that already lies within the field of the test subject technology comprehension in the Danish primary school. In order to understand computational empowerment I have chosen to explore through the framework of Actor-network theory (ANT) and Post Actor-network theory (Post-ANT). As I see computational empowerment as a potential black box in the making, I have come in the right time and at the right place to explore it as it stabilizes.

In this chapter I presented the not-so-theoretical understanding of Actor-network theory as I use it as an analytical toolbox. I also presented the distinction between ANT and Post-ANT. Furthermore I brought in core concepts used in this report.

I will not only draw on the analytical tools, seen in previous works on Post-ANT, I will also draw inspiration from Anne Marie Mols book "The Logic of Care: Health and the Problem of Patient Choice", as to the way this report will be structured. This report will consist of three analyses of networks all concerned with computational empowerment and technology comprehension. This is done to understand the multiplicity in effect.

- Policymakers involved with the creation of technology comprehension
- Subject developers included in developing subject matter for technology comprehension
- School teachers included in the test subject, that has to perform teaching in specifically computational empowerment.

While there exists some overlap, the different focuses create understandings of networks involved in the stabilization of the black box in the making.

This could be a classic ANT story of *translation* like "Circulating Reference: Sampling the Soil in the Amazon Forest" or "Some elements of a sociology of *translation*: domestication of the scallops and the fishermen of St Brieuc Bay" (Callon 1986, Latour 1999). We see the concept of computational empowerment, not yet developed, not yet stabilized being negotiated through humane and non-humane actors, like in classic ANT writings. In this report of negotiation and *translation* I will argue that every hand-off contains *treason*.

As I explore computational empowerment, though a journey from policy, to development, into practice, every step will meet new *translations*, which in turn will mean *treason* of aspects present in the previous *mobilized* actor-networks. Rather than receiving Callons work on scallops as an example of bad *translation*, I read it through the eyes of Galis and Lee, who would like to add to the ANT vocabulary the

term *treason*. At some point *enrollment* or *mobilizations* meet *treasons* such as *disruptions* or controversies (Galis and Lee 2014: 155). Not all *treasons* are bad, as I see it, some *treasons* are made in order to keep actor-networks intact, this happens at times where agendas or actors are dismissed in order to gather the remaining actors in a stronger alliance. As I have tried to explain earlier, ANT sees things through relations, in a hand-off of a concept such as computational empowerment relations change, to avoid a breakdown, a *translation/treason* balance needs to be struck in order to allow new actors to take ownership, while older actors need to recognize the *partially existing object* they are handing off. I call this balance *good treason*.

as many ANT scholars have pointed out, translation is always also an act of treason (see Galis and Lee 2014), as it necessarily modifies the entities that are implicated in the process. By drawing up new contexts, making new juxtapositions, and assigning new meanings, equivalence is necessarily rendered impossible (Dányi 2017, 9-10).

As part of navigating my field I focus on identifying *translation/treason* balance of *good treason*. By *Good* I do not acknowledge it as better, but just as a "necessary evil", The *good* part of *treason*, is the avoidance of a breakdown in the network. I hereby see Dányi as valuing the survival of networks as good. I adopt this understanding of the networks as being beneficial, and I therefore also adopt *good treason* as a term of identifying shifts in alliances in the *translation* process.

7. Presentation of Methods

7.1. Collecting data to create a symmetric analysis

As I have stated numerous times, this project is inspired by and based on approaches found in ANT and Post-ANT literature. With this in mind, a question arises when we approach the subject of methods used to collect data: "How to collect data for a symmetric analysis?". If all of the researcher's previous understandings, should be set aside, how is knowledge then collected and which knowledge is worth collecting? These are the questions I will answer through this chapter.

I have found that the best way to create a symmetric analysis, is to dive deep into the field headfirst. I had no idea where my internship would lead me or where I would find challenges or ideas worth further time and energy. Through this chapter I will describe my time as an intern and how that has benefitted this project. I will explain the chosen methodology for examining human and non-human actors through interviews. I will also go through some of the obstacles I have met along the way (spoiler alert: It is in part COVID-19).

During fall of 2019, I was an intern at *Københavns professionshøjskole* (KP), directly connected with the project managers, who oversaw the test subject. My original plan was to conduct a study alike this project during that time. As my time there continued, I saw how this project continued to grow and I decided to push computational empowerment to be the subject of my thesis. This also means that my data collection is spread over almost a year. This chapter will therefore be containing reflections from both my internship and my last semester of the Master's.

7.2. An internship as a method.

In my time as an intern, I was a part of several conferences with subject developers and I have read through a lot of the lesson plans. As I was exclusively affiliated with the project of technology comprehension at KP, thus I experienced fieldwork to a greater degree than what is normally possible as a techno-anthropology student. I benefitted greatly from being a part of this field of almost 10 months, and not just the 4 months a normal semester takes. I here took inspiration from Malinowski's story of Kula and the silver lining of being stuck under the first world war (Malinowski 1920, Eriksen 2005). First thing was the many beneficial information I got from being so deeply embedded as a participating observer, but I needed time to distance myself from the fieldwork as I feared to go native.

I use the term participatory observation lightly, as I used quite a lot of my time taking care of internal assignments as an intern, but many of my interviews were informed by experiences from my internship.

Participatory observation is an oxymoron, as participation dictates being a part of a practice while observation is an activity done from the outside (Thomas Szilevicz 2020, 100). This therefore creates a need to balance the two in order to actually use it as a methodology to collect empirical data. The balance is often found in the need to document the social practice. By needing to document, the researcher steps out of their participation and into a momentary role as spectator (Thomas Szilevicz 2020, 100). Retrospectively, I did not balance my participation along with observational practice well.

My first two days as an intern was used in Odense as part of conference which the project management was responsible for. This dive into the deep end, meant I felt as if I had no chance to understand my experiences, work as part of the team and document my findings at the same time. I tried writing a log, about my daily assignments, but the log did not provide data to this specific project. But my participatory observations throughout my fieldwork was beneficial in other ways, as it helped opening the field for me, building relation to the actors and inform my interviews. At times, the function of participatory observation, van also be to benefit the researcher field understanding and thereby impact the interview guide (Thomas Szilevicz 2020, 103).

The notes I took during my participatory observation was also used as part of my last semester report and will therefore not be used here, as I seek to illuminate new knowledge and another study focus, as my last semester report ended up having an organizational structure focus.

During my internship I interviewed three people involved with the subject development, three people involved with the expert committee who had a role of defining technology comprehension, two people who are involved with an expert follow-group, and two project consultants. Hence, ten interviews have been executed and empirical data extracted from these will be utilized for this thesis.

7.3. Semi-structured Interview

While ANT dictates non-human actors as having agency too, I have unfortunately not found a way to interview a non-human actor. This meant my interviews needed aspects and understanding of the objects embedded into the questions. This was done through the use of a semi-structured interview guide.

While I do not use the logbook, I created during my ninth semester, I have chosen to use interviews from my ninth semester and to add additional interviews to that roster during my tenth semester. Through both periods of interviewing, using semi-structured interviews, a balance, is needed to be found between the structured and the preconceived, the unstructured and unsolidified. This interview methodology allows for surprises and interesting anecdotes, while also demands a direction and preexisting purpose with the interview. (Tanggaard and Brinkmann 2020, 39-41).

My time as an intern, informed my interviews and gave me and direction to follow during my interviews. While the unstructured interview would normally be a way of opening the field. Unstructured interviews demand more training but is also a good way of avoiding the researcher's preconceptions (Tanggaard and Brinkmann 2020, 40). I choose to avoid a phase of unstructured interviews, and go straight for the interview guide, as my participation already had narrowed down a problem area I wished to investigate.

While semi-structured almost do nothing, to actually explain the amount of structure used in my specific data collection, I would like to explain it bit further. During my ninth semester field work I had a duality in my interview guide, as I had to write a semester report as well as gather information for my thesis. This also meant I created a question guide with two clearly different themes. It was therefore important for me that both themes were introduced in the interviews (See appendix A1 and A2). Sporadic follow up questions were only asked when the informant already went into depth with their

answer in that direction. My logic was to follow the road, the informants lead me down, while still being able to check that I understood what they meant by computational empowerment or their understanding the organizational structure of the consortium.

The interview should feel as common conversations (Tanggaard and Brinkmann 2020, 47). My interview guide was tailored to each profession I came across. This can be seen as I had every informant present themselves and their role in the technology comprehension project. This identification was also important to me, as some informants had dual roles and therefore needed them to present how they saw themselves in the project.

In my interview guide I have no mention of research-questions as they can at times interfere with the situation of an interview, however the interview guide was based on the research questions and could therefore mimic the research related intentions behind. I therefore only bring with me an interview guide with questions to the interviews. The interview guide should only contain questions I believe the informants can understand and are able to answer. I choose this approach as I found it to be the best way of securing a positive interaction.

7.4. Conditions of my fieldwork

As I briefly came across earlier in the chapter on methods, I had different conditions that had influence on how this project were shaped.

First, I had problems with upholding a critical distance and thus not “going native” as an intern. By going native, I mean taking shared values with the informant for granted and thereby misrepresenting the field I am a part of (Aarhus Universitet n.d.). I used physical distance and distance in time in order to recalibrate, from going native. While I will argue that I could not have written this project if I was still connected to the project as an intern. That there can come good research and studies out of native going researchers. I only concluded that I could not write something that would be beneficial for others while I was an *insider*. It was important for me to navigate *insider/outsider* roles as part of my field relations. This terminology I have from Hammersley and Atkinson, and it covers being external observant or being a part of the observed system/group (Hammersley and Atkinson 2007, 86-87). I was, during my ninth semester, to a large degree an *insider*. To the point where it became clear that I could not write a project on computational empowerment before I had distanced myself from the field. According to Hammersley and Atkinson a researcher can play both the part of *the insider* and *the outsider*, sometimes during the same project (Hammersley and Atkinson 2007, 87). This might be true, but I could not escape the role of insider, in a report that, according to me, should contain more than the ideas of the project management and the subject developers.

Because I expected to be seen as an *insider*, by my informants, I made a big deal out of saying to all informants that the interview would be with me, as a Master student rather than with me as part of the consortium. This meaning that I made clear agreements on what I could tell my colleagues at the time. I also prioritized to make agreements, where I traveled to them. I did not find it beneficial if my informants had to be inconvenienced by my interviews.

The biggest challenge I had to overcome, was the unexpected lack of physical teaching in all Danish primary schools closed on the 16 of March due to Covid19 (Birk 2020). I had planned on using participatory observation in order to observe the practice of teaching in, with and about computational empowerment. I furthermore had planned to use this experience in order to recalibrate my understand of computational empowerment in order to have informed interviews on the subject. All of my observations were canceled. With a sudden change towards digital teaching, all of my contacts at schools, involved with the test subject, were increasingly busy with their regular teaching and did not prioritize technology comprehension as a digital course. I could not even be a part of digital observation of technology comprehension. What I heard from the project management I was a part of, this decision was made at the schools before any clear timeline was created. This sudden and large workload also meant some teachers had to drop out of an interview. This has had dire consequences for the last chapter of my analysis, as it does not have enough data to carry equal weight as the other two chapters. I have decided to keep the chapter and base it on the one interview I have done relevant for this topic, with a teacher connected to the project. All interviews done during covid19 were done over the phone, which made for a quite different atmosphere. I found it impacted the interviews a bit in regard to the sporadic questions and stories that sometimes becomes unearthed during an interview. The phone interviews could not produce the same relation as an interview face to face.

Returning to the question of interviews under Covid19. Many reflections have gone into how a single person can be the grounds for a network analysis. I have not found the right answer, I have not found any wrong answer either and were therefore at an impasse. One of the tools I have chosen to use to move on, from this so-called impasse, is a half-way evaluation done by the consortium's subcontractor Ramboll. The evaluation is not yet published, as I am writing this. To my knowledge, the report will be presented during May 2020.

7.5. Coding and transcription

Transcription can be seen as a *translation* between two languages as the spoken language and the written language works in different ways (Tanggaard and Brinkmann 2020, 50). I choose to only transcribe small portions of my interview material. This was done after several rounds of listening to the recorded audio of the interviews. While I was listening, I also tagged a time code and which theme we spoke about. I chose to do this method as many of my interviews from my internship contained a lot of different information that did not found relevant to the problem statement at hand. This form for transcription after a simplistic coding, created a situation were in I found myself very experienced in my data. This is a quite common benefit of having the same person interview and transcribe (Tanggaard and Brinkmann 2020, 50-51).

When I say I coded my material, I mean I wrote small tags, that could summarize the content of a sentence or an answer to a question. All rounds of coding, whether in was through timecodes at soundcloud.com or comments in a writing-program was done in English, even though the material was recorded and transcribed in Danish. I only began a literal *translation* between language when I was

certain I could use the quote. At times I also had to get permission to quote certain informant. Here is shown an example of coding of my material:

I: men da vi ligesom startede, der lød det også som om at du, da du hørte informatik, selv bringer det her med digital myndiggørelse eller digital dannelse på banen og siger det skal ligesom fylde rigtig rigtig meget.

M: ja det er også korrekt.



My codes were mostly data driven. By data driving coding, I mean terms and tags are created through the themes and details told in the interview (Tanggaard and Brinkmann 2020, 55-56). Some codes were not created through transcription, as I already became apparent that the hand-off process and the process of receiving objects embedded with computational empowerment needed to be coded.

7.6. Document analysis

My methodological guidance in this project has been, beside the five years of university, the book "kvalitative metoder – en grundbog" (Tanggaard and Brinkmann 2020.). I use this book as a guidance in working gathering and working with my empirical data. Kennet Lynggard, the author of the chapter on document analysis, writes about the method as some systematic dealing with documents. In this report I have used two collections of documents as data. I used these documents differently. The first collecting of documents I used is produced by the Ministry of Education as an explanation of the technology comprehension as a subject. This collection is seen as an actor rather than just a communication between two groupings. This point back to the Post-ANT vantagepoint this project has, as I see the non-humane actors, as having agency with the same potential as humane actors. I treat these actors as having relations with other actors. These relations are also confirmed through the mentions of the document in some of my interviews. I thereby elevate the understanding of the documents, from being spokesperson for the Ministry of Education, to actually being used in *translation/ treason* processes.

The main difference between these the curriculum and the educational milestones as actors and the Ramboll midterm evaluation I use in the third analysis chapter, is the presence in the network(s). The midterm evaluation is expected to be published during the month of May. I have had access to preliminary versions that have some findings about how teachers received the prototypes produced to teach technology comprehension (See appendix F). Because this document is not a part of any shared network yet, I limit my use to elaborate on analytical points made by my informant. I here use the document as a way of gathering information about the pedagogic personal, the teachers and tech-guides rather than seeing the document as an actor. Because a document is fixated in time, I am hesitant to use the midterm evaluation as a spokesperson as some of the troubles described in the midterm evaluation could be handled through coming *translation* processes. Furthermore the document is created by Ramboll and have gone through some sort of approval process in the Ministry. The document is thereby not an uncontroversial potential spokesperson, as the teachers, the pedagogic personal or the tech-guides have had very little control with the information gathered about them and from them.

7.7. Presentation of the Informants

I used my 9th semester interviewing members of the committee, who wrote the basis for the subject technology comprehension and the subject developers who are responsible for following creating lesson plans to teachers. I followed up on this fieldwork by interviewing the former Minister of Education and a tech-guide.

I interviewed members of an expert follow group, that works as internal group that discusses the process of the consortium. I have excluded informants and interview content concerning the following group, as they do not contribute to other actors than the Ministry. I also excluded members of the consortium project management as I used their interviews extensively in my former project. The project management interviews were also not relevant in creating an understanding of computational empowerment.

I have chosen to anonymize all informants, except Merete Riisager as I found it impossible to hide her role as Minister. This also means I have anonymized people who, told me that I could name them in my study. This is done, in order to disguise all informants, to the best of my abilities. There exist multiple doublet-roles in this project and I have therefore divided the informants into professional settings in my anonymizing. So an informant could theoretically exist in two or three analysis chapters under different names. I have chosen to compare statements from, informants with double roles to informants with similar professional backgrounds, to secure representative statements.

I have therefore interviewed 11 persons for this project and excluded 3 interviews from the analysis, of the remaining interviews three worked with subject development, four worked with the committee work to some degree, one was a teacher and tech-guide and one was a former minister.

8. Analysis part one: Policymaking

8.1. Beginning with the minister

In this I will present the policymaking side of computational empowerment within my field. This is done through the focus of the former Minister of Education Merete Riisager and members of the expert writing group that formulated the thoughts behind technology comprehension as a whole and thereby also specifically computational empowerment. In this chapter, the first pattern of computational empowerment as *partially existing object* conditioned by *translation/treason* will form.

We begin, the furthest back I could clearly trace the history of the test subject technology comprehension as an obligatory test subject. The search lead me to the former Minister of children and Education Merete Riisager, who were Minister from November 28th, 2016 until the change in government on the June 27th, 2019 (Folketinget 2020). Merete Riisager told me during our interview, that she could not trace a clear constructed proposal for a test subject or a definition of computational further back than a test-subject proposal existing in a drawer of an official at the ministry. This does not mean that the project I was connected to is the first manifestation of technology comprehension, as there exist an elective test-subject of the same name. Both are built on the same proposal and with some of the same overall goal.

It is often the case with political initiatives. That there are, after all, many different proposals in the officials' drawers and then of course it depends on the politicians which is brought into action... there existed a pending proposal in the ministry called informatics. It had interest from some of the interest organizations. I think it was the Dansk Erhverv and some of the tech-interest organizations. Perhaps also Dansk Industri, which also has an interest in getting supported technology use in primary school and secondary education. But it was arbitrary what it really was. And it was called informatics. I was then presented with "is this something you would like to invoke?" then i say. I think it is something we should have. But it should not be called informatics (Merete Riisager, translated by me)

According to this quote from Merete Riisager, we can see the first sign of a *translation* process, wherein a *problematization* of technology comprehension is given and how Merete Riisager also begins to *intressement* (and creating *distortion* with and *estrangement* to) actors by discarding the pending proposals name. The problematization which gathers actors, is the want for technology comprehension in the primary and secondary school. This action also defines actors within a network, and therefore creates the beginning of a possible *intressement*. This connects multiple actors across the private sector. These ANT terms help in understanding the process of stabilization the test subject as a whole, I would like to draw attention to something else. The first sign of what I see as *good treason*, as part of the process of creating a network of the proposal, the proposed test subject has to be fixated. This fixating leads to the same struggle as ANT had. Something actors experience *treason* when a stabilization is being created. Some actors experience *distortion*, *estrangement*, *rejection*, and *disruption* as part of the *translation* process (Galis and Lee 2014, 156). In this story, from Merete Riisager, there are no clear disappointed actors to point out. If we, for a moment allow for speculation,

actors involved with the scientific genre of informatic would probably be glad to have influence at a primary school level and are thereby potential disappointed actors. This hinges of course on the fact that the name change comes with additional changes to the proposed draft found in a drawer. This is only speculations based on the comments of Merete Riisager, about interest groups in the private sectors, who were happy about a technology understanding or comprehension subject. Because Merete Riisager does not know more about the origin of the drawer-draft, I am not able to specifically point out changes made to any original material.

This quote also talks into the unspecific status of technology comprehension at its early days. It builds of interest from the multiple trade organizations. The fluidity did not allow for the singular focus of later-in-life careers for school children. This definition and fixation of the subject also talks into the fluidity of the *partially existing object*, that is both the subject and the enactment of computational empowerment. Merete Riisager seek for a name and allies that could embrace something more than competency-based teachings. These allies are private sector interest groups and unspecific scientific community.

It should be called technology comprehension... it is not just a competency thing... when children learn about technology in primary school, there is an incredibly long time before they need to use it in a job market. And so it is totally lopsided to go to it with such a competence angle... one has to think primarily about achieving critical thinking about technology and familiarity with technology, both as a tool but also as a condition in their own lives (Merete Riisager, translated by me).

We here see the precursor for an understanding of computational empowerment. Not only is there an understanding of critical thinking and technology familiarity as something important in computational thinking. We also see glaze of an understanding of computational empowerment as a holistic goal for all technology comprehension teaching, rather than an equal quarter of the subject learning goals. By transforming the proposal, from an official's drawer, about informatic into technology comprehension, Merete Riisager saw herself as the initiator of computational empowerment. In the interview she argued that technology comprehension began because of her. She continued on stating that for her, this subject is not about learning skills, as only a few schoolchildren will eventually end up as engineers and the skills would probably become outdated.

Merete Riisager continued on explaining, what the subject of technology comprehension should be if it should not be about competencies.

That is why it is the common literacy needed to become an essential part. Because it is relevant for all children to understand technology and develop a critical thinking around it and be able to reflect on their own consumption of technology (Merete Riisager, translated by me).

Thereby an understanding of literacy and reflection is included in the concept the Minister discussed with her employees at the Ministry of Children and Education.

The former Minister does not see computational empowerment as being too different from digital literacy. She understands digital literacy as a subcategory of the before mentioned common literacy.

In my opinion there is no difference. Literacy [dannelse] and empowerment [myndiggørelse] are two concepts that are very intertwined. That is, because literacy is about knowing, understanding, incorporating, and relating to knowledge. Empowerment is, of course, well you are able to make better choices when you are an empowered human being. It seems to me. So it becomes one (Merete Riisager, translated by me).

Computational empowerment is thereby the ability, to not only have, but to use your digital literacy. This relation between doing and knowing, offsets Merete Riisager's wish to move away from competency and skill-based learning. In her presentation the computational empowerment ability is focused on knowing what should be done and acting with that knowledge, this do not actually tell us if it is possible to measure the computational empowerment. This intertwined literacy and empowerment aspects meets a lot of complexity in not being based on competencies. This is also a sign of Merete Riisager's insistence on no-competency based learning, to a high degree means no job-relevant competencies. Which leaves room for a practical based computational empowerment. This ambiguity also talks into the enactment of a *partially existing object* as there exist no clear strategy or common understanding yet.

8.2. Expert committee

The Ministry put together a committee in charge of creating the framework for the test subject, this framework is also known as Educational milestones (fællesmål) (Børne- og Undervisningsministeriet 2018). The Ministry of Education presented the expert committees' educational milestones as a thoroughly work through recommendation. This is presented now, as part of a chronologic presentation of the timeline, but feeds into the last section of this chapter wherein we look at the bureaucratic *black box* of the ministry.

When asked how the committee was formed, Merete Riisager explained how most were provided and suggested by officials within the ministry.

Yes, but the officials made a draft, and then I put some more people in, among others a schoolteacher. Because there were no schoolteachers in the committee at first (Merete Riisager, translated by me).

Merete Riisager told me this, with a slight giggle, as I believe we saw eye to eye, in this matter. The idea of creating a committee that deals with aspects of teaching practice without a teacher, I thought, was ridiculous. I found it inconceivable at first, as I found it obvious to involve users in the decision making. This practice of user involvement was not obvious to the administration of the ministry. Among other priorities Merete Riisager had in putting together a committee was the need for critical voices. This talks into ANT-concepted of *enrollment*, as she and the Ministry included potential opponents early on to the test subject. This subject should not only talk into technophobic or technophile understandings of

the world. Furthermore Merete Riisager would also include representatives who could act as spokespersons for educational personal.

One of the actors that needed to be aligned with the ideas of the educational milestones were the learning consultants. This term covers Ministry employed teachers that secures quality in teacher-related projects. In this case I interviewed a learning-consultant, who was a part of the committee and is currently overseeing the quality and professional approval for the ministry. He was also a part of the committee writing on the elective test subject of technology comprehension. He sees this as the prequel to the current obligatory test subject. The elective subject had only two overall goals, none of which were computational thinking.

In both committees, he was joined by a represent of teachers. The teacher who were apart of this committee were, according to her, chosen for her experience with technology comprehension in an educational setting. This makes me question her ability to act as a spokesperson for all the educational personal that eventually became a part of the project. As part of the *Enrollment* process, a spokesperson should be found in order to speak on behalf of a group of actors. If the idea was to bestow the role of spokesperson to the teacher in the committee, all steps before *enrollment* is skipped, and we end up with a *spokesperson* without actors to represent, as the schools included in the project was not yet found at this point in time.

Digital literacy often becomes a raised finger, about something that is dangerous. Something about "the dark net and you are not supposed to go there", or "be a good buddy, even when you are online" or "no dickpics". It becomes a lot of net-etiquette (the learning consultant, translated by me).

Here we see a contrast to what former Minister saw as computational empowerment and digital literacy. While she saw them as two intertwined things, the learning consultant argues that the term digital literacy has deteriorated over time. It has become a term that to a large degree is about how children should be raised rather than this term that can draw together what Merete Riisager calls common literacy, with the aspects of design and computational thinking that the children also needs to learn.

Computational empowerment is such a broad skill that is about, given that we are surrounded by digital technology, that do not seem to disappear... the net is there. So in such a world. What is it then? It is a critical preparedness, but also such an ability. Something one can compare to reading/writing/math. So what are some of the basic skills that you need to have in place to be able to engage in such a type of society? (the learning consultant, translated by me),

the learning consultant understanding of what computational empowerment is, is not far from what Merete Riisager presented. It could be understood as an understanding of a digital context. This further underlines the idea that digital literacy has undergone a change within the minds of the committee. the learning consultants statement also shows me the *partial existence* of the concept of computational

empowerment. By shifting networks, computational empowerment is no longer aligned with digital literacy, and this all happens before anything leaves the doors of the ministry.

8.3. The recommendation

As I have mentioned earlier, the Ministry presents the work of the committee as a recommendation. I know through my participation in the field as an intern and through my interview with a teacher representative, that the committee produced work directly under the ministry. I therefore see the ministry, in relation to the subject and to computational empowerment, as a *black box*. Through interviews I have gathered an understanding of what computational empowerment was among some of the members of the committee, but I do not have access to any product produced by the committee, which has not been past the Ministry. By this I mean, every document produced by the committee, is somehow influenced by the Ministry of Educations officials.

As a consequence of the committee's work, there were produced three documents, one containing a matrix of education milestones, one containing the curriculum and one containing teaching guide (Undervisningsministeriet 2018a; 2018b; n.d.). To clarify, the document will henceforth be named educational milestones. In the document their exist both competency goals and ability/knowledge goals (kompetance og færdighed- og vidensmål). These are two different things, will be referenced accordingly (See appendix E for the curriculum, Appendix B for the educational milestones).

On the same webpage as where the three documents can be found there is also a quote from Merete Riisager, in which she thanks the committee's recommendation, which were comprehensive and ambitious (Børne- og Undervisningsministeriet 2018). In this case we see an input in the work of the committee and the output being the Milestone-matrix, a curriculum and a teaching guide. In the interviews with the learning consultant and the teacher-representative, it became clear, that they mostly worked on specific subject and its goals. They had not an overall picture and can therefore not account for how the committees work is consistent with the produced material of the ministry. With these factors of input and output and the unquestionable structure of the Ministry in relation to these two informants, I see the Ministry as a *black box*. Talking from my experience as an intern, the Ministry officials properly see their work as purely bureaucratic and that it therefore had no impact on the product, meaning the enactment of technology comprehension and its four competency areas. As an intern, I have seen multiple instances where quality control leads to changed prototype.

I recognize these documents as an actor that delivers the Ministry's official understanding of all of technology comprehension as a school subject and specifically computational empowerment. In the introduction of the curriculum, this presentation of the co-dependent bounds there are between the four competency areas

In the description there is a balance between the four areas of competence, which is crucial in enriching each other and are each other's preconditions. Without computational thinking computational empowerment becomes hollow and superficial, and without computational empowerment and digital design, computational thinking and technological ability are detached from the application

perspective, which is crucial for a critical approach to the construction of digital artifacts. (Undervisningsministeriet 2018a, 3, translated by me)

This understanding of codependence somehow coexists with the understanding earlier presented in the interviews with the teacher-representative and the learning consultant. Earlier they explained how computational thinking was embedded in elective course, but as the obligatory test subject had a broader scope. In the work of broadening the scope a codependence is also developed.

Not only are the four corner stones of the subject technology comprehension, called competencies. The document with the educational milestones is presented in different layers. The top layers are called competency goals (Undervisningsministeriet n.d.). Which moves further away from the definition and wishes of the former minister. This process of creating a fixation of the *partially existing object* of computational empowerment, and possible establishing *intressement* among the receiving actors. This is possibly an olive branch to the consortium who had to produce prototypes.

Computational Empowerment	1st till 3rd grade	4th till 6th grade	7th till 9th
Concerns critical, reflective, and constructive exploration and understanding of digital artifacts and its the possibilities and consequences	The pupil can describe digital artifacts in their every day and act appropriately in his meeting with digital artifacts	The student can evaluate digital artifacts intentionality and uses in order to be able to act reflected in specific situations	The student can act with judgement in complex situations relating to digital artifacts importance to individual, community and community
This is the general competency goals for all of computational empowerment, translated by me from the educational milestones (Undervisningsministeriet n.d.) (see Appendix B)			

But this possible attempt at creating *intressement*, also has another effect. It also creates *estrangement* among the allies of the Minister and the committee. They have rejected the move away from competency-based teaching, that was the essence of computational empowerment according to the minister. This move, that simultaneously creates and distances alliances and relations in the network, is what I argue is *good treason*. The project moves on, towards a new constellation and new relation, through *treason* of former relations or alliances.

9. Partial conclusion part one: Policy makers

This conclusion will only follow up on the momentary enactment of computational empowerment seen in the previous chapter. First, I presented an understanding of computational empowerment as the overall point of having a subject as technology comprehension. Were in technology comprehension should provide computational empowerment as a holistic critical reflective gain. The former Minister presentation of the balance of the subject proved to be distorted by another agenda from the committee and the *black box* of the Ministry officials. While the committee agreed upon the reflective nature of computational empowerment, it was rolled in with the three other competency areas, as a fourth cornerstone which should provide a skillset rather than an abstract understanding. Additionally the *partially existing object* of computational empowerment was distilled into educational milestones, which furthermore created *estrangement* from the former Minister rendition computational empowerment as something above competencies.

10. Analysis part two: The subject developers

10.1. The Manifestation of a prototype idea

This chapter is going to be the heftiest, as the field allow for both a description of a receival and a send of computational empowerment in relation to this specific network. Towards the end of the former chapter, I presented three official documents as a way of defining the *partially existing object* of computational empowerment. The document purpose was, bigger than this singular aim, as all of the subject was up in the air.

The production of prototypes is divided up into 3 phases, with the second phase being the only phase with subparts. I started my internship, in fall of 2019 as phase two part one was being presented and going into practice and phase two part two began production among the subject developers. The production of the first prototypes is therefore before my time, but through anecdotes, I was told it was a messy process. In an interview with one of my colleagues in the project management it became apparent, phase one and phase two part one was rushed. The project management does therefore not have a central understanding of how the prototype ideas were created. I learned this though my two interviews with members of the consortium's management, and through my time as an intern.

One of my assignments as an intern, included reading all free externally produced educational material related to technology comprehension. The purpose of this assignment was to provide external input to the subject developers. My colleagues explained that the external inspiration was a term from the ministry. I distilled all of these different ways of teaching about technology in a classroom into some suggestions to the subject developers.

Only a few of the team leaders of subject development ended up responding. A few responded with a message about, how they would write back if they ended up creating a prototype based on my research-work. Others responded over mail with a clear dismissal of the recommended external educational material.

Thanks for the submitted. It is currently not usable. (team leader of one of the independent subject teams, translated by me)

This anecdote should not be understood as a focus on the dismissal of my own work, specifically, but as the dismissal of the project managements involvement in development of prototypes. Because the *translation* of the content in technology comprehension was not our specific responsibility. We were not seen as qualified to translate the common goals into specific activities. I have come to this smaller conclusion of dismissal of us as actors included in this part of the process, as there is evidence that we agree on what external material could be inspiring. In the appendix a prototype and a recommendation for inspiring content can be found, both have mentions of [Teksperimentet](#) and are in chronologic order (see appendix C and D) (Teknologipagten n.d.) The subject developers took care of creating their own ideas for a prototype.

10.2. The educational milestones

The most influential actor in the process of transporting understandings of technology comprehension and computational empowerment is the common goals. They should help move the idea from the *black box* of the Ministry of Education and its writing committee, to the consortium with its subject developers.

As we have seen in the former chapter, the overall competency goals were an *estrangement* of the Ministry's definition of computational empowerment, but in this context and in this analysis the goals are seen as a way of creating *intressement*. The competency goals do not stand alone. There exist ability and knowledge goals (Færdigheds- og vidensmål) as well. They exist as a practical extension of the overall competency goals. All of the goals exist as a way of creating *intressement* and maintaining an agreed upon *problematization*. The subject developers are, through the common goals stabilized in the identified role of developers of technology comprehension. This might sound as a given status, but to a large degree, the goals as an actor actually stabilizes the subject rather than the subject developers. This is of course intertwined and complex balance as there cannot exist a test-subject without a subject developer and vice versa. These two actors are connected through the *translation* process as long as we see the subject developers or the test subject as two whole actors and not the complex constellation both are. The test subject is in fact six different constellations of testing teaching in technology comprehension, with three different age groups and with half trying it integrated in existing subjects and the other half trying it as an independent subject. The Subject developers is also a group of different actors across six different university colleges, all with different responsibilities depending on their professional background. By giving the subject developers common goals and ability/knowledge goals, each team leader can act as a spokesperson and the *translation* process can begin its *enrollment*. I might throw a lot of *translation*-specific terminology after the interworking of alliances created as part of the process of delivering the prototypes. My reason for using this terminology, is search for the antagonists in a *translation* process. If the *translation* process is simple and successful computational empowerment could not remain a *partially existing object*. Because computational empowerment is not yet a *black box* the continuation of computational empowerment as a *partially existing object* depends on the antagonist of *translation*.

The ability/knowledge goals for computational empowerment is divided into five categories, with three subsets of goals based on milestones after 3rd, 6th and 9th grade. The five categories are: *Technology analysis*, *Purpose analysis*, *Use studies*, *Impact assessment* and *Redesign* (Undervisningsministeriet n.d.). These five categories are thereby preconceived definition on milestones, the subject developers have to reach in order to create prototypes that can support computational empowerment teaching according to the Ministry of Education.

10.3. The curriculum and teaching guide

These two documents, named in the section-title have different functions and different target audiences. The teaching guide is focused on the choices the teachers have to make as part of their planning of execution of the subject (Undervisningsministeriet 2018b, 3). The curriculum, on the other hand, is to a larger degree target towards the subject developers, as it defines the four competency areas. In this document all four competency areas are defined individually and though their relations (See the curriculum in appendix E). When focusing on the curriculum, I find a function of computational empowerment, that is pertinent for the Ministry to deliver to the consortium and the subject developers.

...Simultaneously, the subject contributes to empowerment in a society with increased digitalization. Through a profession based [faglig] understanding of digital artifacts and their implications for individual, community and society, pupils will be able to exercise active citizenship and participate in the dialogue about the world that we create with digital technologies. (Undervisningsministeriet 2018a, 5, translated by me)

Here we see a different enactment and actor than the educational milestones, as there is posed a larger spectrum to understand computational empowerment. Whereas the goals in the milestones tried to fixate a narrow understanding of computational empowerment through functions, this document is doing the opposite as it opens up for understandings of computational empowerment. Here it is worth noting that the documents send off by the Ministry is both actors in their own rights and a product of Ministry actions. In the quote above we do not see any sign, of agencies from specific actors in relation to the increasing digitalization. The subject is concerned with digitalization on micro, meso and macro levels, with a focus on digital artifacts. Where in the previous section about goals, had a focus on different milestones the subject developers needed to include, we here see a focus on digital artifacts as the mediator of computational empowerment.

Computational empowerment focuses on embedding attitudes and values into digital artifacts - partly in existing digital artifacts and partly in pupils own constructions. (Undervisningsministeriet 2018a, 10, translated by me)

This specific understanding of computational empowerment as something embedded into technologies, is not only theoretically far from the Post-ANT view of this exploration, it also limits enactments and frames actors in a different light. The quote points toward attitudes being embedded by someone, thereby giving agency to humans.

Once again I will prefer if we go back to the term *partially existing object*, as computational empowerment is both being delivered as a progression based step-by-step competency and as a certain knowledge directly related to specific objects. Before we go into each of the two documents, the educational milestones and the curriculum have different scopes, it is important to actually see which of the two non-human actors that are adopted into the same network as the subject developers.

10.4. Subject development organization

The subject developers are the main workforce in creating prototypes. Through the receipt of the before mentioned documents an unfolding of the concepts had to be done. As part of my research I interviewed a subject developer, and when we discussed the process of developing new prototypes, he told me the following about the team he was a part of.

It is a group characterized by its members busyness and no-one has time to do things. (subject developer, translated by me)

In this quote we see a problem with the group dynamic, in the team the subject developer creates prototypes with. The subject developer continues on, saying not all members are quick to respond if and when someone reaches out in the team to coordinate the prototypes. I understand this as the disorganized creation of prototypes. They are in some teams not created, as a product of coordination. This is not a general thing as some teams are coordinated. This can be seen in the prototypes for technology comprehension integrated in Danish as they use the same theme across all three grade-modules of the project (Teknologiforståelse i folkeskolen 2019a; 2019b; 2019c). The subject developers responsible for development of technology comprehension integrated into Danish, of course adapt each prototype to the specific grade.

Both types of subject development teams, have rejected or ignored the message about external propositions I made as an intern. The teams thereby create their own ideas of how to unfold the milestones.

The subject developer talks on about the mismatch in coordination in his team. By dividing the different prototypes produced among the team and what effect on the prototypes it has.

... The symphonic subject view becomes affected by the way each prototype is developed. We work a little in one subject area, a little in the other subject area. But I think the interplay between them is not good enough ... You might be better off if you had some overall talks among all subject developers on what the technology comprehension discipline is. (subject developer, translated by me)

The subject developer did not only talk into the common understanding among the team, he also saw a need for more general dialog across all of the consortium as there, in his mind, does not exist a fully formed technology comprehension discipline. When the informant talks of symphonic, I understood it as inter-connected co-dependent work. I have contemplated translating the word to interdisciplinary, but left, his own formulation in, as it spoke to an artistic understanding of the give-and-take relationship between the four competency areas.

The subject developers description of a lack of collaboration among the subject developers in the team and how it directly influences the cohesion of the four competency areas, is also a way *distorting* the influence of the Ministry produced curriculum. This two-edge sword of step-by-step milestones and a symphonic balance between all four competency areas, is not coexisting and the curriculum is not able

to be included in the constituted network. We here see a *treason* of the curriculum as an actor, with the agenda of interconnectedness between the four competency areas being distorted.

We also see a further *intressement* of the common goals as they are prioritized as an easy way of including parts of the four competency areas. The common goals are through contractual obligations a necessary part of writing a prototype. The consortium has developed an obligatory template for the creation of prototypes. The second chapter of the template is about the ability/knowledge goals by the demand of the learning consultant on behalf of the Ministry of education.

The lack of symphonic and inter-reliant use of the four competency areas is a *good treason* as it pushes away parts of the actor concerning any holistic benefit of the subject. The *good* part is the *enrollment* of the ability/knowledge goals and the strong bound the goals shares with the subject developers build upon the demands of the Ministry and the actor of educational milestones. I here see an enactment of computational empowerment as something that in part exist as abilities and potential actions and in part as knowledge and reflections on designs, effects and uses of digital artifacts.

10.5. Constituting computational empowerment

Returning too my informant among the subject developers, my interview turned towards the difference between digital literacy and computational empowerment, as a way of understanding the process of unfolding the ability/knowledge goals and competency goals. His understanding was that

... Computational empowerment is about understanding the digital artifacts that others make, understanding them. Understand the context they are in, in our society. The very talk of empowerment versus literacy, and all that. I belong to the school that says digital literacy is some nonsense because literacy is literacy. But we may as well talk about the digital aspects of literacy and the necessity of it... the big problem with talking about digital literacy is that it very quickly becomes about forming and a lot of discourse all about literacy has become about figuring out if something is a spam email (subject developer, translated by me).

I do not define this as a *good treason* towards the Minister, as our subject developers understanding is still fairly close to the temporary enactment of computational empowerment found in the curriculum. He continues on with the *estrangement* of the Minister agenda, as this is continuation of the former dismissal. In the making of the *partially existing object* of computational empowerment, it does not come as a surprise that the informant is shifting between showing alliances between the two point of view. I do not see this as *treason* of the current network, as no alliances are broken, and as this statement underlines the need for reflection and context understanding but does not directly dismiss the ability/knowledge goals. Nor is it *good* as no new alliances are created, the interdisciplinary and holistic understanding of computational empowerment does not win influence, even if it is deemed important that computational empowerment is not easily identified goals.

Not only is this a very different understanding of differences between literacy and empowerment, compared to the Minister but it also says a lot about the non-skill-based enactment of computational empowerment. By insisting on the difference between literacy and empowerment and explaining the

problem with the use of the term digital literacy, in part lies with digital literacy close connecting to skill-based competencies. The subject developer indirectly tells us, he understands computational empowerment as knowledge and reflection based. While I do not explain this as *good treason* there are some conflicts in the negotiating between the interdisciplinary and symphonic understanding of what computational prototypes should be and the competency based computational empowerment. This understanding relates well with the agenda from the curriculum I earlier dismissed based on the less than ideal teamwork. This still talks into the *partial existence* of computational empowerment, not because it does not exist, but because its existence is ever changing even among one singular informant.

10.6. Qualifications of subject developers

Not only are the subject developers challenged by the different organizations of their teams. There is also a general concern about qualification among subject developers and development leaders.

After all, everyone has at most created a technology comprehension activity, previous to the subject. It is just something else to have to create a subject and a discipline and make materials that are not really for the teacher, but for teaching. So how can you still make the teacher ready to professionally support the students when you do not really focus on the training of the teachers. (subject development team leader, translated by me)

They see themselves as the most qualified, but simultaneously acknowledge that they have little experience with the creation of prototypes, this hybrid of plug and play teaching material and collection of goals and a description of an idea. This establishes ones again the *partially existence* of computational empowerment ones more.

I heard this statement as something crucial to understanding how computational empowerment is chosen instead of talking about digital aspect of literacy. I met the clearest understanding of difference between digital literacy, digital aspects of literacy and computational empowerment among the subject developers as they are expecting to develop an interdisciplinary and new subject based on very few experiences. Furthermore this statement talks into the unfolding of the ability/knowledge goals as they do align with the coming actors of teachers. The subject developers have to create building blocks to a subject rather than explain and train teachers into the subject. These few and scattered experiences also become a betrayal of the interdisciplinary work the received documents are setting the stage for. This could thereby be qualified to the terminology of *good treason* as the lack of experiences and the relative existence of the whole discipline of technology comprehension cannot maintain wishes of interdisciplinarity.

As a last note I would like to problematize the teaching. We are making a new subject here, and it is not certain the teachers have the ability to teach it. They might not have any experience with one of the competency areas or all of the competency areas... And we do not even know if we as subject developers know enough about all four competency areas and this perhaps means we need four different points of view (subject developer, translated by me)

While the team leader of one of the subjects, is indirect in the *problematization* of their lack of experiences and the impact it has on the interdisciplinary work, the subject developer is not. He says it quite directly, as he does not see the teachers or the subject developers as interdisciplinary. The lack of symphonic work and the dispersed experiences among the subject developers, feeds into a subject build on multidisciplinary based prototypes and activities.

10.7. Unfolding the ability/knowledge goals

My relentless talk of creating prototypes has a reason and it is related to the problem statement. Because among the things subject developers have to do in order to create a prototype, is to unfold the competency goals and the ability/knowledge goals, through the description of pupil-oriented activities. This unfolding includes a fixation of what computational empowerment is in a specific lesson plans and a potential practice. When our subject developer talks about a lack of cross-team dialog and about a need for a shared understanding of the discipline of technology comprehension, it does not only support the need for an exploration of the discipline. It also means there potentially exist different readings of the competency and ability/knowledge goals. The subject developer also talks into the differences between the independent subject as:

Computational empowerment is in the early grades, focused inwards, in the room the pupils are in. This evolves to larger and larger arenas as the pupils are older. "how does it impact me, my class, another class, a community, a country, a society" this is perhaps the only difference between the different grades and computational empowerment (subject developer, translated by me)

The depth and the progression become more extensive as the pupils are capable of more in-depth understandings of in-depth impacts.

One of the ways to see subject developers understanding of computational empowerment, is to see an example of a prototype where the competency is unfolded. I will now, focus on the "games and gaming with technology" 5th grade prototype form technology comprehension as an independent subject. This specific prototype has the ability/knowledge goals: *Technology analysis, Purpose analysis, Impact assessment and Redesign* connected to computational empowerment. These goals specifically in the middle looking inwards and outward (see appendix D).

Technology analysis	Purpose analysis	Impact assessment	Redesign
The pupils can identify different types of digital artifact's functionality and analyze relationships	The pupils can identify and analyze the connections between the purpose, intentionality, and potential of digital	The pupils can critically reflect on the importance of digital artifacts for their own and shared practice in specific situations.	Pupil can argue for redesign of own and others digital artifacts based on usage patterns and impact assessments

between function and interface	artifacts in specific situations.	The pupils have knowledge of the potential and significance of digital artifacts in specific situations.	The Pupils have knowledge of redesign of digital artifacts
The pupils have knowledge of models for analyzing the functionality and interface of different digital artifacts.	The pupils have knowledge of purpose and intentionality expressed in digital artifacts.		
Table of computational empowerment ability/knowledge goals in "Spil og gaming med teknologi" (Caprani et al. 2019b, 5-7)			

This prototype I use as an example is chosen as it talks into the next chapter, as I interviewed a teacher, who taught with the use of this prototype. This one prototype is also chosen as it comes from the independent subjects and they have a more extensive amount of goals and all the goals are strictly related to technology comprehension, were as the integrated prototypes also needs to manage requirements for the regular subjects.

In this prototype, the pupils have to redesign an analog game with a digital artifact. This touches upon idea generation, construction of digital artifacts, algorithms and block programming from the other four competency areas. The prototypes are structured through a main process, which is interrupted by feedback and skill-based loops [faglige loops]. These loops are linked to activities, often in a process of creating a digital artifact.

In this specific prototype the computational empowerment ability/knowledge goals, in part, comes into play when the pupils have to introduce technology into analog games, and discuss which effect the technology have on the game. The main activity that introduces computational empowerment is through reflective injections in the idea generation process.

Step 1: Consider before you start making the big decisions:

- *Find an audience.*
- *Who should the game be developed for?*
- *What to learn from the game?*
- *Or what better way to get / practice on the game?*
- *How can you possibly extend the game?*

(Caprani et al. 2019b, 9)

This first step, out of seven, is taken from the idea generation process of "games and gaming with technology" (Caprani et al. 2019b). Here computational empowerment and the actor of educational

milestones as a whole, is reduced to reflections on the actions and choices the pupils have to take introducing technology into their new and redesign game,

These four categories feeds into the pupils understanding of digital artifacts.

Technology analysis. If we look at the first category in from the right in the table above, the pupils need to understand the function of digital artifacts, which I see as activities that turn reflection inwards. Were in the pupil is expected to turn to previous experiences in understanding a technology. This understanding is relevant in the prototype when the pupils are choosing technologies to include as they have to know the technologies function and interface to include these factors in their game.

Purpose analysis. Next pair of ability/knowledge goals concerns the pupils understanding of intention in and with a digital artifact. This ability to explore an intention and understand a purpose. While I commonly saw this goal, in my time as an intern, as a goal pair that turned the attention outwards. In this prototype the goal pair is used to comprehend the intentions of digital components in games they, themselves has to play and use this reflection of intention in their own redesign.

Impact assessment. The third pair of ability/knowledge goals feeds into the pupils awareness of technologies necessity in some situation. This is concretely done thought a phase of the game construction were the pupils have to reflect on which technology to include in their design and how it effect their design, and in a later phase were they have to reflect on were a technology best fit into their game

Redesign. Lastly we have the redesign ability/knowledge goals, in this current prototype the subject developers have modulated their understanding of the goals, as the activities support the redesign of games, wherein digital artifacts are include rather than a general redesign of specific digital artifacts. This goal pair is kept up as some pupils might find the need to change artifacts in order to fit them into their games.

My exploration of the use of competency goals and ability/knowledge goals is actually longer than the unfolding in the prototype. In this specific prototype, the computational empowerment goals are worked into goals on design processes and several of the activities serve multiple purposes in relation to the fulfillment of the goals. One of the reasons I have chosen to take the time to dwell on the prototypes, is because they serve as the main element in knowledge transfer from the subject developers to the teachers.

10.8. Double *black box*

As part of the production of prototypes, all prototypes needed to be delivered to the ministry, for approving the prototypes. This is done at the end of each production phase. As this story's narrator, I will for a moment draw on the narration of fictional novels and become an all-knowing narrator. I allow myself this liberty as I draw on my time as an intern, but I also describe situations I am unsure the subject developers as a group are aware of.

The prototypes are handed in to the project management of the consortium, roughly three days before they are handed over to the learning consultants from STUK (a department of the Ministry of education). As an intern I experienced this process as we, all four members of the team, used three days reading and correcting the content of the prototypes before handing them in. According to my interview with one of the project managers the learning consultants do not have the habit of approving all of the prototypes at first try.

About half was given back, with comments. We therefore went through this process of correcting the prototypes again. Our main goal is to correct grammatic mistakes, problem with formats and to align the prototypes with our template.

I tell this part, even though the subject developers might not be aware of this part of the process, because the Ministry and the project management of the consortium, acts as two *black boxes*, where the subject developers delivers a input to the consortium, which turns out another output, that is delivered as input to the learning consultants, which produces two kinds of output approved prototypes or prototypes with comments.

If a prototype ends up having comments, there are then two scenarios. One where in the comments are handled internally by the project management and one where the comments are sent back to the team leader of the specific subject. The first scenario happens if the comments are based of grammatic or if there are very specific suggestions, that works as conditions for an approval. The second scenario happens if larger things needs to be changes.

Provide all of this information, because the handing over of computational empowerment, which is still the focus of this report, is understood as something that happens directly between the subject developer and the teachers, though the prototypes. But the truth is not simple, as there happens a lot of small changes, that at the surface seems bureaucratic and unavoidable. But the limit for when a prototype and comment is sent back down is arbitrary. The most common example of comments we received in phase two part two, was the lack of concrete learning goals, which is a further distillation of the ability/knowledge goals. A lot of the prototypes had not produced these. To save time, I produced several of the prototypes concrete learning goals, these were sent to the team leaders of the specific subject. But as I have experienced earlier, the teams are not always the best to communicate. Therefore I do not know if I came to the same understandings of what the prototype wished to achieve, as the subject developers intended. I will ones again step out of the all-knowing narrator and leave the *black boxes*, as the way the subject developers see them.

11. Partial conclusion part two: The subject developers

Once again I describe the momentary enactment of computational empowerment, that has stabilized between receiving material from the Ministry and sending of unfolded understanding in the form of prototypes. In many ways this is just an update on the most stable enactment of the *partially existing object* of computational empowerment. Computational empowerment is here seen as the understanding of the digital artifacts that others make and understanding the context they are in, in our society. This is manifested in the unfolding of the common goals into prototypes with descriptions of teacher/pupil activities

12. Analysis part three: The practitioners

I have named this chapter the practitioners, as this chapters are about the changes and enactments of computational empowerment that exist in the practice of teaching. I know practitioners often is used to mean healthcare practitioners, but in this context, I mean teachers and pedagogic personal. Based on the prototypes, teachers connected to the technology comprehension project, have to make the document they receive into activities for pupils, in a discipline under development.

In the last chapter I presented a transformation of computational empowerment, that turned toward a goal-oriented enactment and left the curriculum as distant actors within the network. While there still exist an understanding of complementary benefits among the competency areas, the symphonic view was left on the backburner to pursue the goal-oriented enactment of computational empowerment. The symphonic understanding of all four competency areas was also set aside by the speculation on the lack of qualifications on all levels, to run an interdisciplinary subject

12.1. Reival

The exploration of the practitioners reival of the *partially existing object* of computational empowerment is done through one singular interview and a mid-term evaluation made by Ramboll. This mid-term evaluation has gone through an approval process within the Ministry. This approval process has an unknown effect on the presentation of the result and perhaps also the actual result. It is therefore important to note, that this evaluation is not a message from the teachers and is not understood as a spokesperson for the practitioners. The evaluation touches upon the teachers and pedagogic personal perception of the common goals.

As part of the process of developing prototypes, there is several presentations of the ideas and the process to the teachers and the schools techguides. I talked with a school's tech-guide, who also taught the subject. The tech guide was in the middle of the process of commenting on the idea-drafts she had received when we talked. She was very displeased with this way of receiving the prototype in part.

The consortium has sent us some prototypes that are very small, and it is unrealistic when we do not know what the subject developers had in mind, while writing them (tech guide, translated by me).

She is specifically talking about a one-page description of the team's idea for the following phases prototype. It was delivered as a one-pager to better fit into the time schedule of the ministry, who also received the same material. This was not made better by the fact that Covid19 had forced the discussion of the ideas, to be handled online and through text rather than through a plenum discussion among the relevant team of subject developers and tech-guides representing their schools. Rather than having a discussion were the different relevant tech-guides could describe their school challenges related to a prototype. Instead the subject developers received seven or eight schools' comments. This procedure excluded the dialog between schools.

This decision to caterer to both group of actors is here seen as a failing strategy. The one-page idea-draft might create *intressement* among the learning consultants from the Ministry and stabilizing their

involvement but it also creates *estrangement* among the tech-guides and teachers who the tech-guides act as spokespersons for. They are *estranged* as they are phased out and lose power. I once again see this as a *good treason* as the structure wherein a meaningful constitution of computational empowerment was again seen as a change in relations, which might affect any future stabilization of computational empowerment.

This is only a momentary loss of power and it does not happen as a willful attempt at distorting the power of the teaches and their spokespersons or at least I have found no evidence that support this actions as something meant to damage the relation. Instead it was meant to build a better alliance among the consortium and the Ministry and among the consortium and the schools, with the same action. By playing with open cards and having as much feedback as possible an attempt was made to create a broader and thereby stable alliance.

12.2. Goals

One of the findings the mid-term evaluation found among the teachers and the pedagogic personal was their difficulty understanding the goals. As I have previous presented, the educational milestones with the common goals were an influential actor in the journey of computational empowerment and technology comprehension from Ministry to the subject developers

The majority of teachers find that Common goals, curricula and teaching guides are difficult to understand and apply. However, Common Goals are perceived as more understandable and applicable among pedagogic personal who teach technology understanding integrated in subjects (Ramboll 2020, 45, translated by me, see appendix F).

In the previous chapter there where many different kinds of goals as integral actors in the manifestation of an enactment of computational empowerment, we here see findings that show how this alliance does not survive the transfer, as the same stable actors, into actual schools. This is of course a much more complex issue, as the material directly from the Ministry is seen as difficult to understand (Ramboll 2020, 45 See appendix F). In the former chapter, I also pointed towards the process of negotiating these documents for the prototypes in order to have something more digestible for the practitioners. So if these prototypes actually are capable of acting as spokespersons for the Ministry produced documents, there should not be an issue with the difficulty of understanding the original material as it becomes obsolete. The role of spokespersons, that the prototypes might take on, hinges on how well the practitioners are *enrolled* and *mobilized* by the prototypes. If the teachers do not follow the prototypes, it would be a *treason* of the *translation* the subject developers have been working on, with the prototypes and the Ministry documents.

I just sat for an hour writing what I think was ok and what I think was wrong in the prototype ideas. And I do not agree with the way they make those prototypes at all and I do not agree with the choices they make. I mean there are a lot of things that are misunderstood. (tech guide, translated by me)

In the interview my informant mentioned, that she was just finished with the process of commenting on the one-page idea draft from the subject developers, which she directly linked to some of the wrong agendas she felt was being promoted through the prototypes she received as part of the independent subject 4th to 6th grade test-model. The prototypes thereby fail to speak on behalf of the ministry. Through my presentation on how the subject development process has shaped relations to create the prototypes as spokespersons, we also saw *good treasons*, as some agendas were *distorted* to *problematize* other agendas.

I do think really good prototypes have been made but I also think there is a need to change the prototypes locally so we can teach them as our own... they also say from the consortium that of course we have to make them our own. But we need to make a lot of changes. Sometimes we just do not have the time for it, and we end up taking what they have suggested, without being critical enough of it. I think there should be much more collaboration between the subject developers and the people in the project. (tech guide, translated by me)

If the prototypes should be *enrolled* and act as spokespersons for the Ministry produced documents, their also needs to be a consistency between the two actors. The only way the prototypes can act as a spokesperson is if it is acknowledged as a spokesperson by other actors. This quote does not directly contest the prototypes as spokespersons but shows the difficulty in creating a *problematization* of what the subject of technology comprehension is. A *problematization* that needs to contain the Ministry understanding, the subject development understanding and at practitioners understanding. This is not easy when the subject developers are in-between a rock and a hard place, as they have to balance the school comments and create content that is useable in this context while simultaneously fulfill the Ministry understanding which is based on a committees recommendations. The constant need to repurpose the prototypes locally emphasizes my understanding of *good treason* happening locally as well. The *good treason* exists to stabilize an understanding of the subject as a whole and computational empowerment as a part locally.

There is also something particular in her choice of words that tells me something unique. She talks about the "people of the project" as a way of saying practitioners. This wording also excludes subject developers and Ministry personal as being "in the project". She understands the real project, is in the practice, not in the development and professional talks the development leads to. In this part of the interview I saw a strong understanding of the teachers as a united group.

With the midterm evaluation, I have shown that there exists a difficulty in understanding the original material, and it is therefore not common to understand both documents and be critical of the alliances that have stabilized through the subject development. I have interviewed an informant that have a sense of self, as someone who knows better. It obviously takes knowledge of the complete technology comprehension project, to wish for other agendas to be *mobilized* in the prototypes.

The consortium said I should have a course on apps based on lonely old people, and I just knew I should not. Then I discussed it with some of my colleagues and someone said "that's the easiest thing to do, that is what I am going to do" ... it was

about design processes... "How can I teach the kids what design is in a meaningful way for them? How can I make sure they are sharp on what design means? By making my very own content." I had to stick to the structure... but the content I can just change. I did it completely differently because it was there to design it was important to me. (tech-guide, translated by me)

Not only does this quote show me how her colleagues, which she actually acts as a spokesperson for as a techguide, do not doubt the prototypes purpose and trust the prototypes as spokespersons of the subject developers work. It also shows the teachers have the same need to repurpose the prototypes in order to teach it authentically and adapt it to the specific class, as ability differs. The teachers do not have the same need to rebuild the prototype completely.

I know there are those goals that we have to meet, but it turns out that we are not very interested in them because they are still an abstract representation of the reality of what we must teach, written as a goal. We take our starting point in the prototype, and i am not the only one who does this. I have looked at the goals and also read them, but my colleagues do not. They take the prototype and then they find out "what can i understand from this, how can i convey it further. What do i need to spend some more time understanding" (tech guide, translated by me)

While the informant's colleagues do not need to rebuild the prototypes completely, they do not read the goals, and are therefore highly dependent on the subject developers work on unfolding these goals. If the goals are not unfolded into clear activities, they are abandoned. At that school they do not only abandon parts of the prototypes, they actually dismiss roughly one prototype per semester.

So I quickly changed the way we did it at my school. We might receive three prototypes for the spring and three for autumn, but we only do two in the spring and two in the autumn because that's what we can do in a proper way (tech guide, translated by me)

These actions completely dismantle the former alliances, by not reading the goals, only following through on the parts of the prototypes the teachers understand and by dismissing a third of the provided prototypes from the start. The goals thereby lose their power and are as actors *estranged* from the stabilization process. The goals that formally worked as agent of stabilization all four competency areas are not dismissed.

12.3. Symphonic work

In the previous analysis-part and in the former section I showed some complexity in the symphonic collaboration between the four areas of competencies. In the former section, we saw how the informant distilled a prototype down to one specific competency areas. This does not correlate well with another quote of hers.

It is all connected in some way. It is also really hard to say, "now i am just work with one thing". We use digital empowerment to articulate the digital productions that children have done. (tech guide, translated by me)

This singular use of only one competency area is not the norm, and I therefore understand her later quote as taking precedence. I see the symphonic connections between the competency areas as a general *problematization*, that links back to the curriculum agenda, that was dismissed in the development because of the lack of coordinated teamwork. It is broad back into play. According to the midterm evaluation, computational empowerment also only lives up to its full potential through interdisciplinary use.

Computational thinking ...as an area of competence is perceived as fundamentally important because it ensures that the teaching is given an extra technological dimension, so that it is not just a matter of, for example, 'digital social science' (Ramboll 2020, 43, translated by me, see appendix F).

From the mid-term evaluation I do not only see the need for a revival of the symphonic idea, I also see a very negative understanding of what computational empowerment is, when It is only used as a singular competency area.

12.4. Practice based understanding of computational empowerment

This negative interpretation of what computational empowerment is, is quite problematic and ones again underlines that the mid-term evaluation is not a direct spokesperson for the practitioners because the same document also contain as description on how well the practitioners have received the competency area of computational empowerment

Teachers, pedagogics and techguides find that the computational empowerment area of competence is generally more motivating to work with than the other areas of competence because they can more easily see the need to address middle- and high school students to take a critical position on technology and technology use. Among the middle and high school teachers, the importance of the ethical discussions with the students is emphasized, and these discussions are perceived as easy to engage the students. That technology comprehension is about more than learning how to use technology (Ramboll 2020, 43-44, translated by me, See appendix F).

I understand "digital social science" and the describe ability to start ethical discussion based on technology, as two side to the same coin. The easiness to create conversations and reflections among the pupils is a sense of digital social science. This understanding of computational empowerment as conversation-based and reflection-creating is obtained from the tech-guide I have interviewed.

It is, after all, very much source-criticism and it is also common sense. It is like understanding your outside world. And understand what is happening around us. (tech guide, translated by me)

The informant agrees with this understanding of computational empowerment as an entrance to reflections and discussion on ethical problems with technology. The varying factor is to which extend the discussion stems from the digital artefacts the children produce or if it ends up existing as an untethered theme in the subject. Computational empowerment is to a large extent becoming reflection-based capabilities which correlates with the goals set by the Ministry and the unfolding into prototypes by the subject developers. But it happens without the symphonic and holistic purpose that was originally intended.

12.5. Actualizing prototypes

In the end of this chapter it is important to round off the telling of the delivery mechanism of computational empowerment. In Michael Callons text on scallops, which has given me the inspiration to use the terminology of *translation* and its four phases of *problematization*, *intressement*, *enrollment* and *mobilization*. Callon describes an “all or nothing” situation, wherein a betrayal destroys the complete process of *translation*. In this case we see a lot of betrayals in the blatantly disregard for the prototypes content and the number of prototypes actualized in practice. This lack of actualizing thereby also disregards the common goals provided by the ministry. While there exist an understanding of symphonic work within the actual teaching, it is not based on the rigid goals provided. It is based on a *partially existing object* of interdisciplinary work with the subject. This *partial existence* allows for computational empowerment to be defined in the moment. The complex thing in this case, is the continuation of computational empowerment, even when the *translation* process at multiple points fails, some actors are there to pick up the pieces and renegotiate the momentarily enactment of computational empowerment.

There is a constant interaction between competency areas. Because there is a lot of humanistic science. It is really a lot of social science. It is really a lot of all sorts of other stuff. And it is because we have the computational empowerment that can help and justify that we take the angles of things that we do. We do not only code a website, but we find out when we look at other websites, and understand the intention (Tech guide, translated by me)

In the former section we saw how computational thinking was used to enlighten computational empowerment, to be more than “digital social science”. But through this quote we also see the benefit of computational empowerment in regard to the other competency’s areas. The benefit of having technology comprehension as an interdisciplinary subject based on the four competencies goes both ways. And according to the teacher/techguide she benefits from having the opportunity to talk about “digital social science. This enactment of computational empowerment also brings me back to the understanding from Merete Riisager how she saw computational empowerment as the key to having a meaningful subject that could teach familiarity with technology and critical thinking.

13. Partial conclusion part three: The practitioners

Computational empowerment embedded in the competency goal and in the ability/knowledge goals is not understood completely which affects the receipt of computational empowerment as goals. The goals exist as abstract representations and the prototypes are used as starting points from which the teacher's departure from. Not only are the prototypes described as departure points so is computational empowerment. Depending on the amount of success with interdisciplinary use of the competency areas, the understanding varies from a "digital social science" that only reflect about theoretical problems to a computational empowerment which can articulate reflections and criticism of technology based on inputs from the other competency areas.

14. Discussion

computational empowerment is simply put a *partially existing object* within the limits of the technology comprehension project. This chapter will therefore look into the consequences of this status and how to possibly handle computational empowerment as a *partially existing object* and the main semi-*translations* aspects and semi-*treason* aspect that has gone into the postponement of a stabilization of computational empowerment. I add the prefix of semi before both the *treasons* and *translational*, because the relatively character of computational empowerment, has not settled yet and the *treasons* and the *translational* aspects are therefore not finalized yet. As I have presented through the three analysis chapters, some actor makes a remarkable comeback.

By comeback I mean, are re-introduced into the enactment of networks. As we have seen, an actor such as the curriculum, is a part of the network of the practitioners I have had contact with. Even though the curriculum has been *rejected* in the network of subject development, the fluidity of having multiple networks allow for the curriculum to be part of a *translation* process circumventing the subject developers influence.

14.1. Translated or multiple epistemologies of computational empowerment

Looking back at the comments made by the tech-guide, she talked about which misunderstandings the subject developers had about technology comprehension. Following that lead, we see multiple understandings existing at approximately same time and place. In the intersection of delivering prototypes different approaches to computational empowerment meet.

What one investigates in such instances seems not to be a technology, which happens to be distributed but, vividly illustrating and dramatising the variability of practical ontologies, rather many different material and discursive ways of ordering practice, which sometime go by the same name. (Bruun Jensen 2010, 14)

Following the theoretical explanations of Casper Bruun Jensen, the *partially existing object*, might need to be in plural, as the connection to the same actor at times seems almost inconceivable. As he followed the Danish electronic patient journals, a lot of different understandings, practices and actors surfaced under the same name. In computational empowerment, there does not exist the same difference in material ways. Because the comment about "misunderstanding" can be understood both as the recognition of other enactments or "wrong" understandings of computational empowerment, it also could be understood as a coherent computational empowerment which is still battling treasonous actors in their midst. This all boils down to, understanding the glue that binds together a *partially existing object* and how partial an object can exist as. At this point I will draw in the Post-ANT term of *multiplicity* and open up for the possibility that computational empowerment is enacted differently in different groups.

I have asked myself, on several occasion, what it is that bring all these enactments of computational empowerment together? The first thing that comes to mind, is of course the name. Every actor who

have influenced an enactment of computational empowerment has kept the name. No one has dismissed the name of computational empowerment, as the name is fixated into having influence over the subject as a whole. The former Minister saw computational empowerment as an embedded and important benefit of all technology comprehension. The members of the committee I interviewed also understood computational empowerment as something embedded, in their earlier work on technology comprehension as an elective course. The thing that was embedded was an ability to reflect on digital behavior. Digital and technologic behavior has been present in every step of the few computational empowerments relatively stabilized intersections. It is the relations that keeps computational empowerment together as a *partially existing object*, as every *translation/treason* step forward and backwards, depending on perspective, happens in a network of acknowledge actors. Some of the actor's agendas are discredited but the actors are not. The subject developers know that they cannot create a subject without the competency-goals as it is part of the stabilized structure of the prototype template. The teachers also know that they cannot affect computational empowerment, through creating their own prototypes.

Computational empowerment exists both as a translated actor and as multiple independent enactments present at the same time in different positions in the network. It all depends on whether you tell the story of a concepts travel or three multiplicity-stories of *translation*. While this report bears the likeness of three stories, computational empowerment is understood as both a single thing undergoing changes and several things undergoing heterogeneous development.

14.2. The use of a partially existing object

I wrote this thesis because I fear that the *translation/treason* process has created so many misunderstandings and scorn actors that the complete technology comprehension project is perceived as filled with mistakes. My goal with exploring the concept of computational empowerment, was to unfold an understanding of the project that could explain the shifts in understanding as purposeful actions rather than careless mistakes. The goal of technology comprehension as a subject, is directly linked to the former minister's wish for the subject as a reality.

*The technology comprehension project was started to **creating knowledge on how to best strengthen the understanding of technology in the individual pupil, and how technology comprehension best can become a part of primary school teaching***
(Børne- og Undervisningsministeriet 2018, *translated by me*).

There exists some sort of policymaking process, on the other side of the project. It is important that any policy making is based on a nuanced understanding of the different enactments and agendas that exist within the network. If the policy is based on a continuation of the committees understanding of computational empowerment, there will be a distance between legislation and practices in schools. This distance and misalignment are not the best way to strengthen technology comprehension among pupils. I believe that the understanding of computational empowerment as more than one thing needs to be present in any future policymaking.

Having identified computational empowerment as a *partially existing object* and unfolded enactments of the term, we also see a need to renegotiate and understand in order to fulfill the Ministry's wish to understand how to best integrate computational empowerment in primary schools.

integrating a subject nationwide demands some stability between existing actors. This test-subject could potentially be moved from 46 schools to the 1084 public and 556 private schools (Børne- og Undervisningsministeriet 2020). This demands some spokespersons that can *mobilize* common understandings of the subject and the competency areas. I therefore find it extremely important that moving forward, more energy goes into negotiating stabilized enactments of computational empowerment, especially when moving into so large an arena as the nationwide subject would be. Of course the ability to move computational empowerment is also tethered to fluidity in a *partially existing object*. It is therefore important that some aspects are stabilized, and others are left adaptable. Going forward a larger focus should go into acknowledging computational empowerment's ability to be multiple things.

Computational empowerment contributes, in part, to answering how to best strengthen technology comprehension among pupils. The problem is only that there are at least four different answers on how computational empowerment plays into strengthen this understanding and none of them are wrong. This is also an important understanding, gathered in my thesis, that the *partially existing object* should not be seen as wrong just because it has not stabilized yet, and this is an important knowledge when the policymaking goes from ministerial officials to politicians.

I call for a *translation* process of computational empowerment, while warning to avoid the *treason* it brings. I hereby propose an idea that has the appearance of a paradox going forward. This paradox can only be achieved by understanding the multiplicity of the situation. That demands a lot in a policymaking process. Every *translation*/*treason* step moves away from the definitions made within the ministerium, in a chain of "wrongs and rights" every link moves us close to actually knowing how to strengthen an understanding of technology comprehension. But it demands continuous exploration of the links of *translation*/*treason* going into the destabilization of computational empowerment.

This thesis is a contribution into the policymaking based on *partially existing objects*, as every in-house definition of Ministries in general needs to be re-visited on re-entry from the field. In this specific case the four understandings of computational empowerment I touch upon should be revisited. The Former minister, the intern ministry, the subject developer and the teacher all have their own enacted relation to computational empowerment. This multiplicity should be continued into future discussions on technology comprehension policymaking, as there do not need to exist a singular definition.

15. Conclusion

Computational Empowerment is not yet stabilized and are therefore operating as a *partially existing object*. I have found four renditions which still are characterized by a lack of stabilization and continuative *translation/ treason*.

First, I presented an enactment of computational empowerment as the overall point of having a subject as technology comprehension. Were in technology comprehension should provide computational empowerment as a holistic critical reflective gain. The former Minister presentation of the subject proved to be distorted by another agenda from the committee and the *black box* of the Ministry officials. While the committee agreed upon the reflective nature of computational empowerment, it was rolled in with the three other competency areas, as a fourth cornerstone which should provide a skillset rather than an abstract understanding. Additionally the *partially existing object* of computational empowerment was distilled into educational milestones.

Computational empowerment was, among the subject developers the insight into digital artifacts that others make and understanding the context they are in, in our society. This is manifested in the unfolding of the common goals into prototypes with descriptions of teacher/pupil activities.

The educational personal understand the goals as abstract representations and the prototypes are used as starting points from which the teacher's departure from. Computational empowerment and the other competency areas are seen as departure points for the course. Depending on the amount of success with interdisciplinary use of the competency areas, computational empowerment varies from a "digital social science" that only reflect about theoretical problems to a computational empowerment which can articulate reflections and criticism of technology based on inputs from the other competency areas.

These four enactments of computational empowerment, as a set of a new holistic purpose of creating technology comprehension subject, a set of educational goals, a reflection based on digital artifacts and a reflective practice based on discussion are all important in any future policymaking. The status of a *partially existing object* has to be considered in the following policy making process, where in politician has to take over, in 2021.

16. References

- 'Bawden, David. 2008. 'Origins and Concepts of Digital Literacy'. In *Digital Literacies: Concepts, Policies and Practices*, edited by Colin Lankshear and Michele Knobel, 1st edition. New York: Peter Lang Inc., International Academic Publishers.
- Aarhus Universitet. n.d. 'Going native'. Accessed 9 november 2019. <https://metodeguiden.au.dk/going-native/>.
- Andersen, John, f. 1954. 2003. *Empowerment i Storbyens Rum : Et Socialvidenskabeligt Perspektiv*. Socialpædagogisk Bibliotek. Kbh.: Hans Reitzel.
- Bagger, Christoffer. 2018. 'Digital dannelse for ældre Undervisning af ældre i it efter Digitaliseringsstrategien'. *Nordisk Tidsskrift for Informationsvidenskab og Kulturformidling* 7 (1): 33–48. <https://doi.org/10.7146/ntik.v7i1.105409>.
- Bergner, Nadine. 2017. 'Digitale Bildung in der Schule – die Lehrkräfte sind der Schlüssel. Material- und Fortbildungsangebote zum Thema digitales Lernen'. *MedienPädagogik: Zeitschrift für Theorie und Praxis der Medienbildung* 28 (March): 123–32. <https://doi.org/10.21240/mpaed/28/2017.03.09.X>.
- Birk, Christian. 2020. *I dag lukkes skoler og daginstitutioner officielt: Men hvor længe skal det vare, før hverdagen normaliseres?* <https://www.berlingske.dk/content/item/1451982>.
- Børne- og Undervisningsministeriet. 2018. 'Indholdet i forsøgsfaget teknologiforståelse er klar'. 21 december 2018. <https://www.uvm.dk:443/global/news/uvm/2018/dec/181221-indholdet-i-forsoeqs-faget-teknologiforstaaelse-er-klar>.
- Børne- og Undervisningsministeriet. 2020. 'Antal grundskoler'. 10 January 2020. <https://www.uvm.dk:443/statistik/grundskolen/personale-og-skoler/antal-grundskoler>.
- Bruun Jensen, C., C. Gad, and B.R. Winthereik. 2013. 'Practical Ontology. World(s) in STS and Anthropology' 67 (January): 81–100.
- Bruun Jensen, Casper. 2010. *Ontologies for Developing Things: Making Health Care Futures Through Technology*. Brill | Sense. <https://doi.org/10.1163/9789460912108>.
- Bruun Jensen, Casper. 2020. 'STS'. In *Kvalitative Metoder*, edited by Lene Tanggaard and Svend Brinkmann, 3rd ed., 515–32. https://bograolen.dk/kvalitative-metoder_birger-steen-nielsen_9788741277264.
- Callon, Michel. 1986. 'Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay'. *The Sociological Review* 32 (1_suppl): 196–233.
- Caprani, Ole, Anne-Mette Nortvig, Tina Hejsel, and Eva Petropouleas. 2019a. '5.kl. Forløb om appdesign'. Tekforsøget.dk. <https://tekforsøget.dk/wp-content/uploads/2019/08/FORL%C3%98B2-App-design-version-2.pdf>.

- Caprani, Ole, Anne-Mette Nortvig, Tina Hejsel, and Eva Petropouleas. 2019b. '5.kl. Forløb om Spil og gaming med teknologi'. Tekforsøget.dk. <https://tekforsøget.dk/wp-content/uploads/2019/12/5.-kl.-4.-Forl%C3%B8b-om-Spil-og-gaming-med-teknologi-06-12-19.pdf>.
- Elgaard Jensen, Torben. 2013. 'Techno Anthropology - A New Move in Science and Technology Studies', 12.
- Dányi, Endre. 2017. 'Good Treason'. In *World Politics in Translation : Power, Relationality and Difference in Global Cooperation*, by Tobias Berger and Alejandro Esguerra, 14. Routledge. <https://doi.org/10.4324/9781315209333>.
- Eriksen, Thomas Hylland. 2005. 'Hvorfor socialantropologi?' In *Hvad er Socialantropologi*, 11–29. Hvad er. Kbh.: Akademisk Forlag.
- Familieretshuset. n.d. 'Myndig - umyndig'. Text. Myndig - umyndig. Accessed 22 March 2020. <https://www.borger.dk/samfund-og-rettigheder/Myndighed-og-vaergemaal/Myndig--umyndig>.
- Folketinget. 2020. 'Merete Riisager'. Folketinget. 10 February 2020. <https://www.ft.dk/medlemmer/mf/m/merete-riisager>.
- Gad, Christopher, and Casper Bruun Jensen. 2010. 'On the Consequences of Post-ANT'. *Science, Technology, & Human Values* 35 (1): 55–80. <https://doi.org/10.1177/0162243908329567>.
- Galis, Vasilis, and Francis Lee. 2014. 'A Sociology of Treason: The Construction of Weakness'. *Science, Technology, & Human Values* 39 (1): 154–79. <https://doi.org/10.1177/0162243913512681>.
- Gere, Charlie. 2009. *Digital Culture*. Reaktion Books.
- Gilster, Paul. 1997. *Digital Literacy*. 1st edition. New York, NY: Wiley.
- Hammersley, Martyn, and Paul Atkinson. 2007. 'Field Relations'. In *Ethnography : Principles in Practice*. Vol. 3rd ed. London: Routledge. <http://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=197253&site=ehost-live>.
- Heinen, Richard, and Michael Kerres. 2017. 'BILDUNG IN DER DIGITALEN WELT', 18.
- Iversen, Ole Sejer, Rachel Charlotte Smith, and Christian Dindler. 2018. 'From Computational Thinking to Computational Empowerment: A 21st Century PD Agenda'. In *Proceedings of the 15th Participatory Design Conference: Full Papers - Volume 1*, 1–11. PDC '18. Hasselt and Genk, Belgium: Association for Computing Machinery. <https://doi.org/10.1145/3210586.3210592>.
- Jørgensen, Line Pors. 2019. 'Forundersøgelse'. Rambøll. <https://emu.dk/grundskole/teknologiforstaelse/forundersogelse>.
- Laet, Marianne de, and Annemarie Mol. 2000. 'The Zimbabwe Bush Pump: Mechanics of a Fluid Technology'. *Social Studies of Science* 30 (2): 225–63. <https://doi.org/10.1177/030631200030002002>.

- Latour, Bruno. 1987. 'Opening Pandora's Black Box'. In *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, Mass: Harvard University Press.
- Latour, Bruno. 1999. 'Circulating Reference: Sampling the Soil in the Amazon Forest'. In *Pandora's Hope: Essays on the Reality of Science Studies*, edited by Bruno Latour, 24–79. Cambridge, Mass: Harvard University Press.
- Law, John, and Vicky Singleton. 2014. 'ANT, Multiplicity and Policy'. *Critical Policy Studies* 8 (4): 379–96. <https://doi.org/10.1080/19460171.2014.957056>.
- Mäkinen, Maarit. 2006. 'Digital Empowerment as a Process for Enhancing Citizens' Participation'. *E-Learning and Digital Media* 3 (3): 381–95. <https://doi.org/10.2304/elea.2006.3.3.381>.
- Malinowski, B. 1920. '51. Kula; the Circulating Exchange of Valuables in the Archipelagoes of Eastern New Guinea.' *Man* 20: 97–105. <https://doi.org/10.2307/2840430>.
- Michael E. Caspersen, Ole Sejer Iversen, Mogens Nielsen, Arthur Hjorth, and Line Have Musaeus. 2018. 'Computational Thinking -- hvorfor, hvad og hvordan?' 41. IT-vest. https://www.it-vest.dk/fileadmin/user_upload/pdf/2018-12-18--Computational-Thinking--hvorfor-hvad-og-hvordan--PRINT-2-sided.pdf.
- Ramboll. 2020. 'Tekforsøget Midtvejs Evaluering (Udkast)'. (See appendix F)
- Siim, Birte. 2003. *Medborgerskabets udfordringer - etniske minoritetskvinders politiske myndiggørelse*. Aarhus Universitetsforlag. <https://vbn.aau.dk/en/publications/medborgerskabets-udfordringer-etniske-minoritetskvinders-politisk>.
- skoletekno.dk. 2019. 'Forsøgets organisering'. Teknologiforståelse i folkeskolen. 27 February 2019. <https://xn--tekforsget-6cb.dk/om-forsoget/forloeb-og-faser/>.
- Tanggaard, Lene, and Svend Brinkmann. 2020. 'Interviewet: Samtalen Som Forskningsmetode'. In *Kvalitative Metoder*, 3rd ed., 33–64. https://bograolen.dk/kvalitative-metoder_birger-steen-nielsen_9788741277264.
- Teknologiforståelse i folkeskolen. 2019a. 'Dansk – indskoling'. Teknologiforståelse i folkeskolen. 19 February 2019. https://xn--tekforsget-6cb.dk/forlob/fag_dansk_indskoling/.
- Teknologiforståelse i folkeskolen. 2019b. 'Dansk – mellemtrin'. Teknologiforståelse i folkeskolen. 2 december 2019. https://xn--tekforsget-6cb.dk/forlob/fag_dansk_mellemtrin/.
- Teknologiforståelse i folkeskolen. 2019c. 'Dansk – udskoling'. Teknologiforståelse i folkeskolen. 2 december 2019. https://xn--tekforsget-6cb.dk/forlob/fag_dansk_udskoling/.
- Teknologipagten. n.d. 'Tekspexperimentet'. Accessed 9 May 2020. <https://teksperimentet.firebaseio.com/>.

Thomas Szilevicz. 2020. 'Deltagerobservation'. In *Kvalitative Metoder*, edited by Lene Tanggaard and Svend Brinkmann, 3rd ed., 97–115. https://bogreolen.dk/kvalitative-metoder_birger-steen-nielsen_9788741277264.

Undervisningsministeriet. 2018a. 'Læseplan - Teknologiforståelse'. <https://www.uvm.dk/-/media/filer/uvm/aktuelt/pdf18/181221-laeseplan-teknologiforstaelse.pdf?la=da>.

Undervisningsministeriet. 2018b. 'Undervisningsvejledning for forsøgsfaget teknologiforståelse'. <https://www.uvm.dk/-/media/filer/uvm/aktuelt/pdf18/181221-vejledning-teknologiforstaelse.pdf?la=da>.

Undervisningsministeriet. n.d. 'Fælles Mål Matrice'. Accessed 2 May 2020. <https://www.uvm.dk/-/media/filer/uvm/aktuelt/pdf18/181221-maaloversigt-teknologiforstaelse.pdf?la=da>.

Vikkelsø, Signe. 2007. 'Description as Intervention: Engagement and Resistance in Actor-Network Analyses'. *Science as Culture* 16 (3): 297–309. <https://doi.org/10.1080/09505430701568701>.