Sadaf Salavati

Use of Digital Technologies in Education
The Complexity of Teachers' Everyday Practice
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USE OF DIGITAL TECHNOLOGIES IN EDUCATION

The Complexity of Teachers’ Everyday Practice

SADAF SALAVATI

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Abstract


In this dissertation the complex, dynamic, contextual and multi-dimensional practice of teachers’ use of digital technologies in their everyday work has been illustrated and presented. The research draws upon the experience of teachers and school leaders from two compulsory schools as well as representatives from the municipal Department of Education and IT-unit within a municipality in the south of Sweden.

A focused ethnographic approach has been undertaken and applied observations and interviews. Systems Thinking, specifically Soft Systems Methodology in combination with Cognitive Mapping have been applied to analyze the empirical material.

The theoretical foundation builds upon teachers’ worldview towards digital technologies, because it is noted that teachers more easily adopt and use innovations that are in accordance with their personal thoughts and beliefs about teaching and learning. Further, teachers’ attitude and perception towards use of digital technologies are addressed as well as the role of school leadership. Additionally, importance of context, teachers’ knowledge and pedagogics have been discussed referring to various frameworks.

The dissertation aims to illuminate the complex nature of teachers’ everyday practice. To gain understanding of the situation as a whole, there is also need to shed light on various aspects and underlying perspectives. Thus, this research aims to illuminate and advance the understanding of the complexity of compulsory school teachers’ everyday work practices using digital technologies.

The outcome of this dissertation illustrates the complexity of teachers’ everyday practices as well as additional issues adding to the complexity, and shows that these complex issues are worthy of further study. Among the issues emerged from this dissertation are differences in regard to how the complex situation is understood because different actors have multiple and sometimes conflicting worldviews. Ambiguities in core objectives and relevant concepts were found. Additionally, a pervasive lack of understanding about the realities of daily education and teaching practices, including variances in worldviews and mindsets was found adding to the complexity of teachers’ everyday practice using digital technologies.

**Keywords:** Cognitive Mapping, compulsory school education, digital technologies, focused ethnography, teachers, Soft Systems Methodology, Systems Thinking
Dedicated to my parents
The significance of “doing” this research is much more than merely completing a PhD dissertation. Through this process, I have gained so much which will guide and, ultimately, build my future – regardless of directions chosen and paths taken. The knowledge and experience gained through the realization of conducting and finalizing this journey is through, and owing to the contribution and support of many people to whom I will be forever grateful.

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Växjö, Autumn, 2016
Sadaf Salavati
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Sammanfattning på svenska

**Användning av Digital Teknik i Skolan: Komplexiteten i Lärarens Vardagspraktik**


Det är viktigt att betona att forskningen inte syftar till att argumentera att digital teknikanvändning i skola och utbildning är gynnsam eller ogynnsam, eller att den ökar eller minskar elevers kunskaper. Forskningen syftar istället till att utifrån lärarens perspektiv och yrkesroll diskutera användning av digital teknik som ett komplement till de traditionella metoderna.

Den teoretiska utgångspunkten bygger på lärares perspektiv i relation till digital teknik. Tidigare forskning har visat på att lärarytta antar och använder innovationer som är i enlighet med deras professionella erfarenheter, tankar och värderingar. Vidare har teoretiska ramverk som adresserar lärares inställning och uppfattning gentemot användning av digital teknik refererats till och skolledarnas roll har diskuterats. Dessutom har vikten av sammanhang, lärarnas ämnes- och pedagogiska kunskap diskuterats med hänvisning till olika teoretiska ramverk så som TPACK, RAT och SAMR.


Bland de mest centrala områden som bidrar till komplexiteten i lärarnas vardag är absaknad av klargörande av centrala mål och direktiv. Andra faktorer är avsaknad av tydliga definitioner och förståelse för centrala begrepp som 'likvärdighet' och 'naturlig användning av digital teknik'. Dessa begrepp är i dagsläget oklara och tvetydliga och uppfattas många gånger olika beroende på aktör och vilken utgångspunkt hen har. De olika aktörerna och individerna lägger olika och ibland motstridig innebörd i samma begrepp. Dessa olikheter och motstridigheter har identifierats både inom en individ men framför allt mellan olika individer och aktörer.

Ytterligare ett centralt område som identifierats och som bidrar till komplexiteten i lärare praktiker och integrering av digital teknik, är organisationsrelaterade frågor. Dessa består bland annat av den frihet och beslutsrätt skolledare har över den egna interna organisationen samt resursrelaterade frågor där de begränsningar som idag finns påverkar skolledarna och därmed också lärarnas integrering och användning av digital teknik i undervisningen.
Begränsad och otillräcklig IT-support och pedagogiskt stöd av centrala kommunala enheter är ett annat exempel på en organisationsrelaterad fråga. IT-stöd på lokal nivå är ett område som visat sig vara en utmaning att hantera för att möjliggöra och förstärka lärarnas användning av digital teknik som en integrerad del i undervisningen. Även varierande elever, elevgrupper, individer samt bristande ansvarskänsla om sina digitala enheter har visat sig bidra till och påverka den komplexitet som finns kring användning av digital teknik i undervisningen.

Den största utmaningen som identifierats och som därmed kan anses vara det som mest bidrar till komplexiteten i lärarens dagliga arbete är själva undervisningssituationen och att den uppfattats på olika sätt av olika aktörer. Forskningen har visat att de olika aktörerna, men även ytterligare intressenter utanför skolans värld (t.ex. IT-utvecklare, föräldrar, etc.) har sina egna världsbilder och förståelser av digital teknik och hur den bör användas i undervisningen. Dessa olika världsbilder har identifierats att ofta vara tvetydiga och motsägande, och på olika sätt påverkar de lärarnas vardagspraktiker. Utöver dessa skillnader och motsägande världsbilder framkommer det också att det finns en bristande förståelse för lärarens vardagsarbete. En bristande förståelse i hur det dagliga arbetet ser ut, med och utan användning av digital teknik, har betydelse för vilka beslut och direktiv som tas på högre myndighetsnivåer.

Resultatet i avhandlingen påvisar och förstärker tidigare forskning som visat på komplexiteten i undervisningssituationer. En av de mest övergripande och största utmaningarna relaterat till komplexiteten är sammanhang, kultur och traditioner vilka är unika för varje skola och för varje klassrum. Dessa faktorer i kombination med lärares varierande världsbilder influerar och påverkar lärarens användning av den digitala tekniken i deras undervisning och vardagspraktik.
Prologue

“It [writing] will implant forgetfulness in their souls; they will cease to exercise memory because they will rely on what is written, creating memory not from within themselves, but by means of external symbols. What you have discovered is a recipe not for memory, but for reminding. And it is no true wisdom that you offer your disciples, but only its semblance, for by telling them many things without teaching them anything, you will make them seem to know much, while for the most part they will know nothing. And as men filled not with wisdom but the conceit of wisdom, they will be a burden to their fellow men.”

Plato (c. 429-347 B.C.E), "Phaedrus" (c. 360 B.C.E.) 274c-275

“Modern technological tools allow educators to fulfill age-old dreams. We can individualize instruction. We can create simulations through which students can discover important relationships and construct new knowledge. We can even put the reins into the hands of students and watch as these tools take them to destinations they envision. Or, we can lose much of the potential these tools have by using them to help us do the same things we've been doing.”

Peck and Dorricott

The two quotes are chosen to illustrate the contrasting perspectives on use of digital technologies. The first quote is an excerpt from a dialogue between Plato and Phaedrus on writing, and the second quote is a discussion by Peck and Dorricott about opportunities of digital technologies. If writing is replaced with digital technologies in the dialog between Plato and Phaedrus, the two perspectives in the statements contradict one another: digital technologies create hollow humans with no true knowledge, and digital technologies provide possibilities never before imagined – although only if used in the right way. And, then, the question arises: what is the right way to adopt and use digital technologies?

Digital technologies are intertwined with humans’ everyday activities, perceptions, and thinking in contemporary Western society. This is increasingly the situation in school classrooms as well. This dissertation explores the complexity of adopting and using digital technologies within these environments where local leaders and school teachers hold diverse worldviews and perspectives, further complicated by mandates from municipality leaders and directives from policy makers.

1 Bates, 2015, p.190.
PART I
Introduction and Research Setting
CHAPTER 1
Introduction

The school is sometimes a bit crazy, [...] a bit crazy world with demands from all directions.
School leader at a compulsory 1-9th grade school

Education and school practices can be described and illustrated as a practice involving multiple and diverse actors, entities, relationships, and viewpoints, as well as influencing and challenging issues of concern (Salavati, 2013). This description is based on a research including three projects limited in time and purpose, and each addressing specific subjects and areas of concern. The reality for teachers in contemporary Swedish classrooms is much more complex; as stated above, demands come from all directions.

One demand or challenge is to include and use digital technologies in the schools. In a time period of four years (2008-2012), the number of interactive whiteboards in compulsory schools in Sweden tripled (from 11% to 33%). In addition, the use of tablet-devices in schools increased 10% between 2008 and 2012 (Skolinspektionen, 2012) and, by 2015, the number of tablet-devices increased to 40% (Skolverket, 2016a). Since four years ago, more children are allowed to bring their own private devices for education and learning purposes (Skolverket, 2016a). In addition, all teachers at the high school level and almost all teachers at the compulsory school level have their own individual computers. The availability of digital technologies in classrooms has also increased in the last couple of years (Skolverket, 2016a).

Although digital technologies are implemented in education and teaching, various reports from Swedish authorities have stated that the use of digital technologies for education have been limited and highly scattered (Thullberg & Millstam, 2010; Skolinspektionen, 2012; Skolverket, 2013b; Skolverket, 2016a). In fact, these reports state that the technologies are more often used

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3 The Swedish School Inspectorate.
4 The National Agency of Education.
for administrative tasks than as supporting tools for pedagogical work (Thullberg & Millstam, 2010; Skolinspektionen, 2012; Skolverket, 2013b; Skolverket, 2016a). Evidencing a contrasting viewpoint, according to the latest report from the Swedish National Agency of Education, the use of digital technology has increased during the last few years (Skolverket, 2016a).

Despite the challenges of utilizing digital technologies in education and teaching, the importance of the adoption and use of digital technologies in school education should not be underestimated. This importance has been acknowledged and addressed, not only by scholars and researchers, but, also, on regional (south of Sweden), national (Sweden), and European (European Union) authority levels (Salavati, 2013). According to the Swedish Digital Commission (2015), the digital nature of contemporary life has gained predominance and, as such, digitalization has highly influenced crucial aspects of society, including growth, sustainability, welfare, equality, safety, economy, and democracy. This digitalization has transformative impact on the society (Digitaliseringskommissionen5, 2015). It constitutes a strong and powerful influencing force on how education is to be carried out and what is expected of the future generation (Salavati, 2013). The adoption and use of digital technologies has, according to the Swedish IT policy, clearly stated that “school children must, and teachers should, have access to modern learning tools that are required for contemporary education” (Näringsdepartementet6, 2011b, p.33). In underscoring this, the latest national curriculum for the compulsory school, preschool classes and the leisure-time centers, Lgr11, stated that:

*The school is responsible for ensuring that each pupil on completing compulsory school […] can use modern technology as a tool in the search for knowledge, communication, creativity, and learning (Skolverket, 2011b, pp.13-14).*

In addition to this national policy, digital technologies is also addressed on a European authority level. The European Commission states:

*Information and Communication Technologies (ICT) help us learn better, more efficiently and creatively, to innovate, to solve complex problems and access wider and more up-to-date knowledge (European Commission’s Digital Agenda for Europe,7 2015).*

The European Commission argues, in their Digital Agenda for Europe 2015, that digital technologies provide flexible and accessible learning opportunities, both indoors and outdoors. This viewpoint was previously stated by several researchers and scholars (cf. Dillenbourg, Järvelä & Fischer, 2009; Pachler, Bachmair & Cook, 2010; Scardamalia, et al., 2010). Dillenbourg, Järvelä and

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5 The Swedish Digital Commission.
6 Ministry of Enterprise, Energy and Communications.
Fischer (2009), Scardamalia, et al. (2010), and Milrad, et al. (2013) who argued that the opportunities enabled by technology create richer, deeper, and wider learning experiences as well as provide opportunities for learning to take place across various settings. According to teachers participating in Salavati’s (2013) research, the digital technologies enabling learning to become more real and situated by taking the learning and teaching outside the classroom walls, and hence giving the students the possibility to gain a different understanding of what it is they are learning. The teachers in the research further argued observing tendencies that students’ learning can be enhanced with digital technologies as it is possible to create places and environments for the students to collaborate and discuss at a different level.

Grönlund (2014) argues digital technologies have been pushed into schools due to political decisions. However, he further highlights, changes in pedagogical practices and modifications to learning environments have to be made by individuals who work in the schools. Tallvid (2015) states also the mandate for integrating digital technologies in the schools has been imposed on the teachers, after the school leaders and Swedish authorities have taken the decisions to integrate digital technologies into classroom education. However, Swedish schools have a long history of teacher autonomy. Traditionally, teachers have to a large extent been able to shape their own teaching without direct influence or involvement from school leaders or governmental authorities. Thus, the practical realization of digitalization of schools has been conducted by the teachers themselves within their ordinary work practices (Tallvid, 2015). Grönlund (2014) argues the changes required for adopting and using digital technologies in everyday education practices should be developed in cooperation among the schools, including authorities and classroom teachers, the municipalities, and the commercial and industrial life (Grönlund, 2014, p.19).

In his research, Tallvid (2015) who focuses on one-to-one computing initiatives (1:1)\(^8\), finds that, from an overarching perspective, classroom activities can seem pretty much unaffected by these distributed investments. However, he further recognizes that, from a more detailed perspective, a number of changes within the school’s organization have been required to integrate 1:1 into the classroom. For instance, teachers’ lesson planning and students’ technology use are affected. Therefore, as Tallvid (2015) asserts, technology does affect the daily life of a school organization.

Despite these significant implications, the mandate to integrate digital technologies into Swedish schools has not yet changed the traditional processes

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\(^8\) One-to-one computing (1:1) is initiatives carried out all around the world including Sweden, that provides each enrolled student in a school with her or his own laptop, tablet, etc., in order to access digital learning materials, digital textbooks, and Internet. In Sweden these investments included high costs were municipalities initially have carried out a majority of these initiatives and the schools have continued thereafter. Devices are bought by schools and, as loan during their studies, distributed to every student, and every teacher.
of how educational curriculum decisions are made. Current practices therefore ignore that the implementation of digital technology in school education should not purely focus on digital equipment/devices, but, rather, focus more on the pedagogics and learning perspectives (Tallvid, 2015). Grönlund (2014) states also that, it is not merely enough for the teachers to be skillful and competent in using computers, but rather the way the teachers work, and the teaching resources, as well as the students’ schoolwork need to change. This is a change that must include the entire school instead of only occurring in single classrooms or in a top-down approach. The change should be based on factors known to give actual results and conducted in effective ways, making use of the expensive technological resources and, above all, the expensive staff recourses, especially teachers (Grönlund, 2014). However, as stated above the multiple and diverse actors, relationships, and viewpoints also need to be included in addition to carry out changes effective ways and based on factors known to give results.

Based on studies in USA, Cuban (2001) finds all teachers to continually change their classroom practice, and in terms of digital technologies some teachers quickly adopt the technologies while most do not and wait to use or ignore the technologies completely. In a more general context, Cuban (2001) urges all teachers to change various aspects of their teaching: i.e., to incorporate new study material, new ways of group work or new techniques for instruction learned from innovative colleagues. These ‘ground up’ strategies for cultural changes in local school environments contradicts the ‘top down’ approach expressed by reformers and promoters of digital technologies (Cuban, 2001), who blame teachers because digital technologies are not being used in the classroom (Cuban, 1993). Rather, also mentioned by the Organisation of Economical Co-operation Development (OECD) (2010) authorities believe that structural changes will alter and change the dominate teaching practices, causing teachers to integrate “these better ways” of teaching (Cuban, 2013, p.113), leaving the teachers voiceless in the process. A clear difference and ideological clash exists between the worldview of the practitioners (i.e., teachers) and authorities (Cuban, 2013; Grönlund, 2014). The reality of digital technology use in everyday practices is not only complex challenging but also messy which needs to be investigated from a real life practice.

1.1 Research Aim and Questions

While digital technologies are available in Swedish schools, they are not yet being used fully. In 2010, the Organisation of Economical Co-operation Development (OECD) recommended that education systems continue to invest in technology with the belief that schools and teachers will eventually adopt it and benefit from its use, a statement also mentioned by Cuban (2013).
However, previous research has shown that it is challenging due to a range of demands coming from multiple directions.

The education practice is highly complex, consisting of several actors, roles, entities, and relations, all with different power and influencing effects. Within this problematic situation, teachers are central to the adoption and use of digital technologies (Salavati, 2013). Digital technologies, in this dissertation referred to newer information and communication technologies and software, as well as devices and tools (see Chapter 1.2.1), is, according to Griffin (2003), powerful for teaching, and the skill and enthusiasm of the individual teacher defines and determines whether digital technology will be useful and effective. It is the teacher that ultimately influences the enhancement of the learning environment; it comes down to how the teachers use the technologies to their benefit (Griffin, 2003). Illustrative of this concept, as stated by Grönlund (2014), if pencils, when introduced would have been used on slate boards, it would not have led to improvement to the current learning process. The small area of a slate boards allows a very limited number of words, forcing users to erase what was just written in order to have space to write more. Therefore, research is needed to explore how learning processes may be changed by digital technologies and how teachers’ daily work practices in schools may be conducted differently. This includes what the teachers now do differently these days and why these different ways are, or are not, better (Grönlund, 2014, p.19).

In 1929, Dewey claimed that the reality of education is not found in books, laboratories, or classrooms, but in the minds of the individuals who are engaged in educational practices. Similarly, Tondeur, et al. (2008) argues that adoption of educational innovations can only be understood when teachers’ beliefs are taken into account. Tondeur, et al. (2008) further state that teachers more easily accept innovations that are in accordance with their personal thoughts and beliefs about teaching and learning. The integration of digital technology is therefore less successful if the teachers’ educational beliefs and the implications for personal professional practice are not understood (Tondeur, et al., 2008). The OECD (2015a) builds upon the results of a TALIS 20139 report, that the key to enabling the potentials for teaching and learning with digital technologies is the teachers’ professional development, well aligned with their beliefs about their practice. Geertsema (2014) argues in a similar way that teachers’ use of digital technologies in their teaching depends upon the learning objectives, what the teachers aim to achieve, and “of course by how one sees one’s role as a teacher in the first place” (Geertsema, 2014, p.2). Gaffney (2010) takes this a step further by arguing that

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the use of digital technologies by teachers consist of two dimensions: understanding teachers’ multi-dimensional professional world and understanding the external influences. The complex, dynamic, and contextual nature of teachers’ situation in which they adopt and use digital technologies is explained by Gaffney (2010, p.8) as a “wicked problem”. This term is also used in Systems Thinking when addressing messy situations that involve several actors with multiple and conflicting perspectives and interests (Checkland, 1999; Reynolds & Holwell, 2010). By researching a teacher’s mindsets, therefore, insight can be gained into what she or he considers to be learning and teaching and how this is expressed in everyday work practices and then, relatedly, appreciate when and why this is – or might be – expressed in optimal ways, both with and without digital technologies (Salavati, 2013). By applying a Systems Approach to the complex, wicked and messy educational situation, including teachers’ everyday work practice, the assumption is that it is possible to reveal underlying factors and to gain understanding of how certain perspectives and parts influence one another within the situation as a whole (Checkland, 2011; Reynolds & Holwell, 2010).

Hence, the aim of this research is to illuminate and advance the understanding of the complexity of compulsory school teachers’ everyday work practices using digital technologies.

In order to achieve this aim, the following research questions are addressed:

1. What worldviews do teachers in compulsory schools have in relation to digital technologies in everyday education?
   1.1 How do teachers perceive their professional roles in relation to teaching and learning?
   1.2 How do teachers perceive student learning?
   1.3 How are the uses of digital technologies intertwined with teachers’ perceptions of teaching and learning?

2. What are the issues of concern that add to increasing the complexity of teachers’ use of technology in their everyday work practices?

In the development of society and the welfare of humans, education and teachers have had a major part in nurture and support of the next generation to become successful citizens and contributors to society. It is therefore crucial for educational systems to keep up with the use of digital technologies that are used in our professional, public, and private everyday lives. However, schools have not yet managed to adopt and use digital technology to its full benefit in teaching and learning. Several scholars (e.g., Kay, 1972; Dillenbour, Järvelä & Fischer, 2009; Jenkins, 2009; Gärdenfors, 2010; Scardamalia, et al., 2010; Griffin, Care & McGaw, 2012b; Cuban, 2013; Grönlund, 2014; Bates, 2015)
and authorities (e.g., Thullberg & Szekley, 2009; OECD, 2010) argue that schools are challenged from many different perspectives and need to change. In order to enable potential change, there is a need to illuminate the complex, dynamic, and context bound nature of teachers’ work practice. Additionally, there is a need to shed light at various aspects and underlying perspectives to gain understanding of the situation as a whole.

It is of importance to stress that this research does not claim that the use of digital technologies within education is either beneficial or unfavorable or that it increases or decreases students’ knowledge. Rather, this research discusses, from teachers’ perspectives, the role and use of digital technologies as part of the ordinary practices.

### 1.2 Clarification of Central Concepts

A number of concepts are central within this dissertation. The purpose of this section is therefore to clarify the concepts used in this dissertation. Initially the concept of Digital Technologies will be addressed and clarified and thereafter additional concepts central to this research will be discussed, however somewhat more generally.

#### 1.2.1 The Concept of Digital Technologies

A variety of concepts are used to describe digitization in terms of investment, adoption, and use of newer technology in educational practices and educational research. These concepts include digital technology, information technology (IT), information and communication technology (ICT), and educational technology, to name a few. In general, these concepts are used interchangeably, as a clear distinction between them does not exist. As newer and more modern technologies are central to the scope and aim of this research, this section aims to provide an overview of a number of the variations of the concepts used by previous studies and authoritative reports. Swedish authorities, i.e., the National Agency for Education, the School Inspectorate, publish a number of yearly reports addressing the status of digitalization in Swedish schools and national education. The concepts and acronyms used in these reports on digitalization varies between Information Technology, IT, and Information and Communication Technologies, ICT. In reports and websites published in Swedish, the word IT is often used. However, in one report, the distinction between the concepts can be clearly identified. The last digital agenda for Sweden distinguished the use of IT for the Swedish version (Näringsdepartementet, 2011a) and ICT for the English version (Näringsdepartementet, 2011b). As for the Swedish authorities’ websites, they use the concept of IT in Swedish while for the English webpage
the concept of ICT is used. This can be seen in the webpages for, e.g., the Swedish National Agency for Education\textsuperscript{10, 11}, as well as the Swedish Digital Commission\textsuperscript{12, 13}, which are responsible for analyzing progress in meeting the objectives of the Swedish IT policy. However, in a Swedish report published by the Swedish Digital Commission addressing the digital transformation of the society (Digitaliseringskommissionen, 2015), the concept of technology is used rather than the concept of IT.

The use of IT and ICT interchangeably can be identified in scholarly work as well. For example, Grönlund (2014) uses IT and technology interchangeably in his report published in Swedish. Other scholars (e.g., Fleisher, 2013; Tallvid, 2014; Tallvid, 2015) used IT in Sweden, and ICT in English. In addition, the concept of digitalization and digital tools used to a large extent in Swedish published work, both authorities’ reports and other publications, and scholarly works and publications (e.g. Digitaliseringskommissionen, 2015; Grönlund, 2014; Tallvid, 2015).

In English publications by scholars outside Sweden, the acronyms and associated concepts used varies. In general, based on a limited number of publications, the most common concepts used are ICT (e.g., BESA\textsuperscript{14}, 2015) and technology (e.g., Mishra & Koehler, 2006; Ertmer & Ottenbreit-Leftwich, 2010; Bates, 2015). ICT is defined as the utilization of IT and technology. However, in addition to IT and ICT concepts such as educational technology (Bates, 2015) are also used. Mishra and Koehler (2008) further make a distinction between advanced and standard technologies, referring to standard technologies as books, chalkboards, and blackboards, and advanced technologies as the Internet, digital video, operating systems, standard software, web browsers, email programs, and word processing programs.

In agreement with Bates (2015), this research considers digitization to include all tools used to support teaching and learning considered to be, and referred to as technology, regardless of whether they are in the form of computers, software programs, or printed books. For this dissertation, the concept digital technologies will be used to refer to newer technologies used in the digitalization of the schools and into school teachers’ everyday practices. The concept includes various information, communication and administration technologies and software, as well as to devices such as computers, laptops and tablets; either connected to the Internet or not, and to mobile phones.


\textsuperscript{12} Om oss (Digitaliseringskommissionen, 2016) https://digitaliseringskommissionen.se/om-oss/ [Accessed: February, 2016].

\textsuperscript{13} In English (Digitaliseringskommissionen, 2016) https://digitaliseringskommissionen.se/in-english/ [Accessed: February, 2016].

\textsuperscript{14} British Educational Suppliers Association.
equipped with Global Positioning System (GPS) sensors of different kinds, as well as whiteboards and projectors with or without interactivity. Concepts such as IT and ICT are used when referring to research and studies by other scholars and previous research and reports, as addressed by their authors. Older technologies and information systems, such as books, pens, paper, chalks, blackboard, and whiteboards, are referred to as traditional technologies in this dissertation.

1.2.2 Additional Central Concepts

In addition to the concept of digital technologies, several other concepts are central to this dissertation and will be addressed and defined in this section.

The first concept is practice and is defined as “what people really do” (Robertson & Simonsen, 2013, p.7). The concept has, according to Schmidt (2014), changed and evolved over time, especially due to the technological revolution. He further argues that, with the development of modern computing technology, a deeper understanding of work practices, that is, the “unit of action in work”, is required (Schmidt, 2014, p.13). Robertson and Simonsen (2013) discuss practice in relation to Participatory Design and emphasize the importance of what people really do. They refer to the work of Ehn (1993), stating that practice is the action and reflection through which humans create the world, both the objects and the knowledge of it. Practice is also a social activity that is produced in cooperation with others. Practices evolve and modify though the passing of time, due to various kinds of changes and developments (Robertson & Simonsen, 2013). Robertson and Simonsen (2013) argue that the introduction of new technology always changes the practices of practitioners in both predictable and non-predictable ways. However, they also argue that practice can change without the involvement of new technologies. In this dissertation, which focuses on teachers’ everyday practices using digital technologies, the concept of practice will refer to what the teachers do when they do their jobs using digital technologies.

The second central concept is complexity, which is based on the concept of complex addressed and applied within the Systems Thinking field. Reynolds and Holwell (2010) describe complex realities as either difficult or messy. Within this dissertation, the concept of complexity refers to the latter. Complexity in terms of messes, or wicked situations, include higher levels of uncertainty; hardness to pinpoint the actual problem; and involvement of many people with multiple, conflicting, and interconnected perspectives. No single correct solution or path to move forward exists. Cuban has a blog entry

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15 See further description in Chapter 5.1.
from year 2010 addressing the difference between complicated and complex\textsuperscript{16}, stating that complex includes adapting to unplanned changes and dealing with conflicts and constant learning. Complex also includes hundreds of moving parts; varying expertise and independences; a lack of a mission control; and ever changing political, economic, and societal environments. According to Cuban (2010), healthcare, the criminal justice system, and schools are complex systems, while complicated systems, such as rocket landings and surgery, uses various expertise; sophisticated and exquisite knowledge and skills; rational leaders; top-down planning; and policies and delegated work units to solve problems. For this research, the concept of complexity refers to messy situations, which involve many people with multiple, various and conflicting perspectives as well as the need to adapt to unplanned and ever changing political, economic, and societal concerns (Salavati, 2013).

One of the other central concepts within this dissertation is the worldview concept, which is derived from the concept of Weltanschauung, a German word for world image and philosophy of life, initially coined by Churchman (1971) as referenced by Jackson (2003). Checkland uses and applies the concept of Weltanschauung within Soft Systems Methodology\textsuperscript{17}, (e.g., 2000; 2011; Checkland & Poulter, 2010) building on Churchman’s definition “Weltanschauung, a perception of what reality is like” (Churchman, 1968, in Checkland, 2011, p.499). Within this research, Checkland’s definition of the worldview concept is used. In addition to the concept of worldview, the concept of mindset and philosophy of teaching\textsuperscript{18} has been used in this research. Both concepts refer to the teachers’ beliefs, values, and approaches related to teaching and learning. The philosophy of teaching enables clarification of the what, how and why of teaching. The concepts of mindset and philosophy of teaching have in this dissertation been used interchangeably together with the concept of worldview.

1.3 Research Scope and Limitations

The field and the literature of education, fostering and knowledge transfer, as well as closely related fields, such as behavioral sciences, are today very extensive or, as Säljö (2014a) states, incalculable. Given the complexity and messiness of the situation, in order to address the aim of this research, illuminating the complexity of teachers’ everyday practice using digital technologies, a need exists to understand the basics of the educational field. An overview of the fundamental theories and a description of the field will,
therefore, be included in this dissertation in order to create a more thorough understanding of teachers’ practices.

The scope of the dissertation includes learning and social issues and challenges as well as organizational and political perspectives in relation to use of digital technologies in everyday school practices. Engineering and design issues related to technology will merely be mentioned as they are connected and related to other perspectives and issues included in the dissertation.

Mishra and Koehler (2006) state it is difficult to develop theories for technological education because it requires a detailed understanding of complex relationships that are contextually bound. Therefore, the empirical research for this dissertation focuses on two compulsory schools and a limited number of teachers, with the aim to create an understanding of these specific cases and perspectives. As part of the everyday practice of the teachers at the two schools, classroom lessons and preparation and other office work, breaks, and talks with colleagues will be observed and shadowed. The everyday practice of the teachers also includes work at home outside of working hours; however, that will not be included in this dissertation as it was not possible to observe the teachers outside of the school. The teachers were not asked to, for instance, blog or write diaries during this time either, as they were busy with other responsibilities. Therefore, only limited understanding of the total experiences affecting their practice of school was gained based on formal interviews and talks during the observations.

In addition, the student perspective on the use of digital technologies in everyday learning will only be mentioned in passing along side the teachers’ perspective.

1.4 Dissertation Outline

The remainder of this dissertation is structured as follows:

Chapter 2 presents the underlying foundation for this research. The chapter is a summary of the outcome of the licentiate thesis of Salavati (2013), which addresses the factors influencing the novel use of mobile and ubiquitous technologies in everyday practices.

Chapter 3 presents the research setting on which the empirical foundation of this research is built.

Chapter 4 describes digital technologies in relation to education. The chapter initially presents and briefly describes the field of education, focusing on the philosophy of teaching as well as the phenomenon of learning. Thereafter, the chapter’s focus is on digital technology and education as well as technology and teachers in order to further examine teachers’ perceptions.

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See further description in Chapter 6.3.3.
and attitudes toward the use of digital technologies. Within this chapter, two models that describe the adoption and use of digital technologies in educational settings, are presented. The chapter concludes by a summary of how the theories and models are used in the forthcoming of the dissertation.

Chapter 5 describes the epistemological foundation of this research. Systems Thinking and Soft Systems Methodology are presented and discussed.

Chapter 6 presents the methodological approach undertaken for the empirical study. It also includes the data collection methods. Finally, the analytical methodology, Soft Systems Methodology, as well as limitations and ethical considerations, is presented.

Chapter 7 presents the empirical data of the dissertation. The data collected is aggregated as a representation of the situation and addresses the issues of concern.

Chapter 8 includes the analysis of the research using Soft Systems Methodology. A number of main conceptual models are presented and described in this chapter. The chapter also includes a discussion of the models in relation to the previously presented representation of the situation.

Chapter 9 brings together and discusses the outcome of the Soft Systems Analysis in the light of related research and literature presented earlier. It also includes a discussion of the domains of Technology Enhanced Education. Additionally, a model is suggested for further discussing implications of teachers’ adoption and use of digital technologies.

Chapter 10 describes the experience of using the methodologies and methods, and the learning gained by conducting this research.

Chapter 11 presents the conclusions of this research. It also includes contributions to the research field of digital technology and education, as well as contributions to the methodology. The chapter ends with a discussion on potential future work related to this topic.
Introduction

The Complex Picture of Novel Use of Ubiquitous Technologies in Everyday Teaching and Learning
- understanding aspects that have impact on adopting novel use of digital technologies in everyday teaching and learning practices in compulsory schools

Research Objectives
- What worldview do compulsory school teachers have in relation to digital technologies in everyday teaching practices?
- What are the issues of concern advance the complexity in teachers’ use of technologies in their everyday working practices?

Digital Technologies and Education
- education and learning
- philosophy of teaching
- the phenomenon of learning
- education, teaching and technology
- teachers and technology
- teachers' perception and use of digital technologies
- TPACK - RAT - SAMR

Systems Thinking
- systems thinking
- soft systems thinking
- soft systems methodology
- cognitive mapping

Research Methodology
- IS research
- methodology and data collection methods
- data analysis methodology
- limitations
- ethical consideration

School A

Department of Education

School B

Soft Systems Analysis
- rich picture: representing the situation
- purposeful activity modeling
- discussing the perceived everyday practice

Teachers’ Complex Daily Practice Using Digital Technology
- use of digital technologies in everyday practices
- technology enhanced education and teaching
- implications for teachers’ everyday use of digital technologies
- concluding discussions

Learning by a Methodology-informed Approach
- technology enhanced education and teaching
- use of digital technologies in everyday practices
- conclusions

Conclusion
- conclusions
- contributions
- future research

Figure 1.1 Dissertation Overview
CHAPTER 2
The Complex Picture of Novel Use of Ubiquitous Technologies in Everyday Teaching and Learning

This chapter presents the underlying work of this dissertation. The chapter is a synthesis of the outcomes of the licentiate thesis of Salavati (2013) with the title ‘Novel Use of Mobile and Ubiquitous Technologies in everyday Teaching and Learning Practices: A Complex Picture’.

This research is founded on three research projects; Geometry Mobile, GEM, (Spikol, 2010; Sollervall, et al., 2011; Gil, 2012), Learning Ecology with Technologies from Science for Global Outcomes, LETS GO (Spikol, 2010; Pea, et al., 2012; Vogel, 2012; Vogel, 2014), and Collaborative Learning Using Digital Pens and Interactive Whiteboards, Collboard (Alvarez, Nussbaum & Milrad, 2010; Alvarez, et al., 2013). These projects were conducted at compulsory schools in the south of Sweden, in collaboration with teachers, students, and fellow researchers from the multidisciplinary Center for Learning and Knowledge Technologies (CeLeKT) research group located at Linnaeus University. The empirical material was analyzed undertaking two thematic analyses: an Inductive Thematic Analysis concluding in five themes (Salavati & Mörtberg, 2012) and a Deductive Thematic Analysis using the Unified Theory of Acceptance and Use of Technology, UTAUT model, by Venkatesh, et al. (2003) and UTAUT2 model by Venkatesh, Thong and Xu (2012). As a final analysis and ground for a more holistic discussion, the Rich Picture technique of Soft Systems Methodology (Checkland, 1999) was applied.

20 The concept of novel was in the licentiate referred to as new, interesting and unique ways of using the technology.
21 The research projects will not be further presented in this dissertation. See Salavati (2013) for full descriptions.
One of the central concepts of the licentiate thesis is mobile and ubiquitous technologies, a concept that is more research driven and, in the context of this research, has not been recognized by practitioners. The concept of mobile and ubiquitous technologies came together with the research projects the licentiate was built upon. For this dissertation and research, however, the central concept is digital technologies (see Chapter 1.2.1), and, therefore, this chapter will use the concept of digital technologies to refer to the concept of mobile and ubiquitous technologies used in the licentiate thesis.

**The Challenges of Technology Enhanced Learning**

One of the outcomes of the licentiate thesis resulted in identifying seven challenge domains addressing the complexity of Technology Enhanced Learning (TEL). The six main challenge domains include: technology and engineering; design and interaction; learning, social, and cognitive; political; organizational; and resources. All of these fall within the overarching challenge domain of society.

While the first three challenges were identified by Kurti (2000), the last three challenges as well as the overarching challenge were identified by Salavati (2013). Figure 2.1 illustrates the six challenge domains and the overarching challenge domain.

![Figure 2.1 TEL challenge domains (reproduced from Salavati, 2013)](image)

Technology Enhanced Learning, according to Kurti (2009), consists of humans (i.e., the learners); the organizational setting in which the learning takes place; and the technology in terms of different tools, resources, and the
interactions between them. These three aspects can be identified within the seven challenges illustrated above; however, the organizational and human aspects have not been deeply investigated.

All the identified challenges directly and indirectly influence the field of Technology Enhanced Learning. The influence on the field is not only based on the different parts (challenges) but also the interaction between them and their impact on each other. In terms of the overarching challenge of society, all challenge domains are directly being influenced by the society as well as influencing one another within the society, and ultimately again influencing the Technology Enhanced Learning field from yet a different perspective.

The technology and engineering domain challenges concern devices, software, and applications. This includes issues of network connection and access, security, reliability, and accuracy as well as the issue that the majority of technologies are not developed for educational purposes. Design and interaction refers to challenges such as learning activities, addressing how learning activities can be designed using digital technologies, and how to use these digital technologies for full size classes. Challenges concerning interactions with the technologies are also addressed within this challenge domain. The third domain is the learning and cognitive challenge domain. Pedagogical and didactical issues are covered in this domain. Literacies and skills, the learning styles of the students, and styles of teaching are addressed in this domain as well as issues such as collaboration and active student participation. The political domain covers the challenges that affect the field externally, such as regulations, policies, and curriculums, which is implemented and followed in the schools. Economical aspects are also a challenge within the political domain since schools are economically dependent upon decisions made by national and local authorities. The organizational domain addresses challenges that the school faces as an organization, including municipalities and the role of the school leaders in the school and everyday education. Further, the implementation of national curriculums and regulations are also organizational challenges. Resources include challenges in terms of equipment, support, training and education for both teachers and students. However, the most difficult challenge is time as the teachers in the projects expressed, a need to find the time to update their pedagogical approach to include digital technologies. For instance, much of their work with learning to use digital technologies and integrate it into their teaching is conducted outside work hours, with not enough support from the organization and without guidelines from the authorities. The final challenge domain, which is considered to be an overarching challenge, is the society domain. The development and evolution of society has affected and influenced all aspects of society and everyday life, and in contrast to centuries ago, we are living today within a digital and knowledge driven society which has changed individuals’ private, public and professional lives. These changes affect previously mentioned challenge domains and,
hence, novel use of digital technologies in everyday teaching and learning practices.

**The Complex Problematic Situation**

Using the Rich Picture technique of Soft Systems Methodology\(^22\), various entities, actors, roles\(^23\), relationships, and viewpoints were recognized in the complex problematic situation illustrated in Figure 2.2.

At the top of the picture, the evolution of society is illustrated as moving from traditional books and chalkboards to a society that is highly influenced by technology. Interactive whiteboards are becoming more common, replacing the traditional blackboard (Skolverket, 2013b). In addition, mobile phones, desktops, and laptop computers are increasingly becoming more ordinary commodities in everyday life. The evolution of society can be considered the most powerful and influential factor as it influences all aspects of society, from the development of digital technologies to the ways organizations and working life is conducted, organized, and carried out (e.g., Bradley, 2006a; b). The development of society further influences all individuals, including teachers, students, and prospective teachers. The European Commission, Swedish government, The National Agency of Education, municipalities, and schools are all influenced directly and indirectly by the working environments, the development of the digital technologies, and individual people.

The authorities at the right side of the picture illustrate the formal part. The Swedish Government and the National Agency of Education have the official power within the formal educational setting. The School Act 2010:800 and Lgr11 (the National Curriculum for the compulsory school system, the preschool class and the leisure-time center) are developed and provided by the Swedish Government and the National Agency of Education following the Digital Agenda for Sweden. The documents give directives for use of digital technologies as well as foster new skills and literacies. However, the authority level fails to provide strategies and/or guidelines and pedagogical models for how the new requirements for digital technologies should be implemented, adopted, and used in everyday teaching and learning practices. Therefore, although schools today have access to digital technologies, the outcome showed teachers have difficulties to use the digital technologies and to take advantage of their educational enrichment potential. Although the digital technologies exist, there is lack of time and knowledge for teachers to explore opportunities and added values of digital technologies in teaching and learning practices.

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\(^{22}\) See detailed description of the methodology and its techniques in Chapter 5.2.

\(^{23}\) Entities are referred to as distinctive things existing independently. Actors are referred to as those who participate or perform an action or process. Roles are referred to as functions and actions assumed by a person (Salavati, 2013).
Even though the teachers are at the bottom of the decision hierarchy, they are the main actors in this complex situation since, ultimately, the teachers are the individuals who are supposed to integrate and use the digital technologies in their everyday teaching. Regardless of pedagogical models or teaching strategies, all teachers adjust their teachings to follow the School Act 2010:800 and Lgr11. In addition, as students are not a homogeneous group and have varying needs and preferred learning abilities, teachers must also alter their teaching methods to take into consideration these issues. Teachers are further influenced by several other factors, including their own prior school experiences, their own children, their private lives, and the students they teach, which have not been illustrated in the figure above.

The prospective teachers, who will one day be teaching in the schools, are represented at the bottom of the picture. In this context, the prospective teachers have no major formal influence or power in the complex problematic situation. Teacher education programs follow policies, requirements, and guidelines in school acts and other steering documents regulating compulsory school curricula. As the licentiate study results show, teacher education programs fail to provide usage and pedagogical guidance for digital technologies.

The main beneficiaries of this problematic situation are the students, who are the second main actors and are illustrated in the right top of Figure 2.2. The students will, regardless of the approaches required from or objectives set

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24 See Appendix A for a larger image.
25 See Chapter 4.4 and Appendix B for teachers’ perspective.
by the authorities or choices made by the teachers, be the individuals who will be affected the most by the everyday practices. Digital technologies enable bringing informal surroundings into the classrooms by opening the classroom walls, by enabling sharing and influencing of classmates, teachers and the learning environment as a whole with the knowledge and experiences gained from the students’ lives outside of school. The digital technologies also enable learning situations to become more real and situated by moving the learning and teaching outside the classroom walls, allowing students the possibility to gain a different understanding of what is learned. In the earlier study by Salavati (2013), teachers stated that the students use different senses, have different learning styles and, therefore, make different uses of various media, including digital technologies. The teachers considered this positive, arguing that digital technologies can enhance the students’ learning because it is possible to create places and environments for the students to collaborate and discuss on a different, higher level.

The empirical findings of the licentiate research distinguished different student groups with varying attitudes towards use of the digital technologies. This is also reflected in the literature, which recognizes that a majority of today’s young generation have significant knowledge of and skills in the use of digital technologies; however, they are not fully aware of the risks and challenges associated with such use or the complete skills and knowledge required by society outside the home and school environment. Various scholars, including Jenkins (2009), Scardamalia, et al. (2010), Lankshear and Knobel (2011), and, Griffin, McGaw and Care (2012a) argue that today’s students need new knowledge, literacies, and skills in order to become successful citizens of society. Formal education experiences should provide this knowledge and these skills to students.

The introduction and application of digital technologies can both create opportunities and benefits and also produce challenge for the students and the teachers. Within the research projects included in the licentiate research, a number of challenges were seen as more of an inconvenience than a major issue. However, when challenges exceeded a certain level of discomfort and distress or would reoccur, it could create greater frustration and lead to distance taking from the use of digital technologies. Additional challenges, opportunities and possibilities enabled by the digital technologies include ‘sharing’, ‘participation’ or ‘availability’, as illustrated in word clouds in the Rich Picture.

Figure 2.2 also illustrates the final perspective that influences the use of digital technologies in schools: the working environment and the roles of organizations, companies, service providers, and other entities in that environment. This is illustrated in the left side of the complex rich picture. The nature of work and how work is conducted is different prior to digitalization due to the high influence and significant importance of digital technologies in everyday society. The required skills and literacies needed have therefore
changed, and so has the boundaries of the working practices. Bradley (2010) has demonstrated how private, professional, and public lives become blurred and interchangeable. In order to prepare the younger generation for the needs and demands of society and its working environments, educational practices need to implement and use digital technologies in novel ways that feel natural in everyday teaching and learning.

The outcome of the previous study and the foundations for this research

The findings of the licentiate thesis showed various influencing aspects and domains affect novel use of digital technologies. Findings recognize that, despite on-going efforts, a need for strategies, policies and pedagogical models exists. These resources should be provided by government, municipal, and school leaders and should be integrated into education and training for the teachers and also provided to the students. In addition, variation among different groups of teachers and students, with their different perceptions and levels of comfort in use of digital technology, must be considered. As the licentiate research revealed, some teachers do not always see the benefits of using digital technologies; some doubt their reliability and stability; and others need time to update their pedagogy and find new ways to update their teaching. There are also teachers who are enthusiastic and able. They have adopted and integrated the use of digital technology in their everyday practice. These outcomes motivate further research with specific focus on teachers’ everyday practice.

The use of digital technologies should build on traditional education and the already rich and strong foundation of knowledge that exists today. However, simply purchasing and making technologies available within the classroom is not the solution to the complex issue of adopting and using digital technologies in the contemporary classroom. The outcome of the licentiate research has illustrated a need for a deeper understanding of the different worldviews identified, especially teachers and their mindsets in relation to teaching and learning, as well as need for a deeper understanding of existing pedagogical models and potential new models and strategies of benefit to teachers’ daily work.

Therefore, as described in the introduction chapter, the aim of this research is to illuminate and add to the understanding of the teachers’ complex, everyday practice in relation to use of digital technologies by investigating the teachers’ worldviews in relation to digital technologies. In addition to the teachers’ worldviews and perspectives, closely related worldviews of additional actors will be briefly investigated in order to enable a more comprehensive understanding of the teachers’ complex daily practice.
CHAPTER 3
Research Setting

The empirical setting for this research is based on two compulsory schools in a large cities county\textsuperscript{26} in southern Sweden. Four teachers, employed at the two schools, constitute the main foundation of the empirical study\textsuperscript{27}. Each teacher has been observed for a few days and has also been interviewed (see detailed description in Chapter 6.3.3). In addition to the teachers, students in the classes have partially been observed. Two school leaders from the participating schools have also been interviewed. In addition to the schools, three representatives from the Department of Education as well as the head of the IT-unit at the municipality were interviewed and thereby have contributed to the empirical material.

3.1 School A

School A is a 7-9\textsuperscript{th} grade school and has approximately 650 students distributed between eight\textsuperscript{28} 7\textsuperscript{th} grade classes, eight 8\textsuperscript{th} grade classes and nine 9\textsuperscript{th} grade classes. Each grade is divided in two teams consisting of its own team of teachers being responsible for subject classes during all three years. Approximately 66 teachers are employed at the school, and the school is led by one school leader and two vice-school leaders. In addition to the regular school curriculum and activities, the school has special programs for those students who are interested in natural science subjects, technology and mathematics.

\textsuperscript{26} All counties in Sweden are classified within 10 different groups based on various factors. More information can be retrieved from the Swedish Association of Local Authorities and Regions webpage (in Swedish):

\textsuperscript{27} See Table 6.1 for an overview.

\textsuperscript{28} These numbers are for autumn 2015 and spring 2016.
Within the school, all students and teachers are equipped with individual laptops or iPads. Computers were introduced for the first time during spring 2011, since the school was one of the schools participating in the initial one-to-one computing initiative (1:1) provided by the municipality. iPads were introduced in the school and loaned to the students beginning in autumn 2014.

Most classrooms\(^29\) at the school are equipped with interactive whiteboards and digital projectors in addition to the classic traditional classroom furniture, two or three desks in rows and a teacher-desk in front of the class. The classrooms doors were most often equipped with windows. The teachers’ offices are open landscape offices, and also have windows on the door from the hallways.

### 3.2 School B

The second school covers preschool up to 9\(^{th}\) grade and has approximately 230 students distributed between one class for each age group. The school is led by one school leader and two vice-school leaders. The school has approximately 27 teachers employed.

The school was among the first in the municipality to participate in a one-to-one computing initiative (1:1). The school leaders introduced computers to students and teachers during spring 2011 and, to this day, the school teachers still prefer to use laptops rather than iPads. iPads are considered by most teachers to be a digital book with limited possibilities, in contrast to computers. For one single grade, iPads were bought but since there was a low satisfaction rate, the school leader decided to buy laptops for the teachers and students, despite higher costs than iPads.

Several of the classrooms\(^30\) at the school are equipped with interactive whiteboards and projectors, while others have projectors and traditional whiteboards. Student desks are placed in groups rather than straight rows. In front of the class, there is a small tall-table for the teacher rather than a traditional teacher-desk. The teachers’ offices are shared rooms with individual desks alongside the walls and a large bookshelf in the middle.

\(^{29}\) Since all classrooms at the school have not been visited, it cannot with certainty be stated that all classrooms have interactive whiteboard and projectors. However, it is most likely that all classrooms, with the exception of the sports hall [visited], have this technology.

\(^{30}\) Since all classrooms at the school have not been visited, it cannot with certainty be stated that all classrooms have interactive whiteboard and projectors. However, it is most likely that the majority of the classrooms are equipped with this technology.
### 3.3 The Department of Education and IT-unit

Representatives from two different municipality departments have been interviewed: the Department of Education and the IT-unit. The latter is more of a supportive department to the other departments such as Department of Education rather than being a stand-alone department.

The Department of Education includes all compulsory schools, high schools and pre-schools in the municipality. The organization is illustrated in Figure 3.1. Arrows pointing down indicate the decision path going from the top of the hierarchy down to each school. Arrows pointing upwards represent the flow of status reports as well as additional information for decision making. The double-sided arrows between the school leaders and the teachers illustrate the communication and daily work that is conducted among them, which later results in reports and ground work reported to the department. At the left side of the department hierarchy, units are illustrated which support the Department in their work. Among these units, the IT-unit is identified as well as the Organization Developers\(^{31}\), Human Resources, Economics, etc.

![Figure 3.1 The organizational structure of the Department of Education](image)

At the top, the Board of Education is illustrated. The Board consists of representatives from political parties who are the final decision makers for the Department. The Director of Education is the outermost responsible officer in the Department. The Director of Education has had this position for one year and has a background as a teacher and school leader before being involved in

\(^{31}\) Verksamhetsutvecklare in Swedish.
various levels of the organization of the Department of Education. The third level of the hierarchy consists of the Head of Department. The Head of Department has been working as a teacher prior to this assignment and as a school leader and District Manager for a number of years. The Head of Department has a background in finance and administration studies with a complementary pedagogy education.

The schools within the municipality are divided into different geographic districts where each has its own District Manager, illustrated as the fourth level of the hierarchy. The District Manager interviewed for this study has been working as a teacher for 12 years and as a school leader for 20 years prior to receiving the offer to become District Manager. Below the District Managers, the school leaders from the different schools are represented and finally the teachers employed by that specific school and school leader are illustrated.

The IT-unit is separate from the Department of Education and is central for the whole municipality: all departments, units, and employees. For this research, the chief information officer (CIO) of the IT-unit has been interviewed. The CIO of the IT-unit has an educational background as an economist. Before assuming this current employment at the municipality three years ago, the CIO has been working as an IT-chief within the private and the public sector for 15 years.
PART II
Theoretical Frameworks and Methodologies
CHAPTER 4

Digital Technologies and Education

The theoretical foundation of this research is presented in this chapter. The initial section aims to describe the complexity of education and teaching and to provide some background into the education field. The section also discusses the teaching profession, and the teachers’ beliefs, values and perceptions in regard to teaching. The next section describes how technologies influence school education, and specifically explores how integration of digital technologies influences teaching in schools. The following sections present the relation of teachers and technologies and explore the perception and acceptance of digital technology by teachers, which influence their use. Thereafter, the TPACK, RAT and SAMR models are included to illustrate the complexity of balancing pedagogy, technology and education, and to further understanding of using digital technologies in different levels in education. These models are used as a reference point for discussing the empirical data in upcoming chapters. The chapter ends with a summary of how the theories and models are used to achieve the aim of this research.

4.1 Education and Learning

Humans have been learning about their surrounding world since the beginning of time. The establishment of the schools as a distinguishable environment for teaching and learning was created about 4000 to 5000 years ago, an environment that beside teachers and students also included janitors and other people with various tasks, roles and characteristics that have remained throughout the centuries (Lundgren & Säljö, 2014). In order to organize learning within the school so as to achieve educational needs, about 2500 years ago something that today is known as the curriculum was created.
Through passing of some time, a curriculum was created consisting of seven subjects, divided into two groups: (1) trivium\(^{32}\) consisting of grammar, rhetoric and logic, and (2) quadrivium\(^{33}\) consisting of arithmetic, geometry, astronomy and music. The division of trivium and quadrivium can to the current day be seen in our education despite the changes made in these subjects throughout history. Lundgren and Säljö (2014) describe the division between humanities/liberal arts and natural sciences to be a legacy from those eras.

How education is shaped and what it includes is strongly connected to the structure and development of a society’s economic, cultural and social systems. Within each educational level, what should have been learned and what is to be taught are influenced by two things: (1) What is worth knowing? and (2) What is the social significance of this knowing? (Lundgren, 2014). Lundgren (2014) argues education is driven by ideological documents specifying what the purpose of the education is, as well as by the surrounding environment defining what knowing and knowledge is. As can be noted by the brief history above, there is a historical inheritance for each subject curriculum and educational system. The development of the Western culture has shaped various understandings of what education is and what is essential within education, all of which can be identified in various discussions related to school, education and learning (Lundgren, 2014).

The two major disciplines, pedagogy and didactic, are essential components of education. The disciplines are often perceived as complicated, contradicting and confusing as evident in discussion about pedagogy and didactics from a higher education perspective in the field of architecture (Melissinopoulos, 2013). Melissinopoulos (2013) argues that each one of these disciplines, despite their common use of epistemological perspectives, is a distinct field within the same territory of educational research. He states the concept of pedagogy refers to the theoretical and organizational underpinnings of education, derived from political science and drawing upon educational philosophy, educational sociology, as well as educational theory. Pedagogy refers to educational goals, he asserts, rather than referring to programs and methods. The aim of pedagogy is for the learners to become a social subject in their future role in society (Melissinopoulos, 2013). Similarly, within the Swedish pedagogical literature, Lundgren (2014) describes pedagogy as having two meanings: that which can be taught, and that which is taught (Lundgren, 2014, p.141).

The second component of educational research, i.e., didactics, is divided by Melissinopoulos (2013) in three different regions: (1) what-region, concerning the content of teaching, (2) how-region, concerning the method of teaching, and (3) why-region, that addresses the justification of curricular choices. Didactics is the art of teaching together with practical knowledge in teaching.

\(^{32}\) The place the three roads meet.

\(^{33}\) The place the four roads meet.
while it at the same time includes theoretical knowledge about teaching, learning and its conditions (Melissinopoulos, 2013). Within the Swedish pedagogical literature, Lundgren (2014) explains the concept of didactics is used to denote the method that has been or should be used in the school. Melissinopoulos (2013) argues that didactics focus on the individual and her/his cognitive characteristics and function when learning appears within a given content and when learning is transformed to knowledge or knowing. In turn, Lundgren (2014) explains the importance of knowledge and the consequences it has for how learning is perceived. Having its background in philosophy and heavily drawing on cognitive psychology and teaching theories, Melissinopoulos (2013) describes the intention of didactics to provide foundations to change education, how content can be best taught and learned, in what settings and by what means. He further argues that didactics cannot be reduced to certain instruments or a set of teaching methods (Melissinopoulos, 2013).

Closely related to didactics, Lundgren (2014, p.142) also mentions the curriculum, a steering document for goals and content, existing in all educational systems. The naming of the steering document has varied throughout time. However, in the Swedish language, the concept of curriculum has a very distinct meaning: it is a document containing the objectives of education, the content and distribution of time (Lundgren, 2014).

### 4.1.1 The Teacher Profession

Teachers have been known to be those who are the source of all knowledge (Dewey, 1929). According to Kennedy (2008), who refers to a study dated 1932 by Willard Waller, teachers at that time, both within and outside the classroom, were placed on pedestals. Teachers’ authority was central in the classroom and, more broadly, within the school (Kennedy, 2008). Jarvis (2006) describes the teachers in a similar way as Dewey and Kennedy. He argues that the traditional image of a teacher is a person who has mediated knowledge and who has told students what to learn, encouraged them, and practiced with them what they have been taught and learned. However, he continues, this role has changed. Throughout time, Kennedy (2008) argues that the teachers have been forced to become more rigid and inflexible due to the constant pressure from the students. They are expected to always strongly represent adult norms and continuously defend their authority and maintain their own dignity against students’ mischiefs, troubles and various other challenges to their authority (Kennedy, 2008). In addition, Jarvis (2006) argues that the teachers, among other things, no longer have the monopoly on knowledge transmission, nor to teach unchanging knowledge, but rather deal with scientific short-lived knowledge. Furthermore, the teachers no longer only teach theoretical knowledge to their students but also have to help them gain
practical knowledge, and they can no longer assume their students do not know anything about the subject taught. Rather, teachers have to build upon the knowledge the students already acquired from various sources (Jarvis, 2006). Liberg (2014) argues that teachers are those who are responsible for what happens within a teaching and learning situation, serving as composers as well as responsible for the orchestration. However, she also observes that these can vary for specific teachers as well as vary within different countries. To exemplify, teachers in Germany, Norway and Denmark have a more didactic role and are cognitive and morally aware choosers, while in Sweden the teachers are dominated by the American tradition where teachers are implementers of political decisions (Liberg, 2014).

Kennedy (2008) argues that the teachers are thoughtful professionals conducting work that requires professional judgments. Teachers should not be seen as skilled laborers with training in a reduced set of skills. Liberg (2014, p.336) states that the fundamental questions in the teachers’ mission are the didactical questions: what and why this. She further adds that teachers need to ask: what do I as a teacher want the students to learn within a certain knowledge area, and why that? Naturally, steering documents, such as curricula and syllabi, play a prominent role in determining content to be taught in the classroom. However, Liberg (2014) recognizes that teachers make choices in which certain aspects of teaching are enhanced while other aspects move to the background or completely disappear. As Liberg (2014) further elaborates, when teaching is planned, the what-question needs to be considered in relation to the who-question, that is, who the students are, and how they can go about learning the content: that is the what-question. Therefore, motivation for how education is planned lies in the aim of the teaching as well as whom are to be taught. The outcome of what the students are learning also affects the continued planning of the teaching; hence, it can be said that teaching and learning are in a mutual and complex relation to one another (Liberg, 2014).

One of the most important aspects for teachers’ success is to develop skills necessary to manage, organize, and present complex and difficult concepts to students in the classroom (Griffin, 2003). The many conflicting theories about the nature of knowledge, primarily driven by epistemological differences and different value systems, require that teachers have vast knowledge and understanding. In order to make the best choices on possible teaching approaches, based on perceived needs among their students, they must be conversant with diverse learning settings and contexts (Bates, 2015). However, rich variations and considerable differences in theory and practice of teaching illustrates, according to Bates (2015), that there is no universal way to teach which fits all circumstances. He further argues that a good teacher, depending on the circumstances and situation, can draw upon and use tools, methods and approaches that she or he has in her or his arsenal of knowledge and experiences. In addition, each individual teacher will have her or his own
mindset and idea of what represents good teaching, based on what their personal understanding of knowledge, as well as what learning matters most, and what are the prime learning outcomes (Bates, 2015). In a similar line of reasoning, Jarvis (2006) advances the notion that if a teacher’s philosophy and personality could be measured, it would be possible to gain insight into her or his teaching and teaching style. The author understands teaching to be about helping others to learn, which is a process whereby teachers as individuals play an important role. Teaching is described as an art form as well as a science, and hence the teachers’ philosophy or mindset can be revealed by the style of teaching adopted and expressed (Jarvis, 2006, p.33).

Additionally, Bates (2015) argues teachers that have had the most extensive training or theoretical knowledge do not always make good teachers if they do not have talent and emotional connection with the learners. Further, good teachers usually have a passion for teaching which also suggests the importance of emotion and cognition.

4.1.2 Teachers’ Philosophy of Teaching

Liberg’s (2014) description of the what and why questions of the teacher’s didactical mission are similar to Melissinopoulos’ (2013) division of the didactics central regions: what, how, and why. These questions are also important aspects of a teacher’s philosophy and mindset of teaching. A teacher’s statement of philosophy of teaching offers personal perspectives on how individuals think about teaching and perform as teachers, both inside and outside the classroom (Korn, Stephen & Slikorski, 2012). Philosophies of teaching aim to document beliefs, values and approaches of the teacher and provide personal portrait of the teacher’s view of teaching (Goodyear & Allchin, 1998), which illuminates a teacher’s goals and aspirations while teaching. Korn (2003) claims the philosophy of teaching to be a teacher’s conscience (Kron, 2003, p.46). Similarly, Kenny (2008) defines statements of teaching philosophy as follows:

> A teaching philosophy statement clearly and logically communicates what your fundamental values and beliefs are about teaching and learning, why you hold these values and beliefs, and how you translate these values and beliefs into your everyday teaching and learning experiences. (Kenny, 2008, p.6)

These statements on the philosophy of teaching are central to teaching, and enable progressive development of a productive culture of teaching. Philosophies of teaching, further, help teachers clarify the why of teaching, as well as provide foundation for what and how of teaching.

While Goodyear and Allchin (1998) differentiate the why’s of teaching, in contrast to the how’s and the what’s, they stress that it is all essential. They propose four aspects to the statement of philosophy of teaching. First, the
philosophy of teaching should describe one’s identity as well as focus on themes for teaching activities. Secondly, the philosophy defines the role of teaching in relation to other professional responsibilities. It enables monitoring and integrating other responsibilities. Third, the philosophy of teaching clarifies a set of principles by which the teacher acts in order to guide her or his behavior. Finally, when the statement is shared with colleagues, it enables professional dialogue, growth and development (Goodyear & Allchin, 1998).

A philosophy of teaching is dynamic, and will throughout a teacher’s career most likely evolve and change (Goodyear & Allchin, 1998). Korn (2003) claims that a teacher’s philosophy influences her or his decisions, similar to Goodyear’s and Allchin’s third aspect. Schoenfeld (1998) similarly refers to literature saying that the knowledge, belief and goals of teachers are critical determinants of what teachers do, and why they do it. He contrasts this statement by citing other literature that argues for the lack of straightforward connection between teachers’ beliefs and their actions. Schoenfeld (1998) claims a teacher’s knowledge, beliefs, and goals, as well as subject knowledge and experience of practice, are all parts of a puzzle explaining why teachers make certain decisions. Although all teachers have implicit philosophies, statements of philosophy of teaching are personal expressions that support holistic views of a teacher’s teaching (Goodyear and Allchin, 1998; Korn, 2003). As Goodyear and Allchin (1998) state, teaching philosophies can be expressed in belief statements reflecting value systems and policy statements, as well as objectives and strategies. Korn argues that a teacher’s experience form theories - philosophies of teaching – which can increase a teacher’s understanding of what she or he plans to do and what she or he actually does (Korn, 2003; Korn, Stephen & Slikorski, 2012).

Regardless of the influence of the philosophy of teaching on teachers’ teaching styles, strategy choices and pedagogical approaches, the more understanding teachers have about learning processes, the more effective their teaching can become. In other words, understanding learning enables effective teaching (Jarvis, 2006).

4.1.3 The Phenomenon of Learning

Humans are docile and, according to Säljö (2014a), learning is both an essential characteristic of human kind and also a basic requirement for human life (Gärdenfors, 2010). During various epochs of time and cultural perspectives, learning has shifted as a phenomenon (Säljö, 2014a). From the current cultural viewpoint in Sweden, learning continues to have an important role, wherein we believe that economic and social welfare and overall improved living conditions are strongly connected to learning. Säljö (2014a)

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argues that these days, politicians, business leaders, economists and other decision- and policymakers think that a well-educated and highly qualified population is one of the most important requirements for increased economic prosperity and improved quality of life (Säljö, 2014a, p.11).

Social and, increasingly, technological developments influence how humans access and gain information, knowledge and other skills. This observation reflects that types of knowledge have shifted over the centuries, in response to opportunities, needs and requirements of the larger world (Säljö, 2014a). Currently, developed countries are highly knowledge-, innovation- and technology driven. At the same time, they are confronted with complex challenges in science, health, business, politics, education and the environment (Kay & Greenhill, 2011). Therefore, current changes in society suggest that learning for younger generations needs to focus on wisdom and understanding rather than purely knowing and remembering (Wan & Gut, 2011). Learning for the younger generation also needs to focus on collaboration, digital literacy as well as new ways of thinking and solving problems (Scardamalia, et al., 2010; Lankshear & Knobel, 2011; Griffin, et al., 2012b). Säljö (2014a) claims that it is not only what to learn and how much humans need to learn that is changing but also the ways of how we learn and obtain knowledge are influenced and affected by the cultural conditions in which humans live (Säljö, 2014a). In contrast, according to Laurillard, (2008), regardless of changes in society, learning as a phenomenon remains the same and will not change. She doubts that there will be new radical findings on what is required for humans to learn. She notes that learning will always require effortful thinking.

Another interesting dimension of the discussion on learning is offered by Cain (2013), who argues that the word learning is overused, poorly understood, and oftentimes ambiguous. Its theoretical and practical misuse is, according to Cain (2013), perhaps the single largest obstacle to the improvement and development of education. The statement reveals an underlying issue: that the purpose to be accomplished through education is not clear, despite concepts and ideas of “high standard” and “21st century skills” (p.17). People involved in education, ranging from educators, researchers, scientists, policy makers, business people, etc. use words such as learning and understanding, without having shared agreement on the meaning and adequacy of these concepts and words. As Cain (2013) states, the same words do not necessary mean the same thing. He elaborates further in noting that how some people define the concept of education might be completely different from how others use the same word. For instance, scientific literature based on different researchers’ points of view may depart significantly from research conducted and interpreted by educators representing different philosophies of teaching.

Cain (2013) argues that schools are grounded in a set of established ideas on how to get from point A to point B. Given dynamically changing social, economic, and educational landscapes, there is a need for clarity and
consensus on where we are, where we actually wish to go, and, finally, what it really takes to get there (Cain, 2013). He notes that basic human instincts and skills are acquired in other settings than the formal: e.g. in the families, among friends, in societies and associations, and in working places. These settings do not have the primary purpose of mediating and transmitting knowledge as in schools and other educational institutions (Säljö, 2014a). Therefore, Säljö (2014a) states, it is important to study these additional settings and their results as well as when and how humans learn.

Boström (2011) is one of many researchers stating that there are several different learning theories and models, which vary in dimensions and variables. She argues these theories of learning presume that all humans can learn. However, humans learn in different ways and on different levels. Various theories focus on different aspects of learning, such as cognitive processes, practical skills, sensory modalities, learning processes, thinking styles, etc. The theories exist within a comprehensive area that not only addresses individual and group levels of learning but also their effects on the educational system as a whole. Boström (2011) further argues that when teachers have more awareness about learning styles, this gives them more opportunities to positively impact students’ individual learning. In other words, knowledge about how students learn is important for both individual and group instruction. However, Boström (2011) stresses that there is no uniform way of managing education that is suitable for all students. This has also been addressed by Bates (2015) who claims that the existence of learning theories suggesting the different ways that people learn do not automatically tell teachers how to teach (Bates, 2015). However, by reflecting on their own strategies for learning, teachers gain greater awareness and understanding into their own teaching decisions as well as their students’ learning behaviors, which can influence how they teach (Boström, 2011). In line with Boström (2011) and Bates (2015), Christensen, Horn and Johnson (2008) claim that humans learn differently. Similar to Boström (2011) who states that teachers have their own learning styles, Christensen, Horn and Johnson (2008) argue that teachers tend to teach in ways compatible with their own learning style. Students who enjoy that teaching approach will most likely succeed within their studies.

Bates (2015, p.64) states it is important to be aware that knowledge and therefore also teaching is not a purely objective activity. The various values and beliefs about the nature of knowledge is what drive knowledge dissemination and consequently teaching. Säljö (2014b, p.308) argues that teachers cannot escape the fact that they directly or indirectly base their teaching on some assumptions on how children or, in some cases, adults learn. However, Bates (2015) stresses that no scientific theory can explain fully how education is actually conducted and truly enacted. How the theory is actualized and what becomes its consequences is based on the real world relationships between the teacher and the students in the specific context.
Theories of learning as well as methods for teaching and epistemologies for practice are independent of particular mediums of delivery and technology, whether digital or traditional (Bates, 2015). According to Bates (2015), digital technologies can be used for transforming teaching. Based on the characteristics or affordances of the specific technology, different methods of teaching can be more favored. Bates (2015) further argues that teachers who are aware of the multitude of teaching methods and learning theories, as well as the epistemological backgrounds of the theories, have stronger positions in taking decisions on how to teach in particular contexts.

4.2 Education, Teaching and Technology

*ICT is one of the school’s teaching tools, needed to attain the school’s aims.* (Näringsdepartementet, 2011b, p.34).

Looking back at the history of technology and education, (Bates (2015) notes that technologies’ role in education goes back at least 2500 years. Oral communication was the earliest means of education and over time, as various technologies have been developed, technologies have increasingly been used to facilitate or support oral communication. Prior to any technology, in order to learn, one had to memorize by listening and not reading. Transmission of knowledge and information was purely by recitation - but not writing. In about 5th century BC, written documents were introduced in ancient Greece. In about 12th century, slate boards were used in India, while blackboards/chalkboards were initially used in schools in Western countries around the 18th century. Overhead projectors were used by the end of World War Two (1950s) for training by the U.S Army and later became commonly used for lecturing until about the1990s when software such as PowerPoint was introduced. Audio-conferencing using telephones, which has existed since the 1870s but never became a major tool in education, was first used around the 1970s to support other types of media. Video-conferencing with dedicated cable systems and specific conference rooms have been used since the 1980s. Early in 2000, compressed video technology and low cost video servers supported lecture capturing systems and classroom lecture streaming (Bates, 2015).

In line with Bates (2015), Laurillard (2012) also addresses the strong relationship between education and technology. She recognizes technologies as being important drivers for education, even though most technologies used in education have not been specifically developed for educational purposes. Education, typically, does not drive technology inventions.

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35 Cuneiform scripts is the first known art of writing, used about 5000 years ago in Mesopotamian and is considered to be the predecessor of the Greek writing that is the first known phonetic alphabet (Lundgren & Säljö, 2014).
(Laurillard, 2012, p.2); rather, technologies are mostly developed for military and business purposes (Bates, 2015). Laurillard (2012) notes that one of the most important technologies in human development, namely the ability of writing, was invented for commerce and not for education. The traditional printed book, which has for centuries enabled gaining, storing, transmitting and distributing knowledge, was originally invented for spreading the word of religion and not to educate (Kay, 1972; Laurillard, 2012).

Christensen, Horn and Johnson (2008) add that digital technologies have not been invented with educational purposes in mind. They argue that the modest effect which computers have had on how students learn and teachers teach is due to the ways in which technologies are employed in the schools: “perfectly predictable, perfectly logical – and perfectly wrong” (Christensen, Horn & Johnson, 2008, p.73). Similarly, Bates (2015) states that digital technologies are most often simply added to the schools and the way they already do things. Christensen and colleagues (2008) add that the ways in which technologies are introduced into classrooms only marginally improves the way the teachers teach and the way the school is run, never allowing the schools to fully benefit from the innovations.

What is intriguing is that this issue was already mentioned by Papert and Solomon in their publication, *Twenty Things to do with a Computer*, in 1971. In the publication, they argue that devices and developments from engineering have changed human lives; however, within education, it is reduced to “using bright new gadgets to teach the same old stuff in thinly distinguished version of the same old way” (Papert & Solomon, 1971, p.2). For digital technologies to successfully be implemented, reorganization and restructuring is crucial. However, reorganization and restructuring are costly. Therefore, schools invest in digital technologies that enable minimum organizational challenges, and these do not necessarily have high impact on student learning (Bates, 2015).

The Organisation for Economic Co-operation and Development (OECD) published a report in 2010 stating that investments in digital technologies are being made within educational systems in the belief that schools and teachers will sooner or later adopt and benefit from the use of these digital technologies (OECD, 2010). This in turn depends on appropriate leadership. Teachers are considered to be responsible for creating good learning environments and for leading students’ learning processes, while the municipalities are responsible for the schools and have the responsibility to create environments and processes that support activities of the school as a whole. However, responsibility for provision of the conditions for teachers’

36 A forum where governments work together to address the economic, social and environmental challenges of globalization. Member countries consist of 34 countries all around the world, including the Scandinavian countries. More information can be retrieved from: http://www.oecd.org/about/membersandpartners/ [Accessed: June, 2015]
learning and development rests with school leaders. This requires that pedagogical leadership is clear, including knowledge about and competencies for interpretation of effective teaching as well as leading and directing learning (Skolverket, 2013a).

Ottestad (2013, p.108) further observes the importance of strong connection between school leadership and pedagogical usage of digital technologies in schools. For schools to successfully reform school practices and introduce digital technologies into the schools, Hughes, et al. (2005) emphasize that strong leadership is essential. The schools need leaders who are knowledgeable and experienced in both the potentials and the difficulties of integrating ICT in the Information Age (Hughes, et al., 2005). “School leadership for ICT”, a term used by Ottestad (2013, p.107), addresses the role of school leaders in furthering the adoption of digital technologies in schools. Integration of digital technology into teaching and learning requires both implementation by teachers and also changes in work practice. She further notes that leadership for ICT is crucial to facilitate necessary infrastructure and working environments, in addition to visionary plans for pedagogical usage of digital technologies and associated advancement of digital literacy among students (Ottestad, 2013, p.108).

In a report written by Grönlund (2014), Jensinger, the head of a high school district in the city of Malmö in the south of Sweden, has addressed school leaders’ roles and responsibilities concerning integration and use of digital technologies in the schools. As Jensinger (2014, p.100) summarizes, school leaders need to be active, engaged and constructive in order to be successful. The school leaders need to have an understanding of the possibilities and the difficulties of using digital technologies. At the same time, they need to set an example by adopting and using digital technologies in their daily practice. School leaders also have ultimate responsibility for creating opportunities for enabling use of digital technologies for those willing and for eliminating reasons for those who refuse. However, in municipalities where they put strong limitations on IT use, Jensinger (2014) recognizes that it is impossible for school leaders to be successful adopters and users of digital technologies. When teachers and students, e.g., are not given administrative privileges for their own devices, the freedom, flexibility and creativity of teachers are limited. Then, most often, IT departments will make decisions affecting teachers’ daily practice. In these cases, school leaders lose the ability to create and foster opportunities, resulting in obstacles for further growth. In addition, Jensinger (2014) notes the importance of encouraging cutting edge teachers to execute their ideas, since these teachers given needed freedom can revolutionize schools. Therefore, successful examples of how digital technologies have been used by teachers should be highlighted, signaling that this is what schools aspire to achieve. At the same time, of course, Jensinger (2014) clarifies that this does not imply that technology savvy teachers are better than others. Rather, all people have unique and valuable skills. In-
service training is mentioned as important as well as participating in conferences, events, etc. Jensinger (2014) notes that school leaders run the schools, take tough decisions, set budget priorities and establish time plans, etc., which is part of their daily practice. However, in order to successfully implement digital technologies in their schools, decisions and prioritizations need to incentivize use of digital technologies in everyday practice. Jensinger stresses the importance of the schools to be drivers and guides for digital technology solutions in everyday education. He states, IT in schools cannot become a technology issue; it has to be a pedagogical issue (Jensinger, 2014, p.105).

Also, in Britain, a report by the British Educational Suppliers Association, (BESA, 2015) emphasizes that decision making authority should be given to the schools, providing schools with a real opportunity to create their own visions and allocate their budgets to achieve those aspirations. The collective experience summarized in the report, based on ICT use in British schools between 1991-2014, argues for supporting schools by telling them “here is the money and this is what we want you to achieve and this is how we will measure it and you decide how to spend it” (BESA, 2015, p.12).

In Norway, Ottestad (2013) reports that pedagogical use of technologies in Norwegian schools is addressed in the national curriculum. The document provides leaders with mandates to promote and integrate technology usage into teaching practices. However, she also mentions the lack of clarity in how this is to be done and that schools are entirely free to apply the curriculum as seen fit. This independence, according to Ottestad (2013), shows that school leaders and teachers interpret the instructions more narrowly than the policymakers intended them to be interpreted and applied. Investigating whether school leaders follow the Norwegian curriculum and how this is being implemented in pedagogical practice, Ottestad (2013) found correlations between the attitude and behavior of the school leader regarding use of digital technologies in the school and the attitude and behavior of the teachers regarding use of digital technologies. It follows that the perspectives of school leaders on pedagogical and technical infrastructure and support influence their leadership and vision for pedagogical use of technologies. These factors in turn become crucial for development and encouragement of teachers’ pedagogical practice using digital technologies (Ottestad, 2013).

Similarly, the Swedish School Act 2010:800, Chapter 2, §9 also states that the pedagogical work at a school institution should be led and coordinated by the school leader. The School Act 2010:800 addresses the access and use of technology in students’ education (SFS, 2010:800, Chapter 10, §10). However, as stated in several national Swedish reports, including the Swedish National IT policy, there is a lack of understanding and agreement on how these instructions are to be applied. The teachers and the leaders within the schools are responsible for use of tools for contemporary education, and the municipalities have the overall responsibility for issues concerning ICT in the
school area. However, the teachers and those responsible for the schools decide themselves how to apply the instructions, ranging from choices about teaching and learning tools to how to use these selected tools (Näringsdepartementet, 2011a; b).

As stated by several authors (OECD, 2010; Skolverket, 2013b) and also Christensen, Horn and Johnson (2008), most individual teachers but also school administrators have strong ambitions to improve their technology use and technology-enhanced pedagogies. However, as further mentioned by Christensen, Horn and Johnson (2008) and also expressed by Thullberg and Szekley (2009), there is a need for a strategy in order to understand the possibilities and restrictions with digital technologies and how to increase impact. Thullberg and Szekley (2009) further argue for a long-term plan for how digital technologies can be integrated in daily pedagogy and work.

Digital technology reforms within schools have also been addressed and widely discussed by Cuban (e.g. Cuban 1993; Cuban, 2001; Cuban, 2006; Cuban, 2013; Cuban & Jandrić, 2015). Cuban (1993; 2001) observes there are three goals for introducing and purchasing digital technologies in schools. The first driver is to make schools more efficient and attain higher productivity in teaching and learning. The ability to teach more in a shorter period of time, and to do so with a lower cost, has been a constant goal for the education and schooling systems, and can be traced back for decades. The second driver is children’s self-directed learning as well as arguments by academics, educators and foundation officials that teaching should be transformed so that learning becomes more actively engaged with and connected to real life. The third driver is the fear that students will be unprepared to compete in the job market and unable to adjust to changing demands from the work environment. Relatedly, this driver reflects the belief that individuals with high technology skills will strengthen the national economy. In other words, computers are considered to be the future so students need to be prepared to use them (Cuban, 1993). Cuban (2001) further argues that digital technologies are purchased and wired in classrooms with the belief that those digital technologies will be used if digital technologies exist in the classrooms. Buying and providing digital technologies has always been an administrative decision while the use of digital technologies has always been a teacher decision (Cuban 2006).

Cuban (2006) further states that technology reformers far-away-from-the-classroom, most of whom are public officials, corporate leaders, and other non-educators, have a deep belief in the power of technology to transform schools. Given teachers’ slow uptake and use of digital technologies, these technology reformers are rarely happy with the pace of the change or the ways in which teachers in the classrooms use digital technologies; and the blame is placed on the teachers. Critics say that teachers lack access, knowledge, and skills to use technologies properly. The technology reformers ignore that teachers have to handle 30 students a day, maintaining order while creating
personal relationships with each one of them. They must also present academic content and further academic skills while nurturing and encouraging deep knowledge for each student. In addition, they must socialize students to the values of the school educational community while also nurturing and encouraging students’ independent thought. Despite these demands on teacher accountability, as stated above, the blame for low technology uptake in the classroom is placed on teachers (Cuban, 2006). Cuban (2006) argues that as long as teachers are blamed for not using the digital technology as intended by technology reformers, the solution to digitalize schools is oversimplified. As further continued by Cuban, technology reform in schools will remain a struggle as long as out-of-the-classroom technology reformers believe that it is enough to provide teachers with sufficient hardware and software technology, technical assistance using the devices, and preparation programs.

Cuban (2006) notes technology reformers and other influential non-educators frame the problems and the solutions for adopting and integrating digital technologies based their understanding from their access to media. On the other hand, teachers are still not being heard. They have basically been voiceless in this reform initiative.

Like the policymakers, administrators and technology reformers, teachers are very concerned about efficiency. However, the teachers understanding and criteria for efficiency is based on their prior classroom experiences. If the technology reformers frame the problems and determine efficiencies based on non-classroom criteria, rather than teachers formulating these criteria, it will require teachers to achieve conflicting goals (Cuban, 2006). When faced with conflicting goals, teachers will choose what technologies and tools to use (Cuban, 2006) according to their own criteria. As long as politicians, business leaders, academics, administrators and other reformists are determined to solve the problem of digitalization of schools, there will be unanticipated consequences (Cuban, 2001).

According to a later publication by Cuban (2013), the ways of teaching have changed over the past decades. However, not many major changes can be identified within pedagogy, that is the how (Cuban, 2013). Although it is possible to see hybrids of teacher-centered and student-centered classroom practices, much of the how is based on basic instructional practices such as lectures, full-class activities, recitations, homework, black-/whiteboards and paper-and-pencil texts. Technology reformers have assumed that structural changes would alter the current dominant practice. The main strategy to improve classroom teaching and student learning has been to change the teachers to adopt intellectual ambitious, inquiry-driven, skill-rich forms of teaching. Changing the teachers to integrate these “better ways” of teaching is assumed to lead to richer and more effective learning for the students (Cuban, 2013, p.113).

Cuban (2013) presents three fundamental errors in the thinking of these technology reformers: first, the belief that redesigning, replacing and
renovating the key structures of school governance, organization and curriculum will dramatically change the teachers’ instruction and hence the students’ learning. The second error is that schools and classrooms are considered complicated and not complex. According to Cuban (2013), there is a difference\(^{27}\): complicated can be seen as structures that can be broken down and engineered while complex is dynamic, messy and multi-level. The third and final error among these technology reformers is that they think that their worldview is the same as the teachers’, while the reality is that the technology reformers have only a vague idea and limited insight into what teachers think and even less insight into the everyday classroom practice. By way of illustration, Cuban (2013) notes that school board members have all been students and observed teachers during their own education while not many of them have taught in school classrooms, so there is a gap in their first-hand insight and knowledge of the daily practice. Teachers and technology reformers live in separate worlds where there is a dramatic difference in experiences, values and incentives.

Technology reformers, according to Cuban (2013), rarely anticipate the critical and practical questions that teachers have, questions that reveal teachers’ ideas and actions for achieving good and successful learning, as well as meaningful relationships with students. The technology reformers seek specific and concrete solutions to the problems in classrooms, while teachers’ incentives are founded in internal values, such as furthering students’ learning and serving the society, rather than external rewards. Neglecting and/or ignoring teachers’ perspectives, with the intention to transform how teachers teach, will cause credibility problems for policymakers and discourage teachers from supporting their reforms. Cuban (2013) concludes that without the teachers’ support of reform driven policies, few changes will occur in daily practice.

From a learning perspective, the existing technologies and software today allow for and accommodate different pathways and paces of learning where students can choose different approaches and find ways to learn different subjects that is consistent with their style of learning or type of intelligence (Christensen, Horn & Johnson, 2008). Different technologies can be used to individualize learning so students can learn in different ways and reach different learning outcomes (Bates, 2015). Despite the benefits, it is still important to have in mind that not all students find experiences in dealing with technology to be rewarding, and the differences can include variations in gender, socioeconomic class and cultural communities (Gibson, 2001, p.38). Gibson (2001) argues that issues of diversity and individuality that apply to everyday learning situations also apply to adopting digital technologies in learning environments.

\(^{27}\) The difference between complicated and complex has also been addressed by Cuban in a blog post in 2010. See detailed description in Chapter 1.2.2.
According to Säljö (2014a), if we could solve the puzzle of how learning happens, perhaps our living standards would increase and humans could reach maximum happiness. However, he further acknowledges that the riddles of how humans learn and how the human intellect is developed and how manual human skills are advanced will never be fully understood. Neither will there ever be a final technical solution for teaching methods, nor a final digital technology that could automate these processes. Human learning can never be reduced to one single technique or method. Säljö (2014a) states that even the most powerful technology will not be able to solve the problem of learning; it will only change its conditions (Säljö, 2014a, p.12). Grönlund (2014) argues for an extension of that reasoning, saying that technology is not here just to enhance existing ways of working but also to change them (Grönlund, 2014, p.83). In order to teach well in a digital age, Bates (2015) argues, understanding the nature and role of technology in education, including being able to use technology appropriately, is critical. However, identifying appropriate use of technology is a highly complex challenge. Griffin (2003) states the primary motivation to use and integrate digital technologies into education should always be to enhance students’ learning. In line with Bates (2015), Griffin (2003) also states that it is difficult to determine what technology is most appropriate and more effective as a teaching tool (Griffin, 2003). As mentioned by Mishra and Koehler (2008), the selection of technologies is not only based on the course design but also influenced by the subject knowledge area and its requirements as well as the teachers’ beliefs and values about their roles as teachers, and their assumptions about teaching and learning (Tondeur, et al., 2008; Geerstema, 2014; Bates, 2015; Ertmer & Ottenbreit-Leftwich, 2010). Furthermore, Bates states that a lot of teachers’ emotions also influence and affect selection of the digital and non-digital technology (Bates, 2015, p.305).

From initially being seduced by computers, the educational systems have gained a more pragmatic understanding of ways which digital technologies can serve education, rather than the other way around (BESA, 2015). When considering digital technologies, as Bates (2015) argues, the technologies are merely tools that can be applied and used in various ways. Consequently, when judging the value of certain technologies, thoughtful consideration must be given to the ways in which technology could be used or is being used (Bates, 2015).
4.3 Integration of Technology in Swedish Educational Practices

This section presents a brief historical overview of projects and initiatives for integrating digital technologies into Swedish educational practices. While a number of larger projects and initiatives are discussed, all previous efforts are not included.

Among the first efforts to integrate and include digital technologies in the Swedish schools was the project Computer in the School, DIS38, carried out in 1974. The project was promoted by the National Board of Education and included 450 teachers and 8000 students. The focus of the project included three different areas: (1) education about computers, (2) efforts to modernize education by technical resources, and (3) the computer as a learning tool, in other words, computer aided education. The project resulted in computer science becoming a mandatory subject in upper-secondary-school and the initial years of high school (SÖ, 1980 cited in Fleischer, 2013; Tallvid, 2015).

In the 1980’s, the National Curriculum Lgr80 was introduced and computer science became an integrated subject in mathematics and social science subjects (Lgr80, 1980). A shift in focus occurred and knowledge about the function and construction of computers and technologies was elevated in importance. It was further considered important that the students found, used and exchanged information. They were also expected to gain an understanding of and develop critical thinking about consequences of technology, on both an individual level and also on a societal level (Regeringen, 1980; Karlsohn, 2009). Fleischer (2013) refers to Lgr80, describing digital efforts in mathematics and social sciences as promoting technology as an area of application for interested teachers while, for teachers in other subjects, technology appeared abstract and mythical (Fleisher, 2013, p. 15). At about the same time, the availability of personal computers for the general public increased as a result of decreasing prices of microprocessors. This resulted in schools also having the ability to invest in computers and thereby the number of computers in schools increased significantly (Karlsohn, 2009). Tallvid (2015) describes how the government invested large amounts of money, and municipalities also invested significant funding during that time period while grants for traditional textbooks decreased. It was also during this period of time that the concept of computers in the schools was replaced with the concept of information technology (IT) indicating a shift from knowledge about computers to a focus on use and management of information (Tallvid, 2015, p.28). Throughout the 1980’s, several projects and action plans were initiated and advanced in response to directives from the national government. One of these was the larger project, Computer and the School (DOS39),

38 Datorn i skolan.
39 Datorn och skolan.
carried out between 1988 and 1991. The project focused mainly on software and technology usage as pedagogical support, rather than focusing on hardware, which had been the main focus of previous efforts (Karlsohn, 2009; Hylén, 2011; Fleischer, 2013; Tallvid, 2015).

The next stage of integration and adoption of digital technologies in Swedish educational practices came during the 1990s when, according to Fleisher (2013) and Tallvid (2015), several significant changes occurred. When the new curriculum, Lpo94, came into effect, IT as its own subject in the curriculum had disappeared and instead became integrated into some but not all subjects. For instance, IT was not taught in subjects within the natural sciences (Fleisher, 2013). An additional significant change was the creation of The Knowledge Foundation (KK-stiftelsen). The Foundation contributed billions of Swedish kronor for the development of IT as pedagogic aids in schools. Throughout the years, The Knowledge Foundation contributed and invested in several projects addressing this issue (Hylén, 2011; Fleisher, 2013; Tallvid, 2015). At the end of the 1990’s, two larger projects were conducted and financed by The Knowledge Foundation. One of these was the IT in the School (ITiS) project conducted between 1999 and 2002 (Chaib, Chaib & Ludvigsson, 2004; Skolverket, 2016b). The project mainly led to increasing the IT-competencies among teachers in Sweden and enabling the development of pedagogical perspectives on IT in the classroom. As a result, teachers reported IT was now used more and differently than before (Chaib, Chaib & Ludvigsson, 2004). However, some criticism about the ITiS project noted vague objectives. Others observed that oftentimes the focus was not on IT as a pedagogical tool. The experienced teachers working with IT put higher demands on differentiating the educational practices resulting in them having less control of the class. However, the teacher could not be certain if the perceived changes in their practice was due to the ITiS project or if they would have reach that point eventually (Chaib, Chaib & Ludvigsson, 2004).

Between the years 2006 and 2013, a national effort was again conducted, the Practical IT- and media competency project (PIM). According to the National Agency for Education (Skolverket, 2016b), the project reached out to the majority of the Swedish teaching staff, providing support for improved use of information technology in the schools (Skolverket, 2016b). The assessment of the in-service training was based on five levels and the training was provided as free for all teachers. PIM addressed how various software and applications could be used in practice in the schools (Hylén, 2011).

As Tallvid (2015) states, the 21st century brought an uptake in technology use in schools. Due to even more decreased prices, higher performance and faster wireless internet connections, a majority of Swedish schools invested in a

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40 Kunskap och Kompetensutvecklingsstiftelsen.
41 IT i skolan.
42 Praktisk IT- och mediekompetens.
one-to-one computing initiative (1:1). Tallvid (2015) argues that since most of the implementation challenges for IT-technologies were known by then, several schools initiated the 1:1-initiative with a higher focus on pedagogical issues. The 1:1-initiatives were mainly initiated by single municipalities and departments of education rather than from a national level, and, further, no national strategy for IT in education was provided. The more recent developments in integration of technology into Swedish educational practices are more differentiated, where focus is based on pedagogical discussions and what is considered to be more beneficial to support the students’ learning, rather than what brands and types of technology to invest in (Tallvid, 2015). Having passed the first decade of the 21st century, most schools in Sweden were equipped with various digital technologies. The current national curriculum for the compulsory school system, the preschool class and the leisure-time (Lgr11) center was adopted in 2011. The ‘Overall goals and guidelines’, under the section Knowledge, Lgr11, establishes these technology goals:

The school is responsible for ensuring that each pupil on completing compulsory school: [...] can use modern technology as a tool in the search for knowledge, communication, creativity and learning. (Skolverket, 2011a, pp.13-14)

In that same spirit, the latest Swedish School Act, 2010:800, states that every child should have access to learning tools, including books, for an up-to-date education without any costs (SFS, 2010:800, Chapter 10; §10).

Despite such political and governmental steering documents as well as recent investments in digital technologies, a report from the National Agency for Education and the School Inspectorate states that digital technologies are oftentimes not used. In addition, when used, digital technology usage is typically very limited, with considerable variation depending on grade as well as subject matter (Thullberg & Millstam 2010; Skolinspektionen, 2012; Skolverket, 2013b). The report also states that, generally, digital technologies in schools are rarely used as supporting tools for pedagogical work but rather more commonly used for administrative tasks (Thullberg & Millstam 2010; Skolinspektionen, 2012; Skolverket, 2013b).

At the current time, the Unos Uno project is the latest and largest digitalization initiative in Swedish schools. The project was carried out during 2010-2013 and included 23 compulsory and high schools with approximately 11 000 students and 900 teachers from 10 different municipalities across Sweden. The project focused on schools that have fully or to some extent invested in one-to-one computer initiatives (1:1), that is one computer per student. Furthermore, the aim of the project was to study and analyze the effects of the realization of 1:1, focusing on students’ development and learning, the role and mode of work of pedagogues, and the leading and steering of school management, as well as the relationship between the school and the home (Grönlund, 2014). The Unos Uno project resulted in five areas
of further development. The first area of development refers to the teachers’ digital literacy; that is teachers’ ability to effectively and constructively use information and digital resources as well as embrace the methods where the technology can be used in the best way. The second development area recognizes the need of a resource center for each school for collaboratively sharing pedagogical resources. The third area emphasizes a uniform learning environment, or learning platform, considering the needs of the schools in requirement collection, implementation and management. The fourth area of development concerns the economic system. Digital technologies should not be used as replacement for teachers but rather as enhancements of education. The final area relates to school leaders’ ability to develop and improve their organization. To do this, the school leaders need to take responsibility by actively and substantially carrying out and fulfilling enabling changes (Grönlund, 2014). In conclusion, the report states that schools have now passed the 1:1-period and must now engage in more extensive reforms and change processes. The report assigns the municipalities with responsibility and leadership for the changes needed in the educational systems in order to decrease differences and reach equity among Swedish schools (Grönlund, 2014).

The latest development of digitalization strategy in of the Swedish schools is a governmental commission given to the National Agency of Education. In September 2015, the Agency was asked to recommend a national IT strategy for the educational systems (Utbildningsdepartementet, 2015). Further, in December 2015 the Swedish Digital Commission suggested a revision of the national steering documents. The proposed revisions are suggested to include digital competence as a basic skill on curricular and syllabi levels, and increase teachers’ and school leaders’ digital skills and competencies via national investments and coordinated efforts. The report also notes that increased digital knowledge with a focus on the pedagogical effects of use of digital resources in education and teaching are desired in Swedish schools (Digitaliseringskommissionen, 2015).

In March 2016, the National Agency of Education report on a suggested national IT-strategy was published (Skolverket, 2016b). The report suggests changes in the national steering documents, to be made effective before the end of June 2016. The report also offers a vision for year 2022, including two points: (1) all children and students should have adequate digital competencies, and (2) the education system should take advantage of the possibilities brought by digitalization in order to achieve improved results and increase organizational effectiveness. Eleven points are stated as part of the strategy, including: steering documents clarifying the mission; school leaders’ leadership; competencies among personnel; equable access and availability of digital equipment; infrastructure as well as technical and pedagogical support

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43 Ministry of Education and Research.
at each school unit; and resources and working situations. The consequences of the strategy are believed to better equip the education system for continued digitalization development, and thereby enable possibilities for modern education with good results. However, the report also acknowledges the need for a higher level of ambition in terms of enabling equity for all children and students in the country (Skolverket, 2016b).

4.4 Teachers and Technology

Teaching is not a theoretical science that describes and explains some aspects of the natural or social world. It is closer to the kind of science [...] who’s imperative is to make the world a better place. (Laurillard, 2012, p.1)

Teachers are needed for students to learn, now as before (Grönlund, 2014). Teachers are traditionally seen as telling students what to learn, motivating students to learn and then reviewing with them what they have been taught and what they have learned. The teachers have always been “the founder of all wisdom”, and those who have mediated the knowledge to youngsters (Jarvis, 2006, p.13). However, teaching is changing. Education is constantly seeking to respond to market demands and to shift with the ever changing cultural and technological environment. The globalizing forces of societal change are also influencing changes in teaching (Jarvis, 2006; Laurillard, 2012). Laurillard (2012) argues that teachers, like other professionals such as architects, engineers, and programmers, have to improve their outcomes by working creatively and employing evidence. Teachers are therefore faced with playing new roles requiring more and different skills (Jarvis, 2006). As stated by Mishra and Koehler (2006), teaching is a complex activity that draws on several kinds of knowledge. They consider teaching to be “a complex cognitive skill occurring in an ill-structured, dynamic environment” (Mishra & Koehler, 2006, p.1020).

Due to the wide access and use of digital technologies outside and inside school settings, the roles and relationships of the teachers are changing in the classroom. Jenkins argues that when new technologies are introduced, the relationship between the teacher and the learner and their relationship with traditional tools, such as pencils, pens, chalkboards, blackboard, etc., is changed (Jenkins, 2009). As Gibson (2001, p.40) states, the teacher has to become “the ‘guide on the side’ and not the ‘sage on the stage’”, which has now become commonly known (Gibson, 2001). Gibson further argues that regardless of whether the influences and effects of the changes outside the classroom are embraced by the teachers or not, this new complex educational context is guaranteed to change further (Gibson, 2001).
Using the Rich Picture technique\textsuperscript{44}, Salavati (2013) illustrated the complex situation of teachers’ use of digital technologies (see Figure 4.1\textsuperscript{45}). The figure is in line with a number of arguments within this chapter but refers also to additional issues\textsuperscript{46}. For instance, in Figure 4.1, the policies and directives from the authorities are illustrated at the right side. The School Act and National Curriculum (Lgr11) are two of those steering documents and directives addressing the role of digital technologies in education\textsuperscript{47} which the teachers have to follow. The figure also illustrates the lack of digital technology enhanced pedagogical strategies and the need of IT-support when using digital technologies (Salavati, 2013).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure41.png}
\caption{The Teachers’ Picture}
\end{figure}

On the left side of the figure, challenges of lack of time, in-service training and education, as well as need of new pedagogical models are illustrated. Challenges in terms of large class-sizes are illustrated in the bottom-left part of the figure. The top of the figure illustrates evolution of society moving towards a more knowledge and digitalized society, influencing the teachers and their profession. Further, teachers are influenced and affected by external factors such as their own families, their own experiences of being students and their own teachers. The group of teachers illustrated in the middle of the figure

\textsuperscript{44} See detailed description of the technique in Chapter 6.4.2.
\textsuperscript{45} For a larger version of the picture, see Appendix B.
\textsuperscript{46} A number of these issues will be presented and discussed in section 4.5.
\textsuperscript{47} These have been mentioned in the previous section. See section 4.2.
indicates different types of teachers: enthusiasts, reluctant (not accepting) and indifferent (going with the flow without saying much) (Salavati, 2013).

Teachers and their use of digital technologies have also been addressed by several reports outside of the academic field. The Swedish School Inspectorate (Skolinspektionen, 2011; Skolinspektionen, 2012) reported on various attitudes towards digital technologies in schools among teachers. The Swedish National IT-policy argues for the importance of teachers’ understanding, as well as having expertise in use of digital technologies, gaining new opportunities in relation to students, communication with the parents, as well as conducting the rest of their everyday work (Näringsdepartementet, 2011a; b). From a broader perspective, the Organisation for Economic Co-operation Development (OECD) published a report in 2010 with results indicating that many teachers in the member countries are aware of benefits that digital technologies can bring to educational settings. The report presents three challenges to explain why teachers have not yet adopted digital technologies, arguing the reason not to be limited access to technology or lack of basic technical skills. Rather, the three challenges that limit teachers’ adoption and use of digital technologies, according to OECD, are, first, that their knowledgebase shows a poor connection between pedagogy and practice when involving technology in education. Secondly, teacher education programs fail to provide hands-on knowledge of technology-enhanced pedagogics, and therefore fail to give prospective teachers the qualifications and requirements needed to use digital technologies in the classrooms. Lastly, a paucity of incentives for the importance of collective or individual effort which enables pedagogical change (OECD, 2010, p.17). In concluding, the report notes that teachers need resources and time in order to explore applications for digital technologies and to analyze their experiences to thereby decide how these technologies can best help them to teach and their students to learn (BESA, 2015).

As described in the beginning of the previous section (4.2), teachers have used technologies during all times: traditional technologies until recently, and now traditional technologies in combination with digital technologies (Laurillard, 2012; Bates, 2015). Peck and Dorricott (1994) contribute an interesting line of argument close to the argument by Grönlund (2014) in the beginning of this chapter, noting that teachers will still be needed. The authors state a number of strengths that teachers possess which cannot be achieved using only digital technologies. The strengths include strong and productive relationships with students, ability to motivate students to enjoy learning, and ability to identify and meet the students’ emotional needs (Peck & Dorricott, 1994). The authors do not dismiss digital technologies; rather, they argue that technologies should free teachers and enable them to carry out important work that requires human interaction, evaluation, and improvement of learning.

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48 Further elaborated in section 4.5.
environments (Peck & Dorricott, 1994, p.13). However, the authors note, digital technologies, in contrast to their use in the business world, have increased rather than decreased the teachers’ workloads (Peck & Dorricott, 1994).

Gibson (2001, p.40), in his investigation of the forms of learning and teaching most favorable to using digital technologies, describes digital technology supported learning environments that influence and affect teachers is a number of ways. The teachers

- expect more from their students and believe the students to understand more difficult concepts
- can meet the needs of individual students more effectively
- are more student-centered in their teaching
- present more complex material and are willing to experiment
- are open to multiple perspectives on problems
- feel more professional since they help their students to learn rather than distribute and transmit knowledge

On a further note, Gibson (2001) argues that teachers need to consider the impact that use of digital technologies has on their beliefs and philosophies of how to best teach. Using digital technologies with its full potential, may, according to Gibson (2001), lead teachers who in majority apply a variation of traditional pedagogy in their practice, to question their beliefs.

Concerning adoption of technologies by teachers, a research conducted by Gaffney (2010, p.1) shows teachers’ adoption of technologies to be a “multi-faceted undertaking”. Based on extensive literature review and meta-analysis in Australian schools, Gaffney (2010) developed a model for explaining adoption of technologies by teachers (see Figure 4.2). The model consists of two dimensions: (1) the type of factors associated with teachers’ use of technologies, and, (2) the characteristics of various stakeholders, as well as the nature of digital resources including supporting technologies. The factors have been further divided into four themes: contextual factors, general change factors, innovative-specific factors, and systemic factors.
Gaffney (2010) draws upon several scholars and research efforts addressing the complex decision-process for teachers’ considerations in adopting technological innovations. Gaffney’s (2010) study shows that teachers’ decisions are influenced by their personality, experiences, professional knowledge, relationships and specific contexts (as also mentioned by several other authors, e.g., Mishra & Koehler, 2006; Hamilton, Rosenberg & Akcaoglu, 2016). Like these other scholars, Gaffney (2010) argues, if a digital technology is not aligned with teachers’ preferences or orientation, the technology is unlikely used. The digital technology also needs to support a school’s desired teaching and learning culture.

Referring to Rogers (1962) diffusion of innovation model, Gaffney (2010) states the digital technology should be simple and that it should be compatible with existing methods and techniques at the school. Advantages of the digital technology in comparison with established methods and techniques should be clear and obvious. Additionally, availability, suitability and costs will influence teachers’ up-take of digital technologies, as well as how the technology works with their current practice. Accessible and reliable supporting technologies accompanied with technical expertise and timely technical support are, according to Gaffney (2010), important elements which influence teachers’
adoption and use of digital technologies in suitable and effective ways. When these conditions are present, Gaffney (2010) argues that a teacher will use digital technology when given time to become comfortable and confident with the technology. This is especially so when appropriate in-service training and professional development, technical support and organizational arrangements serve to create a culture that promotes use of technology.

In addition to teachers, political efforts, school culture and school leadership are highlighted by Gaffney (2010). In terms of political efforts, Gaffney (2010) claims that balanced and appropriate pressure and support by governments and educational authorities are necessary for change to occur. Coordinated leadership between educational authorities and local schools, as well as adequate finance and suitable infrastructure, also significantly influence teachers’ adoption of digital technologies. Within schools, effective strategic leadership necessarily includes coordination of promotion efforts within the larger school culture, which recognize both the benefits and complexity brought about by digital technologies (Gaffney, 2010).

The model (see Figure 4.2) has been summarized by Gaffney (2010, p.1 and p.21) in eight principles:

- relevance of the digital curriculum resources
- appropriateness of the technological tools to deliver them
- capability of teachers to use them
- motivation and interest of students to learn with them
- culture of schools to institutionalize their use
- political will and capacity of governments and educational authorities to develop policy to promote and monitor their use
- importance of education systems developing awareness and shared understanding about the value of digital content
- means by which the actions of governments, education authorities, schools, teachers and students are aligned and integrated through the implementation process to increase teachers use of such resources for the benefit of students.

These eight principles succinctly describe the complexity of teachers’ everyday practice integrating digital technologies.

Gaffney (2010) cites Bore and Wright (2009), as well as Borko, Whitcomb and Liston (2009), claiming educational research to be naïve in believing that teachers’ higher adoption and use of technology can be gained by the right combination of in-service training, technology access and opportunities for “reflective practice” (p.8). Rather, teachers’ situation is far more complex. Teaching and learning using new digital technologies can be described as a “wicked problem” (p.8) which includes large numbers of complex, dynamic, contextually, interdependent variables. Teachers’ capability in adopting and using digital technologies comprises both an intrinsic dimension, which
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includes understanding and appreciating teachers’ world and the multi-dimensional nature of their work, as well as an extrinsic dimension, focusing on the external influences on the teachers (Gaffney, 2010).

Ertmer and Ottenbreit-Leftwich (2010, p.255) discuss teachers and digital technology in terms of “teacher technology change”. Their discussion builds on extensive literature related to teacher change and technology integration. The authors argue that when teachers are asked to use digital technologies, some changes are required. Even if teachers believe the technology will help them to perform tasks more efficiently, they can be reluctant to integrate the technology in their classrooms for a variety of reasons. These reasons include lack of relevant knowledge, low self-efficacy, existing belief systems and constraining context, which acts to limit individual efforts. Based on these reasons, Ertmer and Ottenbreit-Leftwich (2010) found four key variables of teacher change: knowledge, self-efficacy, pedagogical beliefs, and subject and school culture.

Teachers’ knowledge, according to Ertmer and Ottenbreit-Leftwich (2010), has a significant impact on their decisions. Citing Barko and Putnamn (1995), they argue that teachers need to increase and elaborate their knowledge systems to change their practice (Ertmer & Ottenbreit-Leftwich, 2010, p.258). Teachers’ knowledge includes knowledge of the subject, and knowledge of teaching methods and classroom management, as well as an integration of these dimensions of practice. In addition, teachers must have knowledge of how specific content should be taught to specific learners within specific contexts (referring to the work of Shulman, 1986). However, as also stated by, e.g., Mishra and Koehler (2006), Ertmer and Ottenbreit-Leftwich (2010) mention that teachers need additional knowledge, building from and intersecting with that previous knowledge, in order to use digital technologies. To effectively integrate technology, the interaction of pedagogy, content and technology all need to be considered⁴⁹. Having knowledge on how to use the technology hardware and software is not sufficient for effective teaching. Teachers need to also have knowledge about the specific affordances of each tool so that, when used to teach specific content, technology can achieve meaningful outcomes for the students. Further, Ertmer and Ottenbreit-Leftwich argue that the teachers need additional knowledge about the content they teach as well as knowledge of pedagogical methods for facilitating student learning, and specific ways in which digital technologies can support those methods.

However, Ertmer and Ottenbreit-Leftwich (2010) acknowledge the challenges for teachers learning about technology. The authors represent this learning as like asking teachers to hit a moving target (p.250), since the technology is always in a state of flux. As a result, teachers will never be able to

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⁴⁹ See further elaboration in section 4.6.1 addressing the TPACK framework.
have “complete” knowledge about the digital technology and the teachers will be constant novices in the technology integration process.

The second key variable is self-efficacy. Based on a quantitative study by Wozney, Venkatesg and Abrami (2006), Ertmer and Ottenbreit-Leftwich (2010) note that one of the two major predictors of teachers’ use of technology was their feeling of confidence that they could use digital technology to achieve instructional goals. Even if teachers would have the knowledge necessary to use the digital technology, they still need the confidence to use that knowledge in their teaching to the benefit of the students. Time and effort needs to be devoted to increasing teachers’ confidence to use digital technologies, not only to perform administrative and communicative tasks, but also to achieve student learning objectives.

Pedagogical beliefs are the third key variable to teacher change (Ertmer & Ottenbreit-Leftwich, 2010). Ertmer and Ottenbreit-Leftwich describe teachers’ beliefs as including an uncountable number of beliefs interacting, intersecting and overlapping, and these influence how teachers perform in the classrooms, in this case using the digital technologies. The implications of teachers’ beliefs on how they act has also been mentioned by several other authors (e.g., Tondeur, et al., 2008; Bates, 2015, see section 4.1.2 for more references and further reading). In addition to pedagogical beliefs, Ertmer and Ottenbreit-Leftwich also observe value beliefs. Value beliefs place perceived importance on certain goals and choices. In terms of technologies, teachers’ value beliefs inform whether they think technology can support their achievement of the educational goals which they believe to be most important. According to Ertmer and Ottenbreit-Leftwich (2010), teachers tend to use approaches and technologies they judge to be more valuable, especially when considering digital technologies. Therefore, teachers need to learn how the technology can be used within their specific content areas and or grade levels.

In addition to teachers’ belief, confidence and knowledge, the contexts in which the teachers work also influence their uptake of technologies. For instance, Ertmer and Ottenbreit-Leftwich (2010) note the strong influence of teaching subject and school culture on teachers’ beliefs. Lacking this, few teachers that have necessary knowledge, confidence and beliefs can use the digital technology in their classrooms in meaningful ways. The majority of teachers need a strong school culture that defines effective teaching to include technologies as an important part for facilitating student learning in their assigned subject.

Ertmer & Ottenbreit-Leftwich (2010) acknowledge that each school, and each teacher team within a school, has a set of norms guiding their behavior and practice. These norms include everything from values and goals promoted, to instructional methods preferred and further to which tools or resources that are acceptable to use. Additionally, they also note that peer pressure has impact on teachers’ use of digital technologies. Peer pressure can both have negative impact on, for instance, newer teachers that have their own
struggles in terms of use of digital technologies, but could also have a positive impact motivating teachers, especially if positive results can be observed. Teachers’ knowledge and beliefs interact with the culture existing, which shapes the action performed by the teacher.

Ertmer and Ottenbreit-Leftwich (2010) argue some teacher might have knowledge and beliefs based on previous experiences, however, a majority of these teachers do not understand how to translate these into practices. Ertmer and Ottenbreit-Leftwich argue it is critically important for teachers to believe in their own abilities to implement changes within their school and subject cultures. Teachers further need help to understand how students can learn specific content and how specific practices can be supported using digital technology. For in-service, practicing teachers need to consider a multitude of variables when integrating new innovation, such as digital technologies, in their classrooms.

4.5 Teachers’ Use and Perception of Ubiquitous Technology

According to two reports from the Swedish School Inspectorate (Skolinspektionen, 2011; 2012) significant variation exists in teachers’ attitudes toward IT in schools. Some teachers have a more enthusiastic viewpoint towards use of digital technologies, while others are more skeptical about the benefits of the technology. Additionally, these latter teachers express concerns about the technical problems and the time they need to invest in digital technologies. About 40 percent of the teachers included in the reports believed the opportunities afforded by IT enable adapting teaching to the different needs of students as well as increase motivation and stimulate learning processes. A number of teachers also believed using IT would increase students’ problem-solving abilities (Skolinspektionen, 2011; 2012). Among the limitations mentioned by teachers are the challenges of using digital technologies without IT-pedagogical support. The National Agency for Education (Skolverket, 2013b) report describes associated high desire for in-service training for updating IT-related competencies.

In a recent report from 2016, new trends in training and competence development needs are expressed (Skolverket, 2016b). Significantly, teachers ask for in-service training in how to benefit from IT as pedagogical tools, rather than training in basic knowledge on IT use (Skolverket, 2013b; Skolverket, 2016b). For instance, teachers have expressed interest in learning how to handle violence online and how to use the internet safely. They also requested further knowledge about current laws and regulations (Skolverket, 2016b).

Teachers’ use of digital technologies is mainly affected by need of IT-support and pedagogical IT-support (Skolverket, 2016b). As reported by the
National Agency for Education, almost all Swedish schools have access to technical IT-support; however, it is not considered sufficient by the teachers. About 40 percent of all teachers surveyed argue that malfunctioning equipment and problematic issues when using digital technologies limit their roles as teachers, both in terms of teaching and education, but also in other aspects of their work. Salavati (2013) also found that teachers expressed the need for technical support and functioning technology.

In addition, in Salavati (2013), teachers expressed need of and wish for in-service training as well as increased competencies in use of digital technologies. Her study, based on Venkatesh, et al. (2003) Unified Theory of Acceptance and Use of Technology, UTAUT, and Venkatesh, Thong and Xu, (2012) UTAUT2, showed teachers believed that with proper in-service training, they could more easily use digital technology. Then they could switch their focus from finding ways to adopt technology to, instead, using digital technology to enhance the learning of the students. Salavati (2013) and Straub (2009) argue that although the UTAUT models are quite comprehensive and include valuable information, there are limitations to the models. Straub (2009) argues that the model is incomplete in covering the complexity of educational settings and other influences, such as the influence of technology on the relationship between teachers and students. Straub (2009) further argues that the original model does not measure acceptance completely since the users ultimately do not have any choice besides accepting the technology. Salavati (2013) found six of the constructs and one moderator presented by Venkatesh, et al. (2003) and Venkatesh, Thong and Xu (2012) had a direct influence on the Use Behavior. Furthermore, there are iterations where Use Behavior influences and affects the seven constructs, in particular Performance Expectancy, Effort Expectancy, and Experience and Habit. In an attempt to create an understating of the factors influencing digital technology use, Salavati (2013) modified and adopted the model. However, she found that it still fails to illustrate the complexity of educational practices and lacks the possibility of choices whether to use the technology or not. Figure 4.3 illustrates the modified model. The definitions of the constructs can be found in Appendix C.

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50 The complexity of education and the mandatory use of technologies is illustrated in the teachers’ complex Rich Picture presented in section 4.4.
Salavati’s (2013) findings, based on three research projects, show Effort Expectancy (e.g., ease of use, reliability, user-friendliness) together with Facilitating Conditions (e.g., proper in-service training) and Social Influences (e.g., changes of societal requirements and demands) are the constructs which most influence teachers’ willingness and conviction to use digital technologies in their teaching. Performance Expectancy that includes offering students active-, participating-, and collaborative learning also strongly influences teachers’ perception and use of digital technologies. Teachers are very much aware of their students’ experiences, and the students have a great deal of impact (Social Influences) upon teachers’ perception towards technology use, which is in line with Social Influences affecting teachers’ use behavior. It was also obvious that Hedonic Motivation of the students (enjoying and having fun) using digital technologies while completing their assignments, again affected how the teachers addressed the technology. Keeping up with the students and modernizing how education is conducted are also considered important by the teachers. The teachers believe they have to offer the students an education that they will respond to, and that stimulates them while still being exciting for them (Performance Expectancy, Social Influence). The Voluntariness of Use and actual use, despite not measured fully since the teachers are supposed to use various technologies in their everyday work, is dependent on the Performance Expectancy (e.g., benefits) brought by the technology and the Effort Expectancy (whether the technology is trustworthy and easy to use). If a technology fails for some of the students, teachers will not continue to use it. It naturally follows that for digital technologies to become...
commonly used, teachers need with ease and confidence to overcome issues and challenges that can arise during use of digital technologies. Another perspective of Voluntariness of Use is the evolution and pressure from society, also connected to Social Influence, leaving teachers no other choice but using the technology in their work since everyday life is moving towards an increasingly digitalized future. Depending on teachers’ initial beliefs and perceptions about digital technologies, the Voluntariness of Use varies considerably shifts quite radically (Salavati, 2013).

Due to the limitations of the model, i.e., inability to include complexity of educational settings and relationships between teachers and students, only the underlying constructs of Use and Perception of Ubiquitous Technologies (UPUT) is of interest to this research. The constructs of UPUT will serve as the reference model for collection of empirical data, building upon the previous study of Salavati (2013).

4.5.1 Related Studies with Technology Beliefs and Attitude in Education

This section describes a few related research studies addressing teachers’ perception and attitude towards digital technologies in their everyday educational practice. Topics include teachers’ educational beliefs, similar to their philosophy of teaching, however related to use of digital technologies, as well as teachers’ reluctance to using digital technologies. The related research is presented in chronological order.

In the first previous research identified, Tondeur, et al. (2008) explore teachers’ use of digital technologies based on their educational belief, arguing that beliefs inform the planning, decision-making and behavior of the teacher in the classroom. Educational belief, similar to philosophy of teaching, presented in Chapter 4.1.2, is defined as teachers’ understanding, premises or propositions about education. It helps teachers to define and understand themselves and the surrounding world (Tondeur, et al., 2008, p.2543). The authors argue that teachers use technologies in their classrooms when it is in line with their educational and teaching beliefs.

Tondeur, et al. (2008) distinguish two different beliefs: traditional teaching often associated to be teacher-centered, and constructivist teaching which is based on a student-centered approach. According to the authors, differences in beliefs lead to different use of digital technologies; teachers with a more traditional educational belief tend to have low-level technology use in their

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51 The concept of Ubiquitous Technologies is based on the licentiate thesis of Salavati. See detailed description in Chapter 2.
teaching practice, in contrary to teachers adopting a constructivist\(^{32}\) belief which are more frequent users of digital technologies. Teachers with a stronger constructivist belief most likely use digital technologies as instructional and information tools, and teachers with a stronger traditional belief most likely use digital technologies as a learning tool. In their study, Tondeur, et al. (2008), also notes that there are teachers with both high constructivist beliefs and traditional beliefs. These teachers mostly use digital technologies for all types of use in contrast to teachers that have a stronger constructivist belief. Teachers with both strong traditional and constructivist belief have a wider range in their beliefs that enable them to use the technologies more diversely.

According to Tondeur, et al. (2008), regardless of teachers’ educational beliefs, the beliefs lead to actions, which, in turn create new re-constructed beliefs or re-affirmed beliefs. Tondeur, et al. (2008) state teachers’ on going experiences as teachers continually shape their beliefs and practices. However, if teachers feel pressured to integrate changes in their educational beliefs in order to integrate digital technologies in their practice, they are more likely to become reluctant to use the technology. Policymakers need to have this issue in mind as they tend to think of the change process as a one way path: because directives have been given from the top, teachers will accept, adopt and use the digital technologies (Tondeur, et al., 2008). This issue has also been addressed by several other authors (e.g., OEDC, 2010; Grönlund, 2014).

More recently, Tallvid (2014) studies the cause of teachers’ reluctance towards use of technologies, despite large investments, increased availability and improved technical equipment. The study builds upon participation at in-service training for teachers within the context of a 1:1 initiative at two secondary school in Sweden. The outcome of the study indicates teachers are reluctant to use digital technologies, in this case laptops, due to five different, but overlapping, categories. The first category is lack of technical competence. Teachers felt lack of technical competencies consists of two parts: firstly, lack of pedagogical handling and using different types of technologies and, second, lack of ability to solve technical problems occurring during classes. For the latter, teachers expressed their discomfort in students being more competent than themselves in handling technical issues. The teachers expressed pressure and demands on always having to be “technologically up-to-date”. They expressed this as impossible due to the rapid development of digital technologies. Tallvid (2014) notes that digital technologies provoke and change the teaching environments within which teachers are experts. He further argues that teachers’ epistemological foundation influences their attitudes. Tallvid (2014) states that teachers who are generally more interested

\[^{32}\] Constructivism is one of several theoretical perspectives on learning. It builds upon cognitivism and is based on the idea of constructing a mental model of reality based on experiences gained (Piaget; Papert).
in collaborative learning and teachers that are more familiar with the technologies are keener users of digital technology.

The second dimension identified for the teachers’ reluctance in use of the laptops is the perception that digital technology is not worth the effort. Teachers argued that the quality of or enhancements to education through using digital technologies are not large enough, considering the time and effort teachers had to invest for preparation. Tallvid (2014) observed that the person in charge of the in-service training did not consider additional dimensions to digital technology that can bring about learning. Such dimensions consist of social aspects intertwined with the technical aspect.

Third, the teachers in the study mentioned seldom departing from the pedagogical structures provided by course textbooks. Digital material on the Internet was considered difficult to find, and when something useful was found it rarely was considered to be of a sufficiently authoritative standard. Additionally, the teachers were concerned that if they departed from the textbooks, then they would not be able to cover all parts of the curriculum. The textbook, Tallvid (2014) argues, give the teachers well-framed, unquestioned, sequential organization of educational practice. Teachers acknowledge the need of digital technologies, however, not with the aim to replace successful teaching methods.

The fourth argument for teachers’ reluctance for using digital technology was found to be diminishing control. The category consists of two parts, of which the first part is students’ loss of concentration and focus during class. However, this was not considered a major problem since the teachers perceived it similar to other misbehaviors and believed it should be treated in the same manner. The second part is the teachers’ loss of full control over how the task develops throughout a class. Digital technologies enable students to freely expand the task and find variations that are within the curriculum, but not foreseen or anticipated by the teachers.

Lack of time by Tallvid (2014) is found as the fifth dimension, and is considered the strongest argument for teachers’ reluctance. Teachers argue that they do not have enough time to prepare classes for using digital technologies. Teachers in the study found it hard to find learning material, evaluate and adopt it, as well as have time to alter the assessments and try-out the technical parts. Tallvid (2014) cites Engelsen (2006), who said technology causes focus congestion, which means the issue is not lack of time, but rather too many tasks and duties, resulting in teachers being unable to focus on the right things, in this case implementation of digital technologies. Concluding the study, Tallvid (2014) argues teachers should not be divided into those reluctant to use technology and those accommodating, because teachers can simultaneously be reluctant and accommodating about digital technology use.

In a recent series of reports by OECD, Teaching in Focus from 2015, two articles address teachers’ behavior and practice using digital technologies. The
reports are based on Teaching and Learning International Survey (TALIS), and is the first international survey on teaching and learning environments in schools (OECD, 2015a; b). In the reports, it is observed that the second and third critical need for professional development is in-service training in the use of digital technologies in teaching and in the overall workplace (OECD, 2015a). The report argues that teachers’ use of digital technologies can be encouraged by participation in professional development activities and a positive classroom climate. Teachers engaged in professional development activities and working within positive classroom climates (e.g., fewer disruptive students, ameliorated classroom climate due to students enjoying interacting with digital technologies) tend to more frequently use active learning (OECD, 2015a; b). The survey indicates most teachers have a constructivist belief, where they consider learning to be an active process with the aim to nurture students’ critical and independent thinking (OECD, 2015b). The reports further suggest that teachers’ choice of teaching methods can be influenced by their beliefs on how learning happens, and teachers who hold a more constructivist belief are more likely to use digital technologies together with other active teaching methods in their teaching (OECD, 2015a; b). OECD suggests this can be due to digital technologies which, in contrast to traditional teaching, allow students to more independently pursue knowledge (OECD, 2015b). The report further states that digital technology alone will not enhance learning, but it can open up new opportunities and possibilities when used as part of good teaching practice (OECD, 2015b).

4.6 The Adoption and Use of Digital Technologies

The complexity of integrating and using digital technologies in education has been addressed throughout this chapter. Hamilton, Rosenberg and Akcaoglu (2016) state teachers’ contexts, pedagogical choices and their beliefs and motivation make integration of digital technologies in educational setting very complex. The authors further mention that several models, frameworks, standards and theories have been developed to help educators and researchers in their efforts to integrate and assess use of digital technologies.

In this dissertation, the Technological Pedagogical Content Knowledge (TPACK), Replacement, Amplification and Transformation (RAT) and Substitution, Augmentation, Modification and Redefinition (SAMR) models are briefly presented as a guiding foundation for describing and discussing teachers’ adoption and use of digital technologies. These models have been chosen and included in this research because they are widely known and referred to in various discussions related to digital technology in education, not

53 TALIS 2013 is based on lower secondary education and includes 200 schools with 20 teachers in each school from more than 30 countries.
only by researchers but also by practitioners. In this research, two of the informants mention these models.

It should, however, be acknowledged that these models, as also stated by Hamilton, Rosenberg and Akcaoglu (2016), simplify a complex, diverse and multifaceted process. To assess or explain teachers’ adoption and use of digital technologies following any of these models in isolation does not provide a comprehensive or fully correct understanding. As mentioned above, these models can guide discussion and description of teachers’ adoption and use of digital technologies, which is one part of the complex whole of teachers’ everyday practice. In this dissertation these models are used with those intentions.

4.6.1 The TPACK framework

During the past couple of decades, digital technology has found its way into the classroom where it has – or could have - changed the nature of classes. Proper appreciation of this complex situation requires understanding that knowledge of technology should not be separated from pedagogy knowledge and content knowledge (Mishra & Koehler, 2006). In other words, the core of good teaching with technology, according to Mishra and Koehler (2006; 2008; Koehler & Mishra, 2005; Koehler, Mishra & Cain, 2013), builds on three knowledge bases: Pedagogy, Content, and Technology. The relationship and integration between and among these fundamental components affects how technology is integrated in education.

The Technological Pedagogical Content Knowledge (TPACK) framework enables thinking about the complex problems that occur when digital technology is integrated in teachers’ work practice (Mishra & Koehler, 2008). The authors and other scholars contributed several publications presenting and further developing the Technological Pedagogical Content Knowledge framework (e.g., Mishra, Dirkin & Cavanaugh, 2007; Koehler & Mishra, 2008; Mishra & Koehler, 2008; Koehler & Mishra, 2009; Mishra & Koehler, 2009; Koehler, Shin & Mishra, 2011; Koehler, et al., 2011; Mishra, Koehler & Henriksen, 2011; Koehler, Mishra & Cain, 2013; Koehler, Mishra, et al., 2014). In presenting the framework, the work by Mishra and Koehler (2006), Koehler and Mishra (2005; 2008) and Koehler, Mishra and Cain (2013) is mainly referred to since the first three are fundamental publications while the last represents a more recent publication addressing the framework and its applications.


54 The framework has initially been addressed as TPCK (e.g., Mishra & Koehler, 2006) but has later been renamed by the authors as TPACK – Technology Pedagogy and Content Knowledge (e.g., Thompson & Mishra, 2007; Mishra & Koehler, 2008).
that teachers’ knowledge capacity consists of more than merely Content Knowledge (CK) or Pedagogical Knowledge (PK) in isolation, but rather also consists of the blended interaction between pedagogy and subject content (Shulman, 1986). Shulman (1986, p.9) defines the Pedagogical Content Knowledge (PCK) as “goes beyond knowledge of subject matter per se to the dimension of subject matter knowledge for teaching”. Mishra and Koehler (2006) describe the heart of PCK to be transformation of subject matter adopted and applied for teaching: “when the teacher interprets the subject matter and finds different ways to represent it and make it accessible to learners” (Mishra & Koehler, 2006, p.1021).

Introducing digital technology to education practice, Koehler and Mishra (2005) argue, does not alone lead to change but rather has implications for how and what the teachers teach. Digital technology cannot merely be applied to the pedagogy of the past, simply translating previous content and pedagogy to a new medium (Koehler & Mishra, 2005). The authors argue that technology needs to be an important part of the teachers’ overall knowledge and not separate from the context of teaching (Koehler & Mishra, 2005; Mishra & Koehler, 2006). Koehler and Mishra (2005) state that the digital technology needs to be taught in a context that honors the rich connection between technology (traditional technologies such as chalkboard and digital technologies such as computers), content (subject that is taught and learned), and pedagogy (the means of teaching and learning). The authors have illustrated this by representing the three knowledge domains and the four intersecting areas as represented in Figure 4.4.

![Technological Pedagogical and Content Knowledge framework](image)

Figure 4.4 Technological Pedagogical and Content Knowledge framework (adopted from Mishra & Koehler, 2006; Koehler, et al., 2013)

Content Knowledge, CK, is according to Mishra and Koehler (2006) defined as the what. Shulman (1986) explains CK to include knowledge of concepts, theories, ideas, and organizational frameworks. Koehler, Mishra and Cain
(2013) state teachers need understanding of the deeper fundamentals of the disciplines they teach since the nature and knowledge of each field is greatly different (also mentioned by Shulman, 1986). Pedagogical Knowledge, P, is defined as the how. PK includes the methods, practice of teaching and learning processes, as well as purposes and values of education along side classroom management. Teachers with deep pedagogical knowledge have understanding of how students construct and acquire skills, and further how students develop positive habits toward learning. PK further includes understanding of cognitive, social and developmental theories and how teachers can apply these and knowledge in their practice (Mishra & Koehler, 2006; Koehler, Mishra & Cain, 2013). The third domain, Technological Knowledge, TK, includes how technology, either digital or traditional, can change teaching in respect to that specific technology. TK is described as understanding how technology productively can be applied in every day practice, as well as knowledge about how to continuously adapt to the changes and further development of digital technologies.

The intersections include: Pedagogical Content Knowledge, PCK, which addresses the teaching approach most suitable for that specific content and vice versa (Mishra & Koehler, 2006). Shulman (1986) describe PCK to include teachers’ understanding of what makes specific topics easy or difficult to learn, as well as students’ conceptions and preconceptions given the different backgrounds and ages. Technological Content Knowledge, TCK, includes influences and constraints which technology and content have on each other. TCK is considered as the knowledge and understanding of the way subject contents can change as a result of applying particular technologies (Mishra & Koehler, 2006; Koehler, Mishra & Cain, 2013). Further, teachers need an understanding of which technological solutions are most suitable for teaching within that subject and in reverse (Koehler, Mishra & Cain, 2013). The ability to choose the most appropriate technologies for a particular task, as well as have knowledge of pedagogical strategies and how these can be applied to integrate with digital technologies, are part of the TPK domain (Mishra & Koehler, 2006). Further, TPK requires creative, open-minded approaches and thinking about technology use, not limited to using technology for the sake of using technology (Koehler, Mishra & Cain, 2013). TPACK is the intersection between PCK, TCK and TPK and extends beyond isolated knowledge domains (Koehler, Mishra & Cain, 2013; Mishra & Koehler, 2006). Mishra and Koehler (2006, p.1029) define TPACK as:

 […] pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students’ prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones.
In addition to the three knowledge domains and the intersecting areas, Mishra & Koehler address the context since the knowledge domains do not exist in a vacuum, but is initiated in specific learning and teaching contexts (Mishra & Koehler, 2006; 2008). In Figure 4.4, the Context is illustrated as a dashed circle. Mishra and Koehler (2006) state digital technology in classrooms are context bound in terms of subject matter, grade level, student backgrounds and the type of technology available.

Content, Pedagogy, Technology and Context have individual purposes and purposes taken together. In order to successfully use digital technologies in teaching, there is a need of dynamic interchange among these domains (Koehler, Mishra & Cain, 2013). Mishra and Koehler (2006) argue knowledge in digital technologies use do not automatically guarantee good teaching with technologies (Mishra & Koehler, 2006). Koehler, Mishra and Cain (2013) explain that teaching and learning with digital technologies are difficult to do well; technology, teaching and learning co-exist in a dynamic relationship where a change in one of the domains, presented in TPACK, will have to be balanced with a change in the other two domains.

The TPACK framework has been criticized by several authors (e.g., Cox & Graham, 2009; Archambaud & Barnett, 2010; Graham, 2011) who state lack of context, exclusion of the relationship between students and teachers, differences between grade levels as well as guides and paths on how to acquire TPACK, are the main shortcomings. In a recent publication, Rosenberg and Koehler (2015) address some of the criticism towards the TPACK model, stating that context is important and has been included in the framework since the publication by Koehler and Mishra in 2008.

4.6.2 The RAT model

Replacement, Amplification and Transformation (RAT) are three categories, according to Hughes, Thomas and Scharber (2006), used to understand the role of technology in education, as well as assessing teachers’ adoption of technologies in their teaching. RAT has been developed based on three aspects in which digital technology use is imbedded in education: (1) Instructional methods, e.g., teachers’ role, administrative tasks, professional development and interaction with students; (2) Student Learning Processes, e.g., activity tasks, student attitude and motivation, student thinking and mental process; and (3) Curriculum Goals, e.g., knowledge and experience gained, learned or applied. The RAT model addresses the role of digital technologies in teaching and learning practices whether technology replaces (R) previous practice, amplifies (A) current practice, or transforms (T) practice into something new (Hughes, Thomas & Scharber, 2006). Figure 4.5 illustrates the different categories.
The three categories have been defined thusly: Technology as Replacement focusing on when technology is used as a direct replacement with no change of instructional practices, student learning processes or learning goals. Within this category, the technology is used to replicate what is already functioning. The change consists of medium used to achieve well-established purposes and objectives. Technology as Amplification concerns technology amplifying current instructional practices, student learning processes or learning goals. The idea of this category is based on the work of Pea (1985), conceptualizing how technology can amplify what is already being done. The effects of using technology as amplification increases efficiency and productivity of either instruction, student learning or the curriculum. Technology as Transformation is the final category and focuses on transformation of instructional practices, student learning processes and/or the subject matter. In addition to drawing upon the work of Pea (1985) the authors also have based the Transformation category on the work of Cuban (1988), who argues that digital technology should be used, without disturbing basic features of the organization, to make what already exists more efficient and effective. Technology as Transformation is used for increasing efficiency or productivity of instructions, students learning or the curriculum (Hughes, Thomas & Scharber, 2006).

Hughes, Thomas and Scharber (2006) argue teachers’ reasoning and objectives, having particular ends in mind, direct their choice in adopting and using technologies. The authors stress that it is important that digital technology has explicit connection to the subject matter (Hughes, Thomas & Scharber, 2006, p.1617). RAT focuses more on how technologies, regardless if digital or traditional, fulfills specific features and tasks, rather than placing emphasis on which technologies are being used (Hughes, Thomas & Scharber, 2006).
4.6.3 The SAMR model

The SAMR model is developed by Puentedura (Fleisher, 2013; Geertsema, 2014; Hamilton, Rosenberg & Akcaoglu, 2016) and has been highly discussed and criticized among academics and practitioners, mainly due to its lack of pre-reviewed scientific grounds (e.g., Linderoth, 2013; Fleisher, 2013; O’Hagan, 2015; Hamilton, Rosenberg & Akcaoglu, 2016). The model stands for Substitution, Augmentation, Modification and Redefinition (see Figure 4.6) and it is used as a model to discuss different ways that technology can feature in education (Geerstema, 2014). Puentedura (2006) explains the intention with the SAMR model is to describe and categorize teachers’ use of digital technology in classrooms.

Figure 4.6 The SAMR model (adopted from Puentedura, 2006)

Geertsema (2014) describes the SAMR model as a hierarchy in making teaching more student-centric, based on the idea that each step is better than the previous. Hamilton, Rosenberg and Akcaoglu (2016) describe the model as a four-level ladder addressing selection, use and evaluation of technology in education. The authors refer to a number of Puentedura’s presentation-slides on his website (Puentedura, 2016), describing the models as encouraging teachers to “move up” from the lower levels of the ladder to the higher levels using digital technologies, “which according to Puentedura leads to higher (i.e., enhanced) levels of teaching and learning” (Hamilton, Rosenberg & Akcaoglu, 2016, p.2).

Based on content from Puentedura’s website, Hamilton, Rosenberg and Akcaoglu (2016) describe the levels of the model: **Substitution** has been describes as when digital technology substitutes traditional (analog by authors) technology, but substitution does not generate any functional change. The
example given by Hamilton, Rosenberg and Akcaoglu (2016) is, for instance, replacement of a hard copy test to a digital version. *Augmentation* is described as exchange of technology and the task or tool is somehow positively changed. Hamilton, Rosenberg and Akcaoglu (2016) exemplify this level with a distinction: rather than a teacher-lead read-aloud class, each student uses a hand-held device to simultaneously read and listen to individual digital stories. The third level is *Modification* and at this level the technology use allows for redesign of a task, exemplified as shifting from showing students a diagram of light travel to instead show interactive computer simulations. The highest level of use is *Redefinition* and is reached when technology is used to create novel and new tasks. Hamilton, Rosenberg and Akcaoglu (2016) give the example that students, instead of writing an essay to present arguments on a certain topic, instead present arguments through videos which each student creates and edits.

Hamilton, Rosenberg and Akcaoglu (2016) offer the first peer-reviewed reference addressing the shortcomings and criticism to the work of Puentedura and the SAMR – model. In addition to lack of peer-reviewed theoretical literature explaining the model, Hamilton, Rosenberg and Akcaoglu (2016) also mention the limited explanations or details regarding how to understand, interpret and apply the SAMR model.

The main criticism towards the SAMR model, according to Hamilton, Rosenberg and Akcaoglu (2016), concerns lack of context, rigid structure and focus on the technological product over use process. SAMR does not include context, which according to Hamilton, Rosenberg and Akcaoglu (2016), is important to consider for any model referring to teaching and learning. The teachers’ learning, pedagogy, and practice as well as students’ learning experiences are contextual, so including context enables addressing multifaceted, complex educational settings. The authors stress as important that no uniform solution exists for integration and use of digital technologies, and models that do not address context tend to ignore the complexity of technology adoption and use. Due to lack of context, the SAMR model does not include important contextual components such as technology infrastructure, resources and support, individual and collective student needs, or teacher knowledge and support for using the digital technology (Hamilton, Rosenberg & Akcaoglu, 2016).

Hamilton, Rosenberg and Akcaoglu (2016) claim the SAMR model represents one of four categories of technology integration and use. SAMR ignores the complexity of technology use and defines and categorizes teachers’ use of digital technologies in predefined ways. The SAMR model is linear and deterministic, which contrasts with the dynamic process that the model aims to represent (Hamilton, Rosenberg & Akcaoglu, 2016). The emphasis is on the

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53 This conclusion is based on various searches in scholarly databases and websites using SAMR as a keyword.
hierarchical levels that the teachers should ascend in order to achieve better learning outcomes. Important variables pedagogy, classrooms practices, and learner characteristics are ignored. Hamilton, Rosenberg and Akcaoglu argue the effect of technology use strongly depends on the characteristics of teachers and students and their relationships, as well as the specific tasks for which the technology is used (p.5).

As a final criticism, Hamilton, Rosenberg and Akcaoglu (2016) state SAMR puts emphasis on technology-based products where the model considers education as production of independent stand-alone products rather than education being a process. Hamilton, Rosenberg and Akcaoglu claim digital technology has an important role in learning outcomes and, as long as learning objectives are achieved, single instructional methods or tools should not be promoted in favor of others. Hamilton, Rosenberg and Akcaoglu (2016) note that teachers need an understanding of the relationships between teaching, technology and learning in order to advance student growth and development. When teachers have this understanding, they will be better prepared to access and use digital technologies in order to enhance and support student learning.

4.7 Summary and Conclusion

This chapter has presented the theoretical foundations of this research. It includes literature and previous research on teachers’ philosophy of teaching; learning and teaching with digital technologies; importance of school leadership and organizational culture; teachers’ attitude and perception towards use of digital technologies; and varying adoption and uses of the digital technologies in teachers’ classrooms.

It has been suggested that creating an understanding of how teachers’ perceive themselves as professionals, and what beliefs and values they have in relation to teaching and learning, influence teachers’ everyday decisions, and hence practice. Further, it has been noted that teachers’ attitude and willingness, as well as knowledge of digital technologies and knowledge of subject content, pedagogy and learning have an influence on their integration and use of digital technologies. Providing this literature and previous research as a foundation, the aim of this research is to illuminate how these mindsets, beliefs, values and knowledge affect and influence the teachers in terms of using digital technologies to support their everyday teaching and their students’ everyday learning.

In this research, school leadership, organizational culture and tradition are used to create an understanding of external factors influencing and affecting the complexity of teachers’ practice using digital technologies. Educational practices are highly complex and contextual; therefore, it is not possible to
create a more holistic understanding of this complexity by only focusing on the teachers and leaving out their surroundings and historical backgrounds.

Despite criticism towards frameworks and models such as TPACK and SAMR, these models have been included in this dissertation as a basis for understanding and discussing teachers’ adoption and use of digital technologies. As stated in previous sections, the simplifying nature of these three models, TPACK, RAT and SAMR, are acknowledged in this research. Still they are used as inspirational foundations to simplify the representation of how teachers currently use digital technologies, and what is needed to reach balance between everyday practice and beneficial use of digital technologies. Additionally, relating the framework and models to the empirical material illustrates that the everyday practice of teachers is not as straightforward as presented in these models. The complex, diverse and multi-dimensional reality of teachers’ integration and use of digital technologies is recognized in this research; thus, the complex, diverse and multi-dimensional reality of teachers’ everyday practice using digital technologies is not denied or simplified.

Combining these theories and frameworks enable further discussion of the complexity of teachers’ everyday practice. The TPACK, RAT and SAMR models enable understanding of the balance between Technology, Pedagogy and Content as well as the different levels of adoption and use, while the Philosophy of Teaching enables understanding the teachers’ values and beliefs translated to that specific balance and level of use. Context and organizational culture are also considered. Therefore, in the upcoming discussion chapter, Chapter 9, some of these theories, previous research and theoretical models are returned to and further discussed in relation to the empirical material collected for this research. The remaining literature, not further discussed, is provided to give a context to the work that has been done in this area, and a more holistic understanding of the research context and dissertation arguments.
CHAPTER 5
Systems Thinking

This chapter presents Systems Thinking, the epistemological framework for this research. Initially an overview of the fundamental ideas of Systems Thinking is offered. Next the Soft Systems Thinking approach is presented to build a foundation for the upcoming section, Soft Systems Methodology (SSM). The chapter ends by presenting Cognitive Mapping as a modeling technique used together with the models of SSM.

5.1 Systems Thinking

A systems approach begins when first you see the world through the eyes of another. (Churchman 1968, p.231)

Our everyday life consists of living in the middle of a complex interacting flux of changing ideas and events which evolves with the passing of time (Checkland & Poulter, 2010). Life, either professional or personal, is often neither simple nor straightforward, and there are no obvious answers about what to do about things (Reynolds & Holwell, 2010). People view the same world differently and therefore have different priorities (Checkland & Poulter, 2006; Reynolds & Holwell, 2010), taking actions that lead to sometimes unintended and unwelcomed consequences (Reynolds & Holwell, 2010).

Drawing upon several influential scholars, Reynolds and Holwell (2010) describe and distinguish complex realities to be “difficult” or a “mess”. The scholars’ citations include, among others, Ackoff, coining the term “mess”; Schön, talking about the swamp; and, Rittel talking about wicked problems (Reynolds & Holwell, 2010, p.5). Rittel and Webber’s (1973) concept of “wicked problems” is also referenced by Checkland (199956; 2011) in his initial

56 Checkland’s book Systems Thinking, Systems Practice was first published in 1981. However, for this dissertation the reprinted edition from 1999 is referenced.
development of Soft Systems Methodology (SSM), a methodology for managers to use for multifaceted problematic situations (explained further in the upcoming section). Reynolds and Holwell (2010) explain that the crucial difference between difficult and mess is the extent of uncertainty. According to the authors, messes have more significant levels of uncertainty that may be further heightened by involvement of many people with multiple and often conflicting – yet interconnected – perspectives on a given situation. These conditions make the problematical situation all the more difficult to grasp. Therefore, it is oftentimes difficult to identify the source of unease or concern when dealing with a mess. According to Reynolds and Holwell (2010), it is often things that do not feeling right. Most often there is no agreed upon reasoning to guide solutions when dealing with a mess since it includes many different and changing perspectives. This is in line with Vidgen, et al. (2002) who describe a mess as a problematic situation with no clear solution since there is uncertainty about what the problem is. Further, if there were a consensus on the problem, various people in the situation would have different opinions of the problem and how to address it. When dealing with a mess, the context cannot be disregarded and questions of priorities will be raised (Vidgen, et al., 2002; Reynolds & Holwell, 2010), as well as how much weight ought to be given to different viewpoints and perspectives (Reynolds & Holwell, 2010). Reynolds and Holwell (2010, p.5) argue that it is “a matter of coping with the circumstances as best one can”. A difficulty, on the other hand, has less interdependent factors so it is possible to have a possible answer to the situation. The overall context and purpose in difficult situations can be taken under consideration and it becomes a matter of how it best can be done (Vidgen, et al. 2002; Reynolds & Holwell, 2010). Further, a difference Reynolds and Holwell (2010) mention, is the double dimension of messes in contrast to difficulty. They argue that difficulties involve a few variables and can scale from simple difficulty to complicated difficulty. Messes, however, include an additional dimension: dealing with multiple perspectives and uncertainty, making it a complex situation. Vidgen and colleagues (2010) argue the real world situations are not messy or difficult by default but the degree of messy and difficulty is based on the relationship between the observer and the situation. What may be perceived as difficult for one person may be considered messy for another (Vidgen, et al., 2002). Systems Thinking, as addressed in this section, can be used to simplify our thinking about and management of complex realities and messes (Reynolds & Holwell, 2010).

Viewing this from a different though related perspective, the historical understanding of philosophy, science and human learning contributes to finding an order to the world through thought and rational action (von Bertalanffy, 1972). For instance, Aristotle’s well known statement about the

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57 For a greater detailed description of the historical upcoming and influential marks of Systems Thinking, see Checkland (1999).
nature of the cosmos states: “The whole is greater than the sum of its parts” (in von Bertalanffy, 1972, p.408). This statement was the foundation of General Systems Theory and hence one of the strands of Systems Thinking. von Bertalanffy, a biologist and founder of General Systems Theory, states examination and understanding of isolated single parts and processes do not provide a complete explanation of the organization as a whole or of a system. von Bertalanffy (1928) argues that in order to understand the whole we need to know the parts and the relations between them; it is only then that we gain a higher understanding of the organized whole (von Bertalanffy, 1928:64, in von Bertalanffy, 1972, p.411). Checkland (1999) argues biologists to pioneer in finding new ways of thinking about the whole, however, it was von Bertalanffy that suggested the idea of generalize this thinking to any kind of whole and not only biological systems. In addition, Checkland (1999) lists several fields, e.g., psychology, anthropology, and linguistics, which contribute to the notion of systems ideas and development of Systems Thinking. However, he regards von Bertalanffy and the scholar within electrical communication and engineering as the main founders of Systems Thinking (Checkland, 1999).

Systems Thinking which builds upon von Bertalanffy's (1928) General Systems Theory can be defined as: revealing underlying features of a situation from a set of certain perspectives (Reynolds & Holwell, 2010) or, as defined by Checkland (1999), understanding the complexity of the world by representation of a set of elements or components connected to one another to create a whole. Similarly, Vidgen, et al. (2002) state that within a Systems Thinking framework, consideration of the whole is necessary in order to understand the parts. The whole has properties beyond the parts forming and constituting the whole or the system (Vidgren, et al. 2002). Echoing Checkland’s example of water, he argues the taste of water is a property of the water substance and not the parts hydrogen and oxygen that combined to form water (Checkland, 1999, p.3). The collective properties of the parts within the whole have properties that the isolated parts do not have. In systems terms, these properties are known and referred to as Emergent Properties (Checkland & Poulter, 2006; Wilson & van Haperen, 2015). As stated by Checkland (1999) and also by Vidgren, et al. (2002), emergent properties are not a characteristic of the parts but rather reflect their relationship and connection to the whole. Vidgen, et al. (2002) argue that most often knowledge can be achieved by understanding the parts, but in order to understand the whole, the properties of the whole need to be understood by emerging the parts into a whole.

An additional issue of relevance concerning systems approaches and Systems Thinking is the concept of system. According to Checkland (2011), the concept of system is a whole entity that can adapt and survive in a changing environment. Checkland (1999) describes a system as a conceptual construct that consists of a set of elements or sub-systems connected to each other, which create a whole. The system, with its subsystems, is itself part of a
larger whole, within which it has a function. He further argues that a system has processes for communication and control, allowing adoptions to occur (Checkland, 2011). Checkland (1999; 2011) explains that the concept of system in everyday language rarely meets the requirements of the actual systems-concept. In everyday language, systems have been used to refer to the name of objects (e.g., health systems, transportation systems) rather than the object itself (Checkland, 2011). Wilson and van Haperen (2015) state that the term Systems Thinking is popular due to the idea that holistic thinking is better than merely thinking of parts forming and creating a whole. Rather, the authors contend, this simplistic interpretation is a misuse of the systems concept based on using the adjective systems to describe certain aspects of the world rather than describing the thinking. The term systems should be used as an adjective describing the ways that thinking is conducted. Within Systems Thinking, the distinction between “the real world” and “thinking about the real world” is essential if the Systems Thinking approach is to be used correctly (Wilson & van Haperen, 2015).

Consequently, founding on systems premises and recognizing that the real world is messy and complex, conventional non-systems thinking becomes limited (Reynolds & Holwell, 2010; von Bertalanffy, 1972). Reductionism is one example of non-systems thinking based upon solving problems by taking wholes apart in order to understand how constituting parts work and to thereby gain an understanding of how the whole works (Vidgren, et al., 2002). Reynolds and Holwell (2010) add, in reductionism the inevitable interconnectivity between parts are ignored. That said, the reductionist approach may be appropriate for problems where parts of the whole can be isolated and fixed. Vidgren, at al. (2002) provide an example of the failure of a computer hard disk (part) causing the computer (whole) not to function until the hard disk is replaced, where upon the problem of the non-functioning computer will be solved. Dogmatism is yet another limitation of non-systems thinking, which refers to thinking and working based on one single unquestioned perspective (Reynolds & Holwell, 2010).

Systems Thinking can be applied to address these limitations. Reynolds and Holwell (2010) present holism and pluralism, two aspects of Systems Thinking as contrast to reductionism and dogmatism respectively. The first aspect, holism, describes Systems Thinking to be about “gaining understanding by looking at the relationships between things” (Reynolds & Holwell, 2010, p.8). It is based on a way of looking at, and making sense of the world by considering, a situation as a whole rather than focusing on the parts. This enables emergent properties to be observed which cannot be found by examining mere properties of the parts in isolation. The starting point of the second aspect, pluralism, is the complexity and uncertainties of a situation. Agreement on what the problem is within the situation is part of the problem itself, and pluralism builds upon the idea that there rarely will be a single, right solution to the problem. Within pluralism, System Thinking concerns a
problem-situation and improving that situation, rather than a problem and a solution for solving the problem (Reynolds & Holwell, 2010). The systems terminology *systems of interest* is relevant to this way of thinking, as it refers to multiple interrelated involved factors which include multiple human interests. The wholes of problem-situations are not pre-determined, but someone with a certain purpose select or identify wholes with the aim to learn about the complex situation in order to take some action involving its change or improvement (Reynolds & Holwell, 2010).

Reynolds and Holwell (2010) argue, since the initial publication on systems theory by von Bertalanffy over 60 years ago, many publications about Systems Thinking have been published, resulting in the creation of a “complex clutter of systems approaches” (Reynolds & Holwell, 2010, p.9). Of this, the authors note, different systems approaches are associated with varying perspectives with diverse purposes and interrelationship assumptions for entity organization. The three most common classes of Systems Thinking traditions include hard, soft, and critical systems thinking (Reynolds & Holwell, 2010). Hard Systems Thinking, HST, have been developed by, and built upon works of scholars such as von Bertalanffy, Ashby, Churchman, Hall, and Forrester, to name a few. According to Jackson (2003, p.16) Hard Systems Thinking “was a breakthrough in terms of applying systems thinking to real world problems”. In addition, Checkland (1999) describes Hard Systems Thinking to solve real world problems by engineering human activity systems. Checkland (1999) advances Hard Systems Thinking to tackle problems by identifying, designing and implementing human activity systems. Hard Systems Thinking is described as goal-directed wherein a study is initiated with a set definition of a goal to be achieved (Checkland, 1999). The world, according to Hard Systems Thinkers, is believed to consist of several interacting systems that can be engineered to achieve specific objectives (Checkland & Poulter, 2006). Solutions address the “how” of well defined problems (Rose, 2002). Checkland argues that the Hard Systems Thinking approach does not consider the various, and at times, conflicting worldviews that are essential to all social interactions (Checkland & Poulter, 2006). The systems are regarded as independent of the observer and having an external validity (Rose, 2002). The limitations of Hard Systems Thinking have also been noted by Jackson (2003) who criticizes its inability to handle complexity. Other critics observe HSTs’ inability to satisfactorily address multiple perceptions of reality, beliefs and values, as well as deal with political and power issues.

Reynolds and Holwell (2010) as well as Checkland (Checkland & Poulter, 2006) illustrate that the questioning and abandoning of Hard Systems Thinking...
Thinking resulted in a different way of thinking, Soft Systems Thinking. The genesis of Soft Systems Thinking is found in the work of Churchman, Ackoff and Checkland (Jackson, 2007). The main formal distinction between these traditions, hard and soft, is the emphasis on ontological and epistemological traditions. Hard Systems Thinking builds on an ontological tradition thinking about “systems as representing real world entities” while Soft Systems Thinking builds on an epistemological tradition thinking about “systems as learning devices to inquire into real world entities” (Reynolds & Holwell, 2010, p.7). Soft Systems Thinking will be further elaborated on in the upcoming section.

While sharing the same epistemological foundations as Soft Systems Thinking and, at the same time, questioning the inadequate attention to power relations in both Hard and Soft Systems Thinking, Werner Ulrich and Mike Jackson advance Critical Systems Thinking (Reynolds & Holwell, 2010) which builds on the idea of critical reflection on interpretations of social context but also the social context needs to be critically analyzed and reflected upon (Mirijamdotter, 1998). Flood and Ulrich (1990) state that critical analysis and reflections can be accomplished by equally distributing power in order to liberate people from dominance by other people (Flood & Ulrich, 1990, in Mirijamdotter, 1998, p.70).

5.1.1 Soft Systems Thinking

Prior to his academic career which commenced at Lancaster University in 1969, Peter Checkland worked in industry in various positions, including as a manager. In his autobibliography, Checkland (2011) describes himself as a manager who was concerned about what made situations unique rather than about the logical structure of the situations addressed in Management Science literature. He explains that his experiences as a manager made him wonder if there were no better way for managers to deal with the multifaceted problems faced by managers, amidst considerable uncertainties. As an outcome of this realization, Checkland explains that, once he relocated to academia, he wanted to use systems ideas to tackle these wicked problems. He based the description of wicked problems on the work of Rittle and Webber, who focus on problems that are unique and lack sharp definition. Checkland describes that wicked problems change their form in terms of new important features emerges or what was thought are important features disappear; it is problems where solutions do not apply to (Checkland, 2011, p.497).

Mingers (1980) explains that Checkland’s concern was helping managers to understand and solve organizational problems by applying systems ideas. Therefore, with the aim to investigate the applicability of systems ideas to complex real world problems, Checkland classified the universe in five systems classes: natural systems, designed physical systems, designed abstract systems,
human activity systems, and transcendental systems (Checkland, 1999). Natural systems are the first class and are described as the physical system that makes up the universe. Systems that originate with the origin of the universe, such as subatomic systems of nuclei as described by physics, the living systems on earth, or the galactic system, are all natural systems.

Designed physical systems is the second class and include physical items that are made by humans as the result of conscious design serving certain human purposes. Designed systems can also be classified as abstract. Designed abstract systems, which is the third classification, include products of the human philosophy and the human mind, such as mathematics or poems, which represent structured sets of thought. Checkland states that designed abstract systems can be captured in designed physical systems such as books (Checkland, 1999).

The fourth class is human activity systems that are defined as less tangible than designed and natural systems. Checkland (1999, p.111) describes human activity systems as “innumerable sets of human activities more or less consciously ordered in whole as a result of some underlying purpose or mission”. Human activity systems represent the viewpoint of humans as observers of the real world and their points of view which depend upon where observations are made. Checkland further describes human activities as fundamentally different than, mainly, natural systems, but also design systems, because human activity systems could be different than what they are, while natural systems cannot without human intervention. This difference distinguishes humans from other natural systems. Hence, different kinds of investigation will therefore be needed for these two kinds of systems. In terms of designed systems, Checkland explains that designed physical items or abstract things exist since there is need for them in purposeful human activity systems.

The fifth and final classification are the transcendental systems. Transcendental systems go beyond the previous four systems and include systems beyond knowledge, referring to humans as teleological designers. These class of systems are not further elaborated in SSM.

Additionally, the context in which the real world is observed is also noted by Checkland, who refers to highly complex real world systems as social systems, in everyday language. Checkland (1999) describes social systems as the context in which humans are part in terms of interpersonal relationships and emotions. He describes social systems, including families, political parties, industrial firms, and schools, as a mixture of human activity systems and natural systems, i.e., a set of collected purposeful activities mix with sets of relationships that occurs within communities (Checkland, 2011).

59 Checkland’s book Systems Thinking, Systems Practice was first published in 1981. However, for this dissertation the reprinted edition from 1999 is referenced.
According to Checkland (1999; 2000), the real life world is more complex; it is not enough to apply a systems engineering approach, which was the Systems Thinking approach at the Department of Systems Engineering at Lancaster University when Checkland returned to academia. Checkland (2011) argues that the ideas of Systems Engineering are not rich enough to address the complexity of humans’ real world situations. This realization necessitates rethinking real world systems wherein systems are not seen as in need of improvement or repair. Rather, the real world consists of situations where humans attempt to take purposeful actions that are meaningful for them (Checkland, 2000; 2011). In this way, the concept of modeling purposeful human activities in Soft Systems Thinking emerged, whereby systems are applied to the process of dealing with the world, rather than applied to the world, as is done in Hard Systems Thinking. In Soft Systems Thinking, the priority of dealing with obvious problems that require solutions was abandoned in favor of the idea of focusing on a situation that people, for various reasons, find problematical (Checkland, 2000).

In addition to viewing the world as purposeful human activity systems, another fundamental component of Soft Systems Thinking is the notion of worldview (Checkland, 2011). The concept has its origin in the German word Weltanschauung, which Churchman used in his book, *Challenge to Reason*, to express “a perception of what reality is” (Churchman, 1968, in Checkland, 2011, p.499). Checkland (2011) describes the idea of Weltanschauung, or world-view, as crucial for the development of Soft Systems Thinking. In a complementary fashion, in referring to Checkland’s work, Mingers (1980) describes the notion of worldview as capturing humans’ experience of the world in terms of purpose, knowledge, values, expectations, etc. which are developed in various ways including previous experiences. While humans may have much in common with others, how they experience the world is significantly different and often contradictory, although equally valid.

Checkland’s (2011) idea of modeling purposeful human activity systems together with the notion of worldview allowed movement from Systems Engineering to Soft Systems Methodology, a methodology which guides dealing with “soft” problem situations (Mingers, 1980). Soft Systems Methodology, or SSM (expanded on in the upcoming section), is described by Checkland as “an approach for tackling problematical, messy situations of all kinds” (Checkland & Poulter, 2010). The methodology builds on: Checkland’s sense making of his experiences bringing together human situations; worldviews relevant for each situation; purposeful activities; models of purposeful activity, where each is built according to a declared worldview (Checkland, 2011). SSM, developed by Checkland and his colleagues, is based on the idea of building models of purposeful activity that are relevant to dealing with problematic situations (Checkland, 2000).

In this dissertation, the Soft Systems Thinking approach is applied as a fundamental standpoint for thinking about the social systems of teachers’
complex everyday situation and practice using digital technologies. By applying Soft Systems Thinking, as defined in Soft Systems Methodology, and the notion of purposeful human activity systems enable understanding the multi-dimensional perspectives of teachers’ complex real world situation.

5.2 Soft Systems Methodology

Soft Systems Methodology (SSM) builds upon the Soft Systems tradition and is a methodology used for setting out principles of using methods for unstructured, ill-defined problematical situations (Checkland, 1999). SSM is by other scholars described as, e.g., “a problem structuring and solving methodology” (Rose, 1997, p.3); “principles for the use of methods, that enables intervention in ill-structured problem situations where relationship maintaining is at least as important as goal-seeking and answering questions about ‘what’ we should do as significant as determining ‘how’ to do it” (Jackson, 2003, p.181); or “analysis of complex situations where there are divergent views about the definition of the problem – soft problems” (Reynolds & Holwell, 2010, p.20).

Checkland and Poulter (2010) states that varying situations in real world should be referred to as problematic, since real life is a complex interacting flux of changing ideas and events that unfolds through passing of time. The word problem is not applicable since it implies a solution that would eliminate the problem forever; the complexity of real world problematic situations lies in the fact that a problematic situation is never static. Additionally, it also contains multiple and interacting perceptions of reality because different people have different assumptions about the world, causing them to see the real world in a particular way (Checkland & Poulter, 2010). Soft Systems Methodology builds on the notion of the real world as “very complex, problematical, mysterious, characterized by clashes of worldview” (Checkland & Poulter, 2010, p.198).

The intension of SSM, according to Checkland and Poulter (2010), is to understand and analyze any type of complex problematic situation based on an action-oriented-inquiry approach. Mingers and Taylor (1992) argue that gaining greater understanding of other peoples’ views and perspectives is at the heart of SSM, and its fundamental premise is the importance of different Weltanschauung and perspectives. Mingers and Taylor (1992) further argue that the illustrative name SSM describes its essence: Soft implies fuzzy, ill-defined situations that contain different perceptions and views; Systems refers to a holistic approach used for studying complex real world situation and their wider context; and Methodology means using a structured approach with a set of activities. Checkland (2011) emphasizes the methodology aspect of SSM. He argues methods or techniques solve simultaneous equations, and if the method or technique has been used properly, a particular outcome is guaranteed.
Methodology, however, is described as a set of principles of methods, which allow a specific approach to be customized to particular use in a specific situation, not guaranteeing a particular outcome.

Through the emerging of Soft Systems Thinking, Soft Systems Methodology has been represented in various ways. The initial representation of SSM was based on a seven-stage model (e.g., Checkland, 1985; Checkland & Scholes, 1990; Rose, 1997; Checkland, 1999; Checkland, 2000; Mingers, 2000; Vidgen, et al., 2002; Bergvall-Kåreborn, Mirijamdotter & Basden, 2004; Checkland, 2011; Stowel & Welch, 2012). The model was later abandoned by Checkland in favor of a SSM learning Cycle (Jackson, 2007; Bergvall-Kåreborn, Mirijamdotter & Basden, 2004; Checkland, 2011). The SSM Learning Cycle consists of four phases, and is currently the most frequently occurring representation of SSM, as illustrated in Figure 5.1.

![Figure 5.1 The Learning Cycle of SSM (adopted from Checkland, 2000)](image)

As mentioned above, the SSM Learning Cycle is based on four phases: (1) finding out about the real world problematic situation; (2) creating purposeful activity models based on explicit worldviews; (3) questioning the perceived situation, using the constructed models, with the aim to identify desirable and feasible changes; and (4) taking action to improve the situation (Checkland, 2000; Checkland & Poulter, 2006; Checkland & Winter, 2006; Somerville, Mirijamdotter & Collins, 2006; Mirijamdotter & Somerville, 2009; Checkland & Poulter, 2010). The Learning Cycle also includes iteration, where taking action to improve the initial situation will lead to a changed new situation and, hence, potential need for the process to restart (Checkland, 2000).
As illustrated in the figure above, a number of models, based on the understanding of the problematic situation, are built in SSM. Purposeful Activity Models, as the models are referred to, are systems-based constructs with the aim to compare and question the real world and contribute to a debate about change. The models are not limited to the problems of the real world, explaining the reality, or to presenting a blueprint of the world (Jackson & Keys, 1984; Rose, 1997; Checkland, 2000; Jackson, 2003). Rather, as Checkland (2011) explains, perceiving and understanding a situation depends on the worldview adopted, and he further continues that all worldviews are legitimate. Therefore, the models constructed in SSM aim to gain an understanding of how different actors perceive various aspects as being problematic within a situation (Jackson & Keys, 1984; Checkland, 2000; Jackson, 2003). Working with clusters of ideas and models, according to Checkland (2011), will open minds, and enable and inform debate. Checkland (2011), however, argues even if the debate about desirable and feasible change aims to find a consensus, it is among human groups extremely rare to reach genuine consensus. So, instead, the aim is to find accommodation leading to action to improve the situation. This, Checkland (2011) argues, is due to differences in worldviews and therefore reaching accommodation between the conflicting worldviews yields a version of the problematic situation which not all included people will be in agreement with, but can, nevertheless, live with (Checkland, 2011).

Checkland and Poulter (2006; 2010) describe SSM as normally addressing the problematical content of a situation; however, understanding SSM as a whole also includes considering the role of the practitioner who carries out the study. Carrying out the study, according to Checkland and Poulter (2010, p.213), “can be thought about, and planned, using models relevant to doing this”. SSM can therefore be used for coping and dealing with the content of the situation as well as deciding how to carry out the intervention. These two approaches for using the methodology are described by Checkland and Poulter (2006; 2010), and Checkland and Winter (2006) and referred to as SSM_P and SSM_C, where the P is short for the process of using SSM and C is short for the content of the problematic situation. Figure 5.2 illustrates the applying of SSM_P and SSM_C.

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60 The models are presented in the upcoming section.
Checkland and Winter (2006) describe SSM\textsubscript{P} and SSM\textsubscript{C} as well established among experienced SSM practitioners, where relevant models are made before getting deeply absorbed in the situation in order to clarify what is to be done. The authors argue SSM\textsubscript{P} always enables organize the thinking of carrying out an intervention of a real world situation, regardless of whether SSM or a different approach is used (Checkland & Winter, 2006).

In this research, both SSM\textsubscript{P} as well as the SSM\textsubscript{C} are applied. In addition, SSM is used to understand X rather than to improve it, since the aim of this research is to illuminate and advance the understanding of the complexity of teachers’ situation using digital technologies in everyday education and teaching practices.

### 5.2.1 The Models of SSM

As mentioned above, a number of models are constructed in SSM based on understanding of the problematic situation, which are then compared to the real world. This section provides a brief description of the various models, and a detailed description of each model is presented in Chapter 6.4.1.

The Purposeful Activity Models aim to question the real world and contribute to a debate about change, rather than present a blueprint of the world. The models aim to gain understanding of how different actors may perceive various aspects to be problematic within a certain situation (Jackson & Keys, 1984; Checkland, 2000; Jackson, 2003). In a publication from 1985, Checkland describe the models of the Soft tradition to consider system models as relevant models used to argue about the world, rather than models of the world. The models focus on issues and accommodations and not solutions (Checkland, 1985).
In the first phase of the SSM Learning Cycle, i.e., finding out, the Rich Picture technique is used to illustrate the problematic situation (Checkland & Poulter, 2006). Rich Pictures is one of the most successful and most frequently used techniques in SSM (Mingers & Taylor, 1992; Jackson, 2003). The Rich Picture allows showing the complexity of a situation by illustrating entities, structures and viewpoints, and ongoing processes as well as known and potential issues (Jackson, 2003; Checkland & Poulter, 2006).

In the second phase, as mentioned above, a number of Purposeful Activity Models are developed. The Purposeful Activity Models include CATWOE, Primary Task and Issue Based PQR statements, Root Definitions and Activity Models (e.g., Checkland & Poulter, 2010). CATWOE is a mnemonic abbreviation or acronym for Customer, Actor, Transformation, Weltanschauung (Worldview) and Environmental Constraints (Checkland & Poulter, 2010). CATWOE is used to enrich the Root Definition as well as to evaluate the Purposeful Activity Models to be in accordance with the principles of SSM (Bergvall-Kåreborn, Mirijamdotter & Basden, 2004). Together with CATOWE, the 3E’s (efficacy, efficiency, and effectiveness) are included to measure the performance of the Purposeful Activity Models (Checkland & Poulter, 2010).

The PQR-statements answer the questions What (P), How (Q) and Why (R). The core of the PQR statement defines the transformation (T) in the CATWOE (Checkland & Poulter, 2010). Together with CATWOEs, PQR-statements have a central role in the modeling of Root Definitions and Activity Models since the models build upon the definition of these elements (Bergvall-Kåreborn, Mirijamdotter & Basden, 2004).

Primary Task are models that more or less coincide with exiting organizational structures. Issue Based are defined as models that often cut across existing organizational structures (Checkland, 2000).

Root Definition (RD) describes the purposeful activity that is going to be modeled. It describes the transformation process of an entity from one state to a different state (Checkland & Poulter, 2010, p.119).

Finally, Activity Models include the activities needed to describe the transformation process. The definition and linking activities together which is represented in the Activity Models build on the guidelines provided by CATWOE, PQR, RD, the 3E’s, as well as Primary Task and Issue Based modeling (Checkland & Poulter, 2010).
5.2.2 **The Learning Process**

SSM, as presented by Mingers and Taylor (1992), has been used successfully by practitioners with various backgrounds and in varying fields, as well as by practitioners without technical and academic backgrounds. Checkland has applied and used SSM for various projects together with colleagues throughout the years (a number of these projects are described in, e.g., Checkland, 2000; Checkland & Poulter, 2006; Checkland & Winter, 2007; Checkland & Poulter, 2010). As an outcome of experiences gained using, developing, modifying and polishing the SSM framework, Checkland developed the LUMAS model (Checkland, 2000; Checkland & Poulter, 2010), presented in Figure 5.3. LUMAS stand for **Learning for a User by a Methodology-informed Approach to a Situation**, and is a generic model based on the three elements of user, methodology and situation as perceived by the user of the methodology. The model is applicable for any methodology used for sense making of any real world situation (Checkland, 2000; Checkland & Poulter, 2010). As Checkland (2000) describes it, when a user who is knowledgeable about a methodology perceives a problem situation and uses that knowledge of the methodology to improve the situation, these three elements are linked and interacting with each other. Performing this knowledge to a certain situation, the methodology, which is explained as a set of principles by Checkland (2000), is by the user converted into a specific approach, or set of methods that the user feel is appropriate for this specific situation (Checkland, 2000). This generates new learning and experience for the user, and it can also lead to enrichment and modified appreciation of the methodology (Checkland, 2000; Checkland & Poulter, 2010).

![Figure 5.3 The LUMAS model (adopted from Checkland, 2000)](image-url)
Explaining LUMAS in more detail, the model starts from the user (U) who perceives a problem situation (S) and appreciates the methodology (M), which the user adapts to produce a specific approach (A) to use for the specific situation (S) (Checkland & Poulter, 2010). This, as stated above, leads to new learning (L), changing the user (U), as well the user’s appreciation of the methodology (M) (Checkland, 2000). Checkland (2000) argues that what the user does depends on the convergence of the user (U) and the user’s perceptions of the methodology (M), as well as the user’s perception of the situation (S). Checkland further argues that a methodology by itself never leads to improvement of a situation, but it helps to achieve an improvement that might be better than not using the methodology or its guidelines (Checkland, 2000).

The LUMAS model is revisited in the end of this dissertation (see Chapter 10) reflecting and discussing the learning and insights gained using Systems Thinking as standpoint of this research, and using SSM for representing and analyzing the real world as perceived through the empirical study.

5.3 Cognitive Mapping

In addition to the models of Soft Systems Methodology, Cognitive Mapping is used in this research. Cognitive Mapping can be described as mapping and representing how a person thinks about a particular issue, situation or problem (Ackermann, Eden & Cropper, 1992; Eden & Ackerman, 1998; Eden, 2004).

Cognitive Mapping has its origins in the field of psychology and the work of Kelly (1955) on Theory of Personal Constructs (Eden & Ackerman, 1998; Westcombe, et al., 2002; Eden, 2004), and emerged out of Systems Methodologies, and specifically Operational Research (OR)\(^ {61} \), mainly due to the work of Colin Eden (Westcombe, et al., 2002). Within OR, Cognitive Maps are described by Westcombe, et al. (2002, pp.3) as “a two-dimensional directed graph [...] that represents the way in which a person defines an issue”. Eden (2004) describes Cognitive Maps as networks of nodes and arrows, where the direction of the arrows indicates beliefs about causality between nodes or statements.

Despite the simplicity of Cognitive Maps, they should not be considered as word and arrow diagrams, or mind-maps (Eden, 2004). Eden (2004) argues that Cognitive Mapping is a formal modeling technique with rules for understanding how humans make sense of their world. The models help, according to Westcombe, et al. (2002), to see a bigger picture which other representations or conversations cannot since the maps enable understanding

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\(^{61}\) Operational research (OR) lies in the tradition of Hard Systems Thinking and is one of the most common approaches of HST together with systems analysis and systems engineering (Jackson, 2003).
of cause and effect relationship between nodes within that specific context, including the worldview of the person. The maps enable getting close to the world of the person of interest (Eden, 2004).

Cognitive Mapping in this research is based on the OR adoption, as tools for reflective thinking and problem solving, rather than models of cognition (Eden, 2004). The maps are used as initial models to map different actors’ thinking about the use of digital technologies in everyday education and teaching practices.
CHAPTER 6

Research Methodology

This chapter addresses the research methodology applied to respond to the research aim and research questions of this research. The chapter is initiated by a brief account of the history and background of the Information Systems discipline which positions this research in relation to the field. Thereafter, the methodological stance for this research, based on an ethnographical approach, is presented. The section further describes the methods used for data collection. Next, techniques of SSM, as well as Cognitive Mapping, are presented and their application in this research is discussed. The final two sections of this chapter present the limitation in terms of the researcher’s role and the ethical considerations.

6.1 Information Systems Research

Information Systems (IS) is relatively young as discipline; it is interdisciplinary and diverse. This diversity and breadth of the field, in combination with fluent boundaries, enables both flexibility and variety, as well as the possibility to conduct research from various angles and perspectives (Baskerville & Myers, 2002; Hirschheim & Klein, 2012). However, the IS field has been highly debated throughout its history, both concerning its disciplinary identity and its core characteristics (e.g., Orlikowski & Iacono, 2001; Benbasat & Zmud, 2003; Agarwal & Lucas, 2005). Although, despite the challenges that the IS research field has faced and still faces, including redefinition of its boundaries and identity, it has been considered for some years to be a discipline of its own (Baskerville & Myers, 2002; Hirschheim & Klein, 2012). IS as a research field has progressed tremendously to become an influential field. It has, according to Baskerville and Myers (2002), progressed from a discipline referring to other research disciplines and domains to become a discipline referred to by others (Baskerville & Myers, 2002).
Providing a brief account of the history of IS, in an international context the IS field can be described in fourth eras. First Era (mid 1960s to mid 1970s), Second Era (mid 1970s to mid 1980s), Third Era (mid 1980s to mid/late 1990s), and Fourth Era (late 1990s and forward). In the first Era, several schools of thoughts emerged and thereby provided a fundamental foundation for IS research. Among scholars in the First Era Hirschheim and Klein (2012) mention Churchman, known for conceptualization of inquiry systems. Among Nordic scholars, Langefors is described as one of the most influential. He introduced the term “systemeering” (p.198) based on the idea of systems thinking and included the infological approach to information systems development. Additionally, in Emery’s and Trist’s work in the coal industry, they noted the limitation of hard systems thinking in its impact on the work environment. They argued that system thinking (of that time) was technical in nature and the social dimension of work also needed to be include. Similarly, Checkland began his work on developing the Soft Systems Methodology; a work that has led him to be acknowledged as a main founder of Soft Systems Thinking.

Correspondingly, after the Second World War, the Tavistock Institute of Human Relations in London developed the socio-technical approach. Mumford is a pioneer for applying this approach to the development of computer systems. She included the socio-technical perspective in her development of the ETHICS (Effective Technical and Human Implementation of Computer-based Systems) model (Leitch & Warren, 2010).

In the Second Era, personal computers (PCs) were introduced. Influential in this era are Ives’s and Hamilton’s efforts defining the IS field. Porter is mentioned as part of a team of researchers who attempted to determine IS’s impact on organizations’ competitive advantages (Hirschheim & Klein, 2012).

The Third Era, from between the mid 1980s to the mid/late 1990s, saw the rise of departmental computing. Rogers and his diffusion of innovation, and Davis, the founder of the technology acceptance model (TAM), are mentioned as milestone scholars contributing to the IS field. Other scholars, such as Cooper and Zmud contributed to advancement of various technical and sociological issues that arose as IT was introduced and implemented in organizations.

The Fourth Era includes the pervious but also adds the possibilities brought about by commercialization of the Internet. Globalization, virtual organizations and teams, knowledge management as well as design science are some of the major research focus of the final era. Information systems journal, publication practices and ratings also evolved in during this era (Hirschheim & Klein, 2012).

In a Swedish/Scandinavian context the roots of IS goes back to 1960s, e.g., to Langefors and his work (Langefors, 1972, Dahlbom, 1996). Langefors coined the notion information systems with the motivation to move from data
processing towards the use of information systems in organizations (Dahlbom, 1996). This is illustrated in the following quote:

To guarantee that the users needs are given enough consideration one must specify user oriented (and usage oriented) constraints first and introduce technical constraints as late as possible (Langefors 1973, preface, p.11)

Langefors based his ideas on determining the information on user’s needs in order to satisfy those needs (infological problems) and thereafter determining how their requirements can be translated in the development of an information system (datalogical problems). The research area has evolved since 1960s and 1970s. Dahlbom (1996, p.29) describes the transformation as a move from “administrative data processing” to “a theory and design oriented study of information technology use”. Dahlbom argues that in order to improve the practice of information systems development it is necessary to understand the implications of the system. This argument builds on Langefors’ ideas that information systems should be defined as sociotechnical systems rather than technical systems (Dahlbom, 1996). Information technology use is also what the Scandinavian tradition of Participatory Design (PD) has in focus. PD invites those who will be affected by the design of IS/IT systems or service to participate in the design process (Kensing & Greenbaum, 2013). Today IS research in Sweden/Scandinavia builds not only on System Thinking, sociotechnical approaches, or PD, but on a range of approaches e.g., Structuration Theory, Actor-Network Theory, Computer Supported Collaborative Work (CSCW), Interaction Design, theories of communication (Dahlbom, 1996; Studedahl, et al., 2010).

Orlikowski and Baroudi (1991) classify IS research into three paradigms: positivistic, interpretive and critical. The interpretive paradigm assumes reality, and the access to it and knowledge of it, is through social constructions. Understanding of reality includes social actors and the researchers’ constructions and sense making (Orlikowski & Baroudi, 1991; Myers, 1997). The general aim of interpretive studies is understanding phenomena through the meanings that people assign to them (Myers, 1997). The social world is considered an emergent process created by the individuals concerned; it is “concerned with understanding the essence of the everyday world” (Burell & Morgan, 1979, p.31). Orlikowski and Baroudi (1991, p.13) state that interpretive research aims to:

[...] understand how members of a social group, through their participation in social processes, enact their particular realities and endow them with meaning, and show how these meanings, beliefs and intentions of the members help to constitute their social action.

This dissertation is positioned within the interpretive research paradigm since the research focuses on teachers and a number of surrounding actors in order to understand their reality as created and understood by them. This research is
conducted in order to illuminate and understand the complexity of teachers’ everyday practice using digital technologies. In order to achieve this, Soft Systems Thinking and Ethnography have been applied. Both are grounded in understanding humans and their experiences and perceptions of the real world. Soft Systems Thinking is composed of Purposeful Human Activity Systems as well as the notion of worldview, which emphasize a set of activities performed by humans as an outcome of a purposeful intention within a social system, and based on the humans’ experience and perception of the real world (Checkland, 1999). The methodology of Soft Systems Thinking applied in this research is the Soft Systems Methodology (SSM), which Checkland (1999) places within the interpretive paradigm.

The philosophical positioning of SSM has been addressed by several other authors as well (e.g., Mingers, 1980; Rose, 1997). Mingers (1980) discusses similarities of SSM and Critical Social Theory. He argues that SSM helps actors to solve their problems by bringing to light varying worldviews and their contradictions, thus, increase awareness of actors’ different perspective within the problem situations which can lead to accommodation and change. Rose (1997) describes SSM from an interpretive and social constructed view of reality but he also discusses characteristics of SSM to be in accordance with both interpretivism and realism. He describes the realism in SSM occurring when models are built as an account of the examined phenomenon revealing the underlying mechanisms of reality.

This dissertation aims to understand how and why individuals give certain meaning and status to the social world through their socialization, integration and participation in that social world. Therefore, this research applies Soft Systems Thinking, and SSM with an interpretive stance.

In order to understand the situation by understanding the reality of the people in a specific situation this research is applying an ethnographic approach. An ethnographic approach allows for examination of humans in their social settings, which is relevant for an interpretive research. The ethnographic research and Soft Systems Methodology applied in this research is further elaborated in the upcoming sections.

6.2 Ethnography

Ethnography has its origins in anthropology, which is strongly identified by certain data collection methods. During its long existence, ethnography has been applied, adapted and shaped within different research areas (Pole & Morrison, 2003; Knoblauch, 2005; Hammersley, 2006; Pink & Morgan, 2003). Despite variations in ethnographic approaches, the common agreed upon principle of the ethnographic idea is that the researcher can only understand the culture and way of life by living and experiencing the native life in its own environments (Randall, Harper & Rouncefield, 2007a).
Ethnographic research can be described as the study to “appreciate what it means to be human in particular social and cultural contexts” (Madden, 2013, p.17). Further, it is an approach “based on the first-hand experience of social action within a discrete location, in which the objective is to collect data which will convey the subjective reality of the lived experience of those who inhabit that location” (Pole & Morrison, 2003, p.16). In short, ethnographic research is a “process of learning about people by learning from them” (Roper & Shapira, 2000, p.1).

Ethnographic studies are qualitative, where emphasizes is on observations of people in their natural occurring settings, seeking to build theories of culture and societies as well as theories of behavior and attitude of humans (Randall, Harper & Rouncefield, 2007a; Madden, 2013). People are studied in typical circumstances, where they interact with one another in routine, or even ritualized, ways specific for that situation (Madden, 2013). Tacchi, Slater and Hearn (2003 p.9) argue that the ethnographer, besides taking a holistic approach to the study subject, also contextualizes the social settings and social relationships in a wider context, e.g., government policies, politics, wider economy, etc. The value of ethnographic studies lies in the possibility to study interactions and structures, which shape locations, communities as well as social groups (Pole & Morrison, 2003).

To make ethnographic research implies to make an incursion into other peoples’ lives (Randall, Harper & Rouncefield, 2007a). However, the people studied are likely not giving much concern or relevance to the effort and time of the researcher due to their own preoccupations, troubles and interests. Further, conducting ethnographic work, according to Randall, Harper and Rouncefield (2007a), does not require massive amounts of education searching for difficult things to find, and it is not “simply ‘hanging around’”. “Hanging around” is a means to an end and despite the ethnographer not having a fixed role, the ethnographer will be involved in the setting and the activities of the study with the aim to as much as possible gain the same perspective as the people being studied (Randall, Harper & Rouncefield, 2007a, p.180).

One of the main characteristics of ethnography is the relationship between the **emic** and the **etic** understanding of human behavior. The emic perspective reflects the participants’, or the insiders’, points of view (Fetterman, 2010; Madden, 2013). The etic perspective, on the other hand, reflects the researchers’, i.e., the external, points of view (Fetterman, 2010; Madden, 2013). There should be a balance between the two perspectives since the emic and etic are synthesized to explain certain human behavior from a broader perspective. To conduct a proper ethnographic study both the emic perspective and the etic perspective are required (Fetterman, 2010; Madden, 2013). Thus, combining the emic and etic perspective ensures deeper insight is gained in comparison to what would be possible focusing on the native alone or the ethnographer alone (Roper & Shapira, 2000).
Ethnography in IS research
Information Systems (IS) research can be described as investigating the phenomenon that emerges when technological systems and social systems interacts (Lee, 2001, p.iii). Much of IS research is based on social contexts of information systems design, development and applications (Myers, 1997). This, implies that IS research has a complex, constantly changing social context (Myers, 1997). In terms of the ethnographic approach, the objectives are to understand humans’ thoughts and actions by interpreting their actions within specific contexts. To reach this understanding, Myers argues that the ethnographer investigates how information systems in an organization affect the social interaction and shared meaning creation (Myers, 1997). Ethnography is and has been used in IS research to explore various topics and to provide rich insights in human, social and organizational aspects of the IS field (Baskerville & Myers, 2015). For instance, Wynn (1979), Suchman (1987) and Zuboff (1988), used ethnography to study office conversations, human-machine communication, and automation of work places. Further, the methodology has been widely used to study development, management, design and impact of information systems in organizations (Myers, 1999).

The ethnographic approach has been recommended as a methodology to overcome shortcomings of other single methods that have not been able to capture the richness and complexity of organizational realities (Myers, 1997; Randall, Harper & Rouncefield, 2007b). Blomberg, Burrell and Guest (2002) describe ethnography as becoming a resource during the 1980s when computers become more mainstream and no longer only existed in research laboratories and engineering environments. They further explain there is a need for designers and developers to understand the diverse setting in peoples’ everyday work practices since IS researcher can no longer solely rely on their own experiences but have to pay attention to those who will be affected by the design (Blomberg, Burrell & Guest, 2002). Mörtberg, et al. (2010) describe how ethnographic studies have had a long tradition in IS research communities in Nordic countries. They state that ethnographic research has been often applied within Participatory Design research. It has been used to study and understand work practices and use of technological artefacts, providing the foundation for participatory design or user perspectives in technology design.

In this research, the traditional anthropological ethnography will be applied since the research aim (see Chapter 1.1) is to illuminate and understand the complexity of the information systems (digital technologies) and the interactions of the social system (everyday work practice of compulsory school teachers).
Ethnography for Education research

Ethnography has been used also in education research (Pole & Morrison, 2003). Ogbu (1981) argues that it is possible to apply traditional ethnography to study school systems. Properly applied traditional ethnography can provide rich and valid descriptive data useful for theoretical and practical objectives (Ogbu, 1981). School ethnography needs to be holistic in terms of illustrating how education is linked to economy, the political system, local social structures and the beliefs of the people in the school (Ogbu, 1981, p.5). Zaharlick (1992) argues that ethnographies’ sensitivity towards people, culture and context provides new insights that can contribute to improvements and reforms in education. She further argues that ethnography enables researchers to examine educational systems as a whole, because the methodology reveals the relationships between the many parts, and, hence, can contribute to the improvement of education and school practice (Zaharlick, 1992).

Since this research, based on first-hand experience, aims to illuminate and advance the understanding of the complex reality of teachers in their daily practice using digital technologies, the ethnographic approach has been chosen. Further, the aim of this research is to look at the teachers, the specific professional role of certain people that are active during certain hours a day and certain days of the year, even if their private life affects their professional role. The ethnographical approach applied for this research is the focused ethnography, further described and presented in the following section.

6.2.1 Focused Ethnography

Pink and Morgan (2013) argue that the research discipline to which an ethnographic approach is applied shapes the ethnography process and product. They observe that, for instance, ethnographic research in design research or within health research, does not characteristically include long-term engagement in peoples’ lives, which contrasts with what is expected in conventional anthropological ethnography.

Short-term ethnography (Pink & Morgan, 2013) or Focused Ethnography (Knoblauch, 2005), which will be the naming used in this dissertation, is different than conventional ethnography, although it builds upon similar foundation. Knoblauch (2005) states that focused ethnography should not be considered as a new phenomenon but rather a complement to the traditional anthropological ethnography.

The characteristic of focused ethnography is a brief, short time stay in the field (Gobo, 2005; Knoblauch, 2005; Pink & Morgan, 2013). That is because the aim of the study is to investigate selected, specific, circumscribed, and focused problems (Gobo, 2005; Knoblauch, 2005). Focused ethnographic research is further characterized by the intense data collection, better selection
of informants, greater informant interaction, large amounts of data and scrutiny of data analysis (Knoblauch, 2005; Pink & Morgan, 2013).

Since the intention of focused ethnography is to concentrate on specific questions, it is, according to Roper and Shapira (2000), possible to do so within a shorter period of time. Focused ethnography shares the commitment of conventional ethnography: conducting intensive participant observations within naturalistic settings; asking questions with the aim to learn what happens in the setting by the people in the setting; and using various sources of information in order to gain as complete as possible understanding of the place, the people, and the event of interest (Roper & Shapria, 2000; Knoblauch, 2005). Focused ethnography, according to Pink and Morgan (2013), suits theoretical, methodological and empirical issues within the contemporary contexts in which people are working. The authors describe this to include practice, i.e., what people actually do as they live their everyday life, and address the unspoken, unsaid, and tacit essentials of daily life (Pink & Morgan, 2013, p.353).

Humans have different worldviews and cultural logic and, according to Madden (2013), it is the ethnographer’s task to infiltrate and understand these constructs. Regardless of whether the ethnographic study is long-term or short-term, both share the aim to create theories of cultures and society based on human behavior and attitudes (Madden, 2013). However, it is important to bear in mind that conducting recent forms of ethnographic fieldwork only includes parts of people’s lives over relative short periods of time (Hammersly, 2006). In terms of ethnography within education, the school, besides being one part of a larger societal whole, is, as described by Ericson (1984, p.58):

A whole composed of parts — differentiation of persons according to different classes of formal and informal statuses and roles (teachers, students, administrators, paraprofessionals, custodians, parents), with different rates and modes of interaction between statuses, and different spheres and amounts of authority and influence accruing to various statuses.

The school consists of more people than only teachers and students. For instance, school leaders might not come to nor be part of the classroom setting; however, in one way or another, they contribute to the reality of what goes on in the classroom and in the school. Classrooms are only one of several settings where people in a school interact and socialize (Ogbu, 1981).

In the next section the data collection in schools, using focused ethnography, is presented.
6.3 Methods for Data Collection

The ethnographic research is a multi-method approach which allows for a mixture of methods appropriate for the situation at hand (Tacchi, Slater & Hearn, 2003). In this research several data collection methods are used to capture several aspects and, as far as possible, gain a complete picture. Considering all the data and comparing the various findings can offer a better understanding of the whole picture. In the following sections, the data collection methods used for this research are described.

6.3.1 Observations

Participant observation is the primary method in ethnography (Hammersley, 2006; Fetterman, 2010; Madden, 2013). In participant observation the ethnographer participates in the practice, culture or society being studied, that is, living among the people. However, Tacchi, Slater and Hearn (2003) counsel, the ethnographer must assume an observational position in order to describe and interpret the subject of the study. Participant observation combines participation in the reality of the people participating, as well as maintaining professional distance (Fetterman, 2010).

Mörberg, et al. (2010, p.110) argue that observations can be difficult in terms of “see what you see”, due to the researcher does not always understand people’s actions and doings. Further, observations can be challenging in terms of what to observe and where to start. They state that in order to simplify these challenges, it is a good idea to follow a single person for some time to get that specific person’s perspective on the practice. Thereafter, observing additional people will provide a richer picture of the setting of the work practice.

Pole and Morrison (2003) describe three approaches for observation: (1) total participation, where the researcher’s role is kept secret, and (2) participation in normal setting where the researcher’s role is known to certain “gatekeepers” but hidden from most people (p.22). These approaches allow for observation without affecting the natural setting while at the same time distance is maintained from the research subject. In the third (3) approach, participation as observer, the researcher’s role and identity is fully open and takes advantage of “shadowing” and witnessing first hand the study subjects’ normal life and intimate details of interest (p.23). Bruni, Gherardi and Poggio (2005) describe shadowing as observing different levels of action and interaction by gathering data about “on-the-ground” (p.198) phenomenon. This is carried out within predetermined time periods documenting how people engage in their everyday activities, individually and collective. Shadowing enables the researcher to act invisibly and to concentrate on taking notes on the actions of the people observed, as well as asking questions when alone with the person of interest (Bruni, Gherardi & Poggio, 2005).
6.3.2 Interviews

Madden (2013) argues that interviews are one of the most important ways to know other people. Interviews enable gaining descriptive (how do you…?), structural (what is the relationship between…?), and comparative (what is the difference between…?) data. Information from informants allows the ethnographer to gain insight into how the participant sees the world, and thereby creates insight into the participant’s weltanschauung, worldview (Madden, 2013, p.73). Interviews provide explanations that can be placed into larger context to reveal the significance of what the ethnographer has seen and experienced (Fetterman, 2010).

Within ethnographic research, both formal and informal interview approaches can be used. The former is within predefined questions and/or themes while the latter can be referred to as a form of daily conversations during and following observations. A researcher might start with more informal approaches in the early stages of the study and then, by the end of the research, move more towards formal questions (Madden, 2013).

6.3.3 Performing the Data Collection

In this research, observations have been the main source of data collection and, in addition to the observations, formal interviews have been conducted. This section presents the data collection, summarized in Table 6.1.

The observation fieldwork for four teachers lasted for a period of time between a couple of days to one week with each participant, depending on what was most convenient for that specific teacher. Since schools consists of more people than only teachers and students, and classrooms are only one of several settings in which people in schools interact (Ogbu, 1981), observations are based on full days following the teacher step by step in her everyday routines: lessons, breaks, talks with colleagues and/or students in the hallways, etc., taking notes on the participant’s actions. The observation approach was a combination of participation in normal settings and participation as an observer, shadowing. Based on the situation or the class setting, the teacher sometimes presented the researcher in the role of a researcher conducting observations, while in other settings, the researcher was not introduced and conducted her observations quietly in class or as she listened to the teacher talking with colleagues. Extensive notes were taken, based on what the researcher could see, learn about, and reflect upon.

The ethnographic study started with informal interviews in the form of daily conversations during and following observations (Madden, 2013). The informal interviews were combined with the observation of teachers’ daily activities. The informal interviews and observations were documented in a notebook on site. After a day in school those notes were transcribed digitally.
and also added some additional observations, which were fresh in my memory. During the observations, no video or audio recording, nor pictures were taken due to ethical considerations (see section 6.7). The observed setting involved school children and there was, therefore, limited possibilities to ask for consent from all students in all different classes.

The semi-structured interviews were conducted with four teachers at different times during the study period: prior to the field work, a few days into the field work, or after, based on what was the most convenient for the specific teacher. Each interview with the teachers lasted approximately 60 minutes. These interviews followed interview guides (see Appendix D and Appendix E), originally based on English templates which were translated into Swedish which is the native language of the informants.

Interviews were also conducted with two school leaders, three the representatives from the Department of Education, and the CIO of the IT-unit. These interviews lasted also for approximately 60 minutes. These interviews followed interview guides which are presented in Appendix F and Appendix G.

All interviews were recorded with the researcher’s computer and a Livescribe Smartpen which was also used to take minor notes. The interviews were transcribed verbatim using the software ExpressScribe. The transcriptions carried out in Swedish aimed to stay true to the statements of the informants and therefore all hesitations, pauses and hesitations were noted.

Table 6.1, below, presents an overview of the data collection methods used including observations and formal interviews.

<table>
<thead>
<tr>
<th></th>
<th>Observation</th>
<th>Interview</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>School A</strong></td>
<td>4 teachers</td>
<td><strong>8 interviews with 4 teachers</strong></td>
<td>May – Jan. 2015/2016</td>
</tr>
<tr>
<td><strong>School B</strong></td>
<td>4 teachers</td>
<td><strong>8 interviews with 4 teachers</strong></td>
<td>May – Jan. 2015/2016</td>
</tr>
<tr>
<td></td>
<td>16 full days</td>
<td>(2 interviews each) Total: 8 hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>51 classes (40–90 minutes) Total: 98 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>School Leaders</strong></td>
<td>2 interviews</td>
<td>2 interviews</td>
<td>Sept. 2015 and Jan. 2016 respectively</td>
</tr>
<tr>
<td></td>
<td>Total: 1,5 hours</td>
<td>Total: 4 hours</td>
<td></td>
</tr>
<tr>
<td><strong>Department of Education &amp; CIO</strong></td>
<td>4 interviews</td>
<td>4 hours</td>
<td>Sept. – Dec. 2015</td>
</tr>
<tr>
<td><strong>IT-unit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The observation notes and transcriptions were thereafter printed out and read through or listened to once more and mistakes were corrected. During observation sessions and transcription-work, colored post-it stickers were used for additions in the observations and reflections. Some of the text on the post-it notes was later added to the observation notes. All observation notes and
interview transcriptions were sent to each informant for verification and for possible corrections, if any, to avoid any misunderstanding. After the observation notes and interviews were transcribed and verified by the informants, they were printed and bound into booklets and the transcriptions were once again reread and other colored post-it notes were used to add reflections and complements to the transcriptions.

In this dissertation, since the research had been conducted in Swedish, all quotes present in the upcoming chapters have been translated into English. During translation and presentation of quotes, minor edits have been made without changing the meaning of the statements, in order to ensure ease of reading and translation accuracy to written language in contrast to the spoken language. The editing of the text has been limited to rephrasing phrases from the spoken language, adding punctuations, removing duplications, etc.

6.4 Soft Systems Methodology – Data Analysis

This research has undertaken the Soft Systems Methodology (SSM) approach as the aim is to illuminate and advance understanding of the complexity and the issues adding to the complexity of school teachers’ use of digital technologies in their everyday practices. Addressing a complex situation includes various people and, hence, perspectives and worldviews. SSM provides a structured approach to explore and illuminate the contextual and multi-dimensional complexity of a situation.

In SSM, a number of models are constructed based on the understanding of the problematic situation which are then compared to the real word. The Purposeful Activity Models aim to question the real world and contribute to a debate about change, rather than present a blueprint of the world (e.g., Checkland, 2000; Checkland & Poulter, 2006). The models are built upon certain techniques presented in the upcoming sections.

6.4.1 The Models and Techniques of SSM

A number of the SSM models have been constructed to illustrate the complexity of teachers’ everyday practice using digital technology, as well as to gain understanding on how different actors perceive the situation from their perspectives. The subsections below present the different SSM techniques and discuss how they have been used.

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62 See detailed description in Chapter 5.2.
Rich Pictures

One of the most frequently used techniques in SSM is the Rich Picture (Mingers & Taylor, 1992; Jackson, 2003). Rich Pictures enable the capture of rich, open representations of a problematic situation without imposing rigid structures, requiring certain elements or using systems terms (Checkland & Scholes, 1990; Vidgen, et al., 2002; Jackson, 2003; Checkland & Poulter, 2006; Stowell & Welch, 2012). In the recognition that human situations are complex and include multiple worldviews and interacting relationships, Checkland and Poulter (2006) argue that the best way to show complexity is through pictures. The authors state that by using pictures, a situation can be understood as a whole and at the same time multiple relationships can be illustrated (Checkland & Poulter, 2006). In other words, Rich Pictures enable more holistic representation of a situation (Checkland, 2000). Entities, structures and viewpoints within a problematic situation, as well as ongoing processes, can be captured. Furthermore, known and potential issues can be identified. Rich Pictures aim to illustrate and thus enable an understanding of problematic situations (Jackson, 2003; Checkland & Poulter, 2006).

Included in the Rich Picture technique are three distinctive, but related, elements of analyses intended to enable recognition and expression of cultural, social and political interrelationships within the problematic situation. Analysis One, Analysis of the Intervention, reflects the intervention mainly from three different roles: first, the person (or group) causing the intervention to take place, referred to as clients; second, the person or those who conduct the investigation and wish to do something about the situation, referred to as practitioners; and finally, those concerned about, or being affected by, the situation and its outcome, referred to as issue owners (Jackson, 2003; Checkland & Poulter, 2006; Checkland & Poulter, 2010). Checkland emphasizes the importance of specifying roles in the modeling rather than naming specific people. A person, or groups, might be included in more than one role, and a person can change or abandon a role (Checkland & Poulter, 2006; 2010). Viewing the problem situation from different roles and perspectives allows the analysis to become more holistic and also ensures good sources for relevant systems that can be further analyzed (Jackson, 2003).

Analysis Two addresses the roles, norms, and values that create the social context of the human situation in focus. Roles, either formal or informal, can be defined institutionally, e.g., head of department, or defined behaviorally, such as, e.g., confidant (Jackson, 2003; Checkland & Poulter, 2006). The informal roles in a social context reveal much about the culture of ways in which those roles view the world (Checkland & Poulter, 2006; 2010). Further, the norms define expected behaviors associated with various roles and thereby suggest values considered to be standards or criteria to judge performance of the behavior-in-role (Checkland & Poulter, 2006; Jackson, 2003). As Checkland and Poulter (2006; 2010) explain, roles, norms, and values are closely related and can both endure and also change over time.
Analysis Three concerns political aspects that determine how power is expressed, obtained and used within the situation. Checkland and Poulter (2006; 2010) use the metaphor of commodity to illustrate how power is obtained, used, defended, transferred and relinquished. Analysis Three has a direct link to Analysis Two because commodities of power elements, such as personal charisma, intellectual authority and professional reputation, can also be found in social roles. Similar to Analysis Two, elements of Analysis Three will change and can be redefined with the passage of time (Checkland & Poulter, 2010).

**Purposeful Activity Modeling**

In the second phase of Soft Systems Methodology, Purposeful Activity Models are developed. The models include the mnemonic CATWOE, PQR statements, Root Definitions and Activity Models (e.g., Checkland & Poulter, 2010). Checkland (2011) describes Purposeful Activity Models as models used to bring structure to a debate rather than describe something that exists or ought to exist in the world. Building Purposeful Activity Models, Checkland (2011) explains, requires identifying activities relevant to the input, activities to transform input to output, and activities to do something with the output.

Checkland and Poulter (2010) argue that analysis of human situations reveals that people act purposefully, and therefore this model building can be used to ask questions about the real world situations in focus. Because each model is built according to a single declared worldview, the models are never definite descriptions of the real world but, rather, they illustrate “one way of looking at complex reality” (Checkland & Poulter, 2010, p.218). It is also important to notice that clusters of models are typically built, rather than one single model, which both enables participants to open their minds and also informs the debate (Checkland, 2011). To help the modeling process, SSM offers a number of guiding techniques in which models of Purposeful Activities can be built, illustrated in Figure 6.1.
In the upcoming sections, a description of the various techniques used to build Purposeful Activity Models are presented. These SSM techniques have been presented, described and discussed in several publications by Checkland (1985; 2000; 2011), together with other authors (e.g., Checkland & Scholes, 1990; Checkland & Poulter, 2006; Checkland & Tsouvalis, 2007; Checkland & Poulter, 2010), and by other authors (e.g., Wilson, 1990; Mirijamdotter, 1998; Jackson, 2003; Bergvall-Kåreborn, Mirijamdotter & Basden, 2004; Wilson & van Haperen, 2015). For this dissertation, the main publication used to describe the techniques will be the Checkland and Poulter publications while other publications are used to add on to the descriptions.

The **PQR statement**

The PQR statement answers the questions *What* (P), *How* (Q) and *Why* (R). The formula can be stated as “do P, by Q, in order to help achieve R” (Checkland & Poulter, 2010, p.219). The PQR statement helps to shape and formulate any and every Root Definition. When the PQR is complete with all three elements defined, the transformation (T of CATWOE) is captured in the *How*, that is, the Q of the formula. Checkland and Poulter (2010) also state that Q has to be defensibly plausible for the *What*, captured in the P. The PQR-formula and CATWOE has, according to Bergvall-Kåreborn, Mirijamdotter and Basden (2004), a central role in the modeling since the...
Root Definition, as well as the Activity Models are based on the definitions of these elements.

**CATWOE**
The mnemonic CATWOE represents: Customer, Actor, Transformation, Weltanschauung (Worldview), Owner and Environmental constraints (Checkland & Poulter, 2010). The elements of CATWOE is defined as the following (Checkland, 1985; Checkland & Poulter, 2010):

- **Customers** – beneficiaries or victims affected by the transformation process
- **Actors** – the people that carry out the activities of the transformation process
- **Transformation** – conversion of input to output
- **Worldview** – the viewpoint of the world making the transformation meaningful
- **Owners** – the person, or those that can stop or change the transformation
- **Environmental constraints** – constraints from the outside of the system to which the systems have to adapt

Checkland and Poulter (2010) suggest starting by defining the T and W first and thereafter moving on to the other elements of the CATWOE process. Usually CATWOE, according to Bergvall-Kåreborn, Mirijamdotter and Basden (2004), is used to enrich the Root Definition and the Activity Model. Furthermore, CATWOE can be used to ensure and evaluate that the Root Definition and the Activity Models are complete according to SSM principles (Bergvall-Kåreborn, Mirijamdotter & Basden, 2004).

In parallel with CATWOE, measures of performance should be included to ensure achievement of three criteria relevant in every case: efficacy, efficiency, and effectiveness – also referred to as the “three E’s” (Checkland & Poulter, 2010, p.222). The three E’s are defined as:

- **Efficacy** – criteria for telling whether the transformation is successful in terms of reaching the intended outcome
- **Efficiency** – criteria for addressing whether the transformation is achieved with minimum use of resources
- **Effectiveness** – criteria for judging whether the transformation is contributing or helping achieve a longer-term or higher level aim

In addition to these criteria, other relevant criteria can be applied. Checkland and Poulter (2010) mention elegance, which evaluates if the transformation is beautiful, or the criteria of ethicality, which evaluates if the transformation is morally correct.
Primary Task / Issue Based
The models, and specifically Root Definitions, can be divided into either Primary Task or Issues Based. This division can be done without affecting the model building techniques. Checkland and Poulter (2010) state that many of the Purposeful Activity Models developed are within the structure of the organization. Checkland (2000) defines these models as Primary Tasks. On the other hand, considering and developing models that cross organizational boundaries are defined as Issue Based. These enable broader consideration than models based only on organizational boundaries, thereby encouraging questions about the situation as well as increasing engagement of stakeholders (Checkland & Poulter, 2010). When developing Purposeful Activity Models, the general rule is, as stated by the authors (Checkland & Poulter, 2010), to never exclusively work with Primary Tasks (PT) or Issue-Based (IB) models, but rather to mix them because that will enable the best investigation (Checkland & Poulter, 2010).

Root Definition
Root Definitions, RD, is a precise account of what a system is (Jackson, 2003). It describes the purposeful activity that is to be modeled as a transformation process where some entity is transformed from one state into a different state (Checkland & Poulter, 2010, p.119). The CATWOE elements can be used to compose the Root Definition as a statement. Mirijamdotter (1998, p.49) explains that a heuristic for a well-formulated Root Definition observes the form: “A[n] O-owned and A-operated system, which, affecting C, transforms T to a new state of T according to some W, within the given constraints E”.

Activity Model
The Activity Models are described as “putting together the activities needed to describe the transforming process” (Checkland & Poulter, 2010, p.223) in the light of the specific worldview. Applying the guidelines provided by the SSM techniques, presented above and illustrated in Figure 6.1, enable achieving the transformation process of defining and linking together activities needed and, hence, creating an Activity Model that is purposeful.

Checkland and Poulter (2010) emphasize that in order for an Activity Model to be defensible, it must ensure that the activities of the model can be traced back to something in the RD and the CATWOE, etc. The authors, however, also acknowledge the varying semantics and connotations of everyday words resulting in the possibility that people interpret the words in the RD, CATWOE, etc. differently. This, therefore, can lead to that different people produce somewhat different Activity Models although they build on the same RD and CATWOE (Checkland & Poulter, 2010).

In terms of the activities in the Activity Models, Checkland recommends the number to be 7±2 activities, although, if necessary, the recommendation does not need to be followed. Furthermore, each activity can be illustrated at a
more detailed level, which can be modeled as a separate RD and Activity Model. The lower level models then consist of connected detailed activities that, when combined together, constitute a higher-level activity (Checkland & Poulter, 2010).

6.4.2 Applying the SSM Techniques

For the first phase of the SSM cycle, the Finding out phase, the Rich Picture technique has been used to combine its traditional approach with an applied approach, similar to Mirijamdotter and Somerville (2009). The Rich Picture includes the perspective of Issue Owners as defined by Analysis One, and enables a representation of teachers’ complex real world situation using digital technologies in their everyday practice. In order to maintain its traditional hand drawn nature, the Rich Picture has been initially drawn using the SketchBook application to illustrate the individual elements of the picture and then later completed as a final picture using the OmniGraffle software.

The Purposeful Activity Modeling in the second phase mainly consists of PQR statements and CATWOE’s as well as Activity Models. In total over 80 PQR statements, 50 CATWOE’s and 25 Activity Models have been developed, and a limited number of these has been included in the dissertation. Of these 19 PQR statements and corresponding CATWOEs are included in Chapter 8 (Soft Systems Analysis) and 31 PQR statements are included in the appendix. The Purposeful Activity Models included in this dissertation aims to exemplify how the research has gained more understanding of the complex situation and it has further been used to exemplify and contribute to the complexity found in the research.

The Activity Models have been drawn by hand on paper and thereafter some of them have been scanned and included in the dissertation. The hand drawn nature of the models of SSM are inspired by the work of Checkland as he, in his publication with Poulter (Checkland & Poulter, 2010) argues that hand drawn diagrams convey an organic impression. Checkland underscores that it looks more human and attractive with hand drawn models, as they are working diagrams and part of the learning process, in contrast to straight lines and angels which, rather, convey the impression of blue prints of the actual case.
\section*{6.5 Cognitive Mapping}

Cognitive Mapping has been described as mapping and representing how a person thinks about a particular issue, situation or problem (e.g., Eden and Ackerman, 1998). Cognitive Maps are simple, non-linear representations where nodes represent concepts that have meaning for the individual, while the links represent casual relationships between the concepts that “may lead to” or “have implications for” the other node (Westcombe, et al., 2002, p.7). The maps are characterized by a hierarchical structure with a goal statement positioned at the top of the hierarchy (Eden, 2004). The nodes consist of short texts, ideally 8-10 words in imperative form and, as far as possible, are based on the wording expressed by the individuals (Westcombe, et al., 2002). The arrows are unidirectional where the node, or statement, at the tail of an arrow is the cause, or influence, for the node at the arrowhead (Eden, 2004).

In this research, Cognitive Mapping, based on the OR adoption, has been used to map different actors’ thinking about the use of digital technologies in everyday education and teaching practices. To create the cognitive maps, the OmniGraffle software was used.

The Cognitive Mapping enabled identifying the hierarchy of the PQR statements in the Purposeful Activity modelling. One node on one level represents one R, the nodes on the level below represents the P and the nodes below to that represent the Q. The combination of PQR and Cognitive Mapping has been described in greater detail in Chapter 8.1.

\section*{6.6 Limitations}

The outcome of the empirical material, and ultimately the result of the research, is mainly dependent on a limited number of teachers, school leaders and municipality representatives. Therefore, it is important that the outcome of this research should be considered as illustrative examples enabling understanding of a complex problematic situation rather than generating definitive findings or reality blueprints.

In addition, the influence and bias of the researcher should be considered. Performing qualitative data collections, observations and interviews, the possibility of the researcher’s bias, in terms of opinions and prejudices, as well as her own background may affect the outcomes. The researcher, having experience in teaching in academic education, may more easily relate to the teachers’ situation rather than that of other actors, whose experiences are unfamiliar to the researcher.
6.7 Ethical Consideration

Ethical compliance in this research has been ensured by following the guidelines of the Swedish Central Ethical Review Board. All informants have given their consent in writing to participate in this research. The informed consent document consisted of two parts: an information sheet and a consent certificate. The information sheet presented the purpose and aim of the study, the research methods and procedures, the processes for data collection and storage including who had access to the data, as well as the voluntary nature of participation. The informed consent documents were written and presented in Swedish.

The informed consent document for teachers was more thorough and detailed in comparison to the informed consent document for school leaders and municipality representatives because more extensive data was collected about teachers’ experiences and perceptions. The informed consent documents have been reviewed and approved by the Ethical Advisory Board in South East Sweden. The approved research ethics protocols were followed throughout the study.

Part of the ethical constraints, also addressed in the informed consent sheet, is the issue of confidentiality of the participants. To ensure confidentiality of the participants, and especially the individual teachers, all collected data have been stored under coded filenames and with no access by unauthorized individuals. During observations no names were written; if needed, coded names were used for teachers as well as for students. All audio recording was also coded. During interviews, neither the name of the participant nor the school was mentioned. In the dissertation, new code names are given to the teachers, while school leaders and representatives from the municipality have been referred to by their titles. The results are anonymous by ensuring teachers will not be able to be traced to a specific school, a specific school leader, or colleague participating in the research. Similarly, this has been done for the school leaders, ensuring that it will not be possible to trace an individual school leader to a specific school or specific teacher. The high level of confidentiality has been applied in order to ensure that the teachers felt comfortable and, as far as possible, behaved naturally in their everyday practice.
PART III
Empirical Representation, Analysis and Discussions
CHAPTER 7
Empirical Findings: Representing the Situation

In the empirical findings chapter, the outcome of the collected empirical data is presented. The empirical findings are illustrated as a Rich Picture and described throughout this chapter.

The empirical material is based on four teachers, two school leaders, three representatives from the Department of Education and the head of the IT-unit. The teachers were at the time of data collection working on either School A or School B, and so were the school leaders. A short presentation of the different informants is initially provided. This chapter can be considered a detailed summary presenting issues of concern identified in the empirical material, presented to represent the situation.

Due to anonymity of the teachers, their names have been coded with two random letters neither representing their initials nor their schools. Information such as their age and gender will not be described either. Similarly, has been maintained for school leaders and municipality representatives by using their organizational titles instead of coded names. In order to enhance the confidentiality and ensure reading ease, all informants will be referred to as her. Furthermore, quotations or representations of individual teachers are sometimes stated without referring to the name of the teacher. This has been done in order to enhance the confidentiality, making it impossible to trace specific teachers to specific schools or school leaders. Similar have been done for the school leaders and the specific schools.

Additionally, since the material has been conducted in Swedish, quotes have been translated into English. In order to ensure reading ease, quotes with minor edits have been presented by rephrasing phrases from the spoken
language into written language, adding punctuation, removing duplication, etc.\(^63\) The symbols in the interview quotes and field notes illustrate the following:

[ ] researchers’ comments and explanations

[...] shorter exclusion in the interview material

/**/** longer exclusion in the interview material or longer sequence of time passage during observations

… hesitations and pauses by the informant during interviews

A Brief Presentation of the Informants

The teacher informants for this research consist of Teacher DK, Teacher LA, Teacher LF, and Teacher MK. The teachers are all teaching in 7-9\(^{th}\) grade classes and have an experience working as teacher between 12 to 21 years. The teachers teach both theoretical subject as well as practical subjects.

School Leader 1 has been a school leader in various schools for six years. Prior to that, she taught language and social sciences for compulsory school. School Leader 1 has, in addition to her teacher education, also earned a degree in leadership and management. She also completed a school leader-training program at the university after becoming a school leader.

School Leader 2 has a background as a natural science and mathematics teacher. She has been working as a school leader for six years and prior to that worked as a part time teacher and part time assistant-school leader.

The Director of Education has a background as a teacher and school leader and has had her current position for one year.

The Head of the Department has been working, prior to this assignment, as a teacher, as a school leader for a number of years, as well as a District Manager. The Head of the Department has a background in finance and administration studies with a pedagogy complementary education.

The District Manager has been working as a teacher for 12 years and a school leader for 20 years prior to receiving the offer to become the District Manager.

The CIO of the IT-unit has an educational background in economics. During her early career, she worked as an IT-chief within private and public sectors for 15 years. Three years ago, she commenced her current employment at the municipality.

\(^63\) See detailed description in Chapter 6.3.3.
A Brief Presentation of the Department of Education
Within this municipality located in the south of Sweden, approximately 100 schools exist. They are managed by the municipal Department of Education. The smallest school is a compulsory 1-3 grade school consisting of approximately 30 students and 3 teachers while the largest school is a high-school with approximately 1300 students and 110 teachers. In total, there are approximately 2600 employees supervised by the Department of Education and approximately 18000 children and youngsters from pre-school up to the age of 19.

Figure 7.1 illustrates the organizational structure of the department.

For a detailed presentation of the organizational structure and the hierarchical levels, see Chapter 3.3.

Representing the Situation
The complexity of the situation has been represented through a Rich Picture\(^\text{64}\), presented in Figure 7.2. The Rich Picture is the first phase of SSM and it aims to represent the problematic situation without imposing unnecessary structure or excluding elements or terms. The Rich Picture reveals a number of issues of concern which are further presented and discussed throughout this chapter. The issues addressed includes: Philosophy of Teaching; Everyday Work Practices; Combining Digital and Traditional Technologies; Using Digital Technologies; Students and the Parents; Centralized IT; and Department of Education and the School Leadership. In

\[^{64}\text{See detailed description of the technique in Chapter 6.4.2.}\]
order to ensure reading ease and enhance deep understanding of the Rich Picture, close-ups figures will be presented to focus on different parts of the Rich Picture.

The connections and relations between actors and entities within the Rich Picture, Figure 7.2, are represented in different strokes and different colors. *Dashed lines* illustrates differences in ways of working, modes of thinking, etc., where a number of teachers have that specific connection but it does not include all teachers, e.g., some of the participating teachers would use Google Drive, others would use Dropbox and one does not use any of them. Such variation is illustrated in the lower middle right part of the figure. *Red crosses* indicate lack or dysfunction in the relationship or connection at all times while a *dashed red cross* illustrates the lack or dysfunction occurring or existing sometimes. An example is students’ mobile phones that in the beginning of some classes and by some teachers are collected; however, not all teachers collect the phones and not for all lessons. This variation in practice has been illustrated in the bottom right part of the picture. The colors of the lines navigates as follows: *grey* concerns the IT-unit at the municipality, *dark green* concerns authorities either municipality or the school leaders, *bright green* addresses political and other steering documents, *orange* is related to issues concerning IT-support and IT-help, *purple* addresses use of digital technologies, *teal* concerns the pedagogy and didactics, the *blue* color concerns the philosophy of teaching as well as teachers others beliefs, values and ideas, and the final colors are dark and light pink where the *light pink* addresses other concerns and issues of relevance while the *dark pink* addresses classrooms issues. Within the Rich Picture, all the stick-figures have been illustrated as the traditional stick-figure since the gender of the participants is kept confidential.
Figure 7.2 The Complexity of Teachers' Everyday Practices Using of Digital Technology
7.1 Philosophy of Teaching

As part of the teachers every day practices the teachers’ worldviews, beliefs and values of teaching and learning influences them in their teaching. This section therefore presents the teachers’ philosophies of teaching as well as their conditions of teaching affecting their everyday teaching practices, regardless if using the digital technologies or not. The light blue cloud in the right side of Figure 7.2, and the close-up Figure 7.2.1, illustrates the collective worldviews of the four teachers, which does not reflect consensus.

For most teachers participating in this research, their personal experiences in school affected their choices to become teachers (illustrated as a building at the top, middle of Figure 7.2.1). Either they have been inspired by their own teachers (presented as a stick-figure at the left of the school building in Figure 7.2.1) or, as one of the teachers said, compensating for her own failed studies. Only one teacher chose this profession as a result of not knowing what else to choose when she was not able to follow her chosen career. All but one of the teachers did not know from early on what subject they wished to teach. The teachers describe their reasons to become teachers as:

Because I could not become an actress/actor. Then I chose to teach, when I was thinking “What is left to do?” [...] And I have always thought that I would never become a teacher...Dad is a teacher, so I figured I would not become that. But I became it anyway. (Teacher DK)

There is a link to my own school education. I crashed completely... somewhere, and I think it started as a little thought of revenge. But also, the importance of what you accomplish as a teacher is so great [...] It’s the future, I want to be a part of that and shape it. I want to help those who will become our future to get the best future. That’s where it comes from, and then there were not so damn many ways. (Teacher LA)

It’s been something that has been there since I was in middle school. So I kind of felt that it would be fun to be in that position where my teacher was standing and get to communicate and give the message and teach others. So that have been, like a dream almost, from early age, since 10-11 years it was something I felt. (Teacher LF)

I was fascinated by, as I said, by my old teacher [teachers name] when I finished 6th grade. I gave him a hug and said, “I want to be just like you,” I told him. [...] So I have all the time been set to become a teacher. (Teacher MK)

As illustrated on the top left side of the cloud in Figure 7.2.1, none of the teachers wished to become friends with students. With minor variation, all teachers aimed to form respectful and trustful relationships with their students.
Teacher LA expressed aiming for a respectful-distance that would still allow students to be able to turn to her when they needed an adult or when something was bothering them. Teacher LA expressed it as:

[…] respectful distance, perhaps you could say […] I want to keep the distance. Somewhere professional. But I also want them to be able to come to me if there is anything.

Teacher LF expressed a wish to have a relationship with the students that was kind, strict and fair. The teacher also mentioned the lack of respect among students at times, however Teacher LF have not had major issues herself even if sensing the lack of respect sometimes. Below the teacher-student relationship, harsh and strict eyes are illustrated next to an appreciative rose. This illustrates the double-sided perception of the teachers, as they think the students perceive them. Teacher LF recalled the best moments of her teaching career as the times when students come to give her a hug, especially those students with whom she had had difficult times with during the semester. She describes it as:

[…] when someone comes and gives a giant hug at graduation even though we might have had little tussles and had some nagging and stuff during the semester. And the student has not really been happy, but at the end of semester comes and they give you a hug. It is a bit of the reward you can say.

Teacher LA, who has the reputation of being the toughest and strictest teacher among the students, specifically mentioned the students’ double-sided perception and said that she does not care if she is considered to be strict, rigid and tough as long as her students develop and learn what they need to know. She further continued that she does not mind if the students would not consider her to be the kind teacher if that will result in them progressing and learning. This teacher explained that several of her students, at the end of their education, wrote letters of appreciation. The teacher had tears in her eyes when she told about it:

For me it is important that my students learn much and progress, and sometimes it must mean that they think that I’m a horrible [human]. Can they do that without thinking I am a horrible old [human], it is of course good, but if the choice is between having students who think that I am a fantastic person and students who are ignorant…

Yes, but then, I get…it…it…it…it hits so damn deep, because you toil so hard for it to be…for it to be good. And then it was…it was these two girls…who basically wrote “We had never been here without you”
In one class, a student expressed surprise at the teacher’s kindness and knowledge. She told the teacher: “But I thought you were supposed to be strict!” The teacher later mentioned this statement by the student, in one of the formal interviews, where she said it was funny to hear that since no one would deny she being a strict and harsh teacher. However, the teacher further said that humans are multifaceted and that she has high expectations for her students, in the conviction that they are able to achieve much.

To the right of the eyes and the rose in Figure 7.2.1, the happy and sad moments are illustrated as well as a crossroad and a wave at the top right corner. These drawings illustrate the struggles of the teachers in terms of difficulties and challenges they come across on a daily basis, as well as the happy moments illustrated by the rose which motivates their continuing employment as teachers. Teacher MK said that she had to find her own way in order to survive and to thrive in the profession, she said:

> [...] for me to thrive as a teacher, I have to find my way to...a little dramatically stated, to survive, or find a reasonable level, so that I get to say what I want to convey.

The teacher mentions colleagues who experienced excessive stress and mental unhealthiness. Finding balance, given the high demands placed on the teacher, is also mentioned by Teacher LA. She mentioned chaotic situations or changes of context were the teacher had to be able to take control of the students in the classroom and to regain balance and energy. Such situations can at times be challenging.

In terms of the difficult moments with the students, Teacher LA said that when receiving the symbolic, thankful, praising rose (mentioned above), all those struggles and all the negativity disappears. She said it is then easy to once again return to an idealized romantic picture of teaching. Closely related to this the teacher also said is teachers’ self-criticism and self-blaming which can lead to mental unhealthiness. Teacher LA explained:

> [You just] need that small little gratitude and it is...then just...then everything is back tack to the beginning...everything else...all the negatives, all the pains, all the late nights you have had a stomach ache, it’s just “shwift” goes away [...] had I just came here [to the school] because it was a just a job, I had ignored coming. /---/

> [...] the self-criticism...there are many that take the self-criticism...blame themselves, hard. There are many who cannot manage...mental illness is of course enormous.
How the interviewed teachers perceive and see their profession and role as teachers has been the same for most of the teachers, but all have had different images of how it would be and how it is. The teachers’ perception and view of their role as teacher and the reality has been illustrated in the top right side of Figure 7.2.1. Teacher MK mentioned that the reality of working as a teacher

Figure 7.2.1 Philosophy of Teaching
includes more challenges than she ever imagined. However, she also said there are much more opportunities than she initially thought, before starting to work as a teacher. She expressed it as:

*In reality, it is so damn fun, but it is so damn more challenging […] so there are a lot more opportunities and more limitations than I thought.*

Teacher LA said that she used to have an ideal romanticized image of how it would be to be a teacher, referring to the movie Dead Poets Society and the scene of “Oh Captain! My captain!” However, she told that it was a brutal awakening once she actually began to work as a teacher. Teacher LA described it as:

*When you start your career as a teacher you often have a rather romanticized image of how it should be […] You have an image of how it should be, and then you are quite brutally awakened by reality. And it must also be said that there is also a learning here; that reality does not really look as it does at the teacher training college or when you are out on your practices, or as illustrated by the media, but… it is different. You become very disillusioned very quickly. Then this romantic, perhaps idealistic, notions are toned down. You can still have idealistic notions but they gain different forms and they get… well… they gain new shapes.*

Teacher DK, who did not have teaching as a primary career choice, mentioned the profession to have changed much since she initially became a teacher, and based on how it is today she would not recommend anyone to become a teacher. All teachers described the negative image portrayed in media whereas this specific teacher explicitly said that she does not recognize herself in that image (illustrated at the top left of Figure 7.2.1).

In relation to the image of the reality of the teaching conditions all four teachers explained their workload is more than the time they have to their work. The teachers, as illustrated by the stack of books in the middle right part of Figure 7.2.1, argued that new work is added to the work they already are doing without anything being eliminated or more time being given.

The teachers explained the subject knowledge is very important. This is illustrated as a green circle at the right part of Figure 7.2.1. Three of the teachers stated one of their strengths as teachers is their knowledge about their subject matter. Teacher LA described having a flipped teaching approach and using digital technology puts higher demands on the teachers, in terms of content knowledge and pedagogy. Teacher LA said:

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65 Flipped Classroom is a blended learning approach developed by, among others, Eric Mazur, Salman Khan, Jonathan Bergman and Aaron Sams, whereby digital technology is used to flip the learning environment. The students are given lectures, study material or research tasks to prepare at home and during classes the students discuss what they have prepared and further work with the teacher as a mentor or facilitator.
It requires quite a lot of me...it requires very, very much more of me as a teacher today than it did for about 6-7 years ago when I did not have these possibilities [...] It is more difficult to manage when you have to be more focused in class, it places much higher demands on me. [...] Then it also requires higher subject skills [...] Now I have to raise my own general subject [knowledge] level all the time because I know there will be a question that is about things that will come later on [...] So that it places greater demands on me at almost every level.

In commenting on the status of teachers, and whether a technology skilled teacher was considered a good teacher (illustrated in the middle of Figure 7.2.1), the opinion of the teachers varied. One of the teachers argued that since the majority of the teachers at the school are technology innovative and the school has made great progress in adoption and use of digital technology, the status of the teachers is not connected to the teachers’ skills in digital technology. Teacher MK, however, argued that teachers who have high skills in use of digital technology and apply it in their teaching have the status of being good teachers. She refers to a colleague, known to be one of the early adopters in terms of use of digital technology in her everyday education and teaching practice. The teacher said that she is considered a good teacher because of that, and the teacher herself is aware of that and enjoys the fact that she is considered a good teacher. Teacher tells this by saying:

If you know the digital then you have a higher status. Those who know the technology have a head start [...] those who know this, they automatic receive a high status. If you just look at [colleagues name], s/he is...s/he is damn good, s/he knows it and s/he talks about it as well. S/he is very good, and everyone knows it. They turn to her/him and s/he enjoys it, and s/he delivers [the answers]. Ehh... on the other hand I do not have to deal with all those issues... [...] So, you are considered to have greater competencies if you use... Yes, you are probably a more modern, a more...a good teacher if you know digital technology. They will think you are a lot more interesting, more modern, probably a better educator and probably have better knowledge of your subject. But it does not need not be like that in practice.

The teacher education program, illustrated as a lecturing room at the middle of Figure 7.2.10, was mentioned by all teachers. However, their viewpoints varied. One teacher said that when in school, she was inspired to become a teacher and had a clear idea about her pedagogical approach and how she wished to teach. However, after entering the teacher education program, she became “brainwashed” and lost some of that clarity. The teacher further wished that the teacher education program did not provided sufficient training on how to deal with practical situations occurring in the school and in the classroom. Teacher LF said:

You could say that the teacher education program is a bit of a brainwash, and unfortunately, I think I lost a little bit of my...the way I envisioned it. So, I
really rather wanted to learn the subjects and then I would have liked to had more concrete suggestions on approaches, which is not given in the teacher education program.

Another teacher noted that the teacher education program today is completely different from the courses in her day. Content subjects were taken with undergraduate program students of the specific subjects you were focusing on, and passing the courses were therefore much more difficult.

The power and status of the teachers was something not directly in focus, although it could be observed in some classes (illustrated in the lower middle part of Figure 7.2.1). For instance, the following was observed after a short recess during a class:

Somehow they [the teacher and one student] begin to talk about the panel discussion that 9th graders will have in the spring. [teacher] says that s/he will place her in the group that is debating against nuclear power. The girl says her father sells something, and continues that therefore her father, and thereby also she, is for [pro] nuclear power. [teacher] says again that s/he will place her in the group that is against and continues that s/he’ll write it up so s/he does not forget it. [teacher] walks to her/his desk and the student follows. [teacher] writes it down and the student gives up convincing [teacher]. The girl comes back to her seat and continue to say it is unfair because she is for and not against.

After a minute she turns around and asks me to toss the note [teacher] have written. I said she could use her knowledge being for nuclear power to beat the others if she is in the opposite group because her knowledge about its benefits. She says I’m smart and I should become a teacher. She shows a winning attitude and says she will get on with it right away to show and revenge [teacher].

I informed [teacher] about our conversation since the girl was very upset and [teacher] said s/he appreciate interactions with colleagues and what I said is just what the student is supposed to learn (field notes, 2015-09-18)

The power and status of the teachers could also implicitly be observed in their talks of grading wherein one teacher mentioned that there are teachers assigning unfair grades to students to create the impression of being kind teachers among the students, or skilled teachers having students with high grades.

The teachers further had different beliefs in their objectives of their teaching. The varying objectives or aims for approaches have been illustrated in the bottom right of Figure 7.2.1. Teacher LA said that for her talkative, collaborative students is important. She mentioned what she wants to achieve during a lesson is that the students, as observed in one class working with maps, sit in groups on the floor coloring, or a different group creating memory
representing the situation

games, or as a third group put their benches together, or sit as assigned and find ways to work. She said that for other teachers that are not used to this way of working, the students in her classes may appear to be messy and loud. However, this is how she believes that students learn. She argued that if she was to make the students at their benches to do their tasks, they would not be motivated and to learn what they are supposed to. She described it by saying:

[...] that they [student] work with each other, discuss, interact, collaborate.
[...] if someone just arrive in the middle of my...in most of my classrooms, they think “oh what they talk much” and is exactly what they do, and that is the point [...] I thought about yesterdays’ class, that was an excellent example of when it works the way I want it to; when suddenly a group of girls sat on the floor and cut and pasted pieces of paper notes and colored maps. There are quite a few teachers that would not tolerate that, or accept that [...] For me it is more important that they [students] are there now, engaged...and do well...do something...had I just put them straight up and down [at their desks] with a map they would had never worked.

Student collaboration was also emphasized by the language teacher. For her, learning happens through interaction with others so a classroom should be minimalistic. There is no need to have many things, just a place to sit for the students and to be able to reposition the desks in order to have someone to interact with. For teacher MK, the most important thing is to build a personal, human connection with the students and to have a dialog with them. Teacher MK wants to talk to students and to share her own experiences when talking about a certain subject or to connect some part of the lesson to something in the students’ everyday lives. The teacher argued that having this approach makes the students more interested and it reaches them in a different way than a PowerPoint with “cold words” would. She said:

I want to have much contact with the students [...] if you, for example, in your teaching dare to talk about your own life, your own thoughts [...] I think, that they will think it is interesting, it affects them. You do not see a PowerPoint with a bunch of cold words, but it comes from [MK], “[S/he] has been through this”.

The teachers’ beliefs were highly connected to what the teachers’ ultimate wish and aim with their teaching was. All four teachers stated that their wish and ambition with their teaching would be to have strong, successful students, however stated differently. This is illustrated in the lower right side of Figure 7.2.1. Their ambition was to achieve successful, functioning humans with high confides and good self-image, that would indicate if the teacher had been successful with their teaching. Slightly above the successful humans illustrated in the lower right side of Figure 7.2.1, high grades are included in the close-up rich picture. One teacher said that she valued students earning high grades and get as many students as possible to choose the natural science program for
high school were indicators that she had been successful, but throughout the years this has changed. Now the grades are not the most important any longer, which was a common opinion held by all the teachers. For one of the teachers, having good relationships with students and parents and having parents talk positively about what their children have learned or when receiving tokens of attitude is more highly valued. For another teacher, she argued her students having more knowledge than other classes and the students to be well prepared for the upcoming phases in education and life. A third teacher mentioned increased student self-confidence and creativity, in addition to knowledge, to be what she wishes to be the outcomes of her teaching, while the final teacher mentioned reaching the achievements of learning objectives stated for the 9th grade as of primary importance.

The teachers’ philosophies and worldviews affect and influence their everyday practice which will be presented in more detail in the upcoming section.

7.2 Everyday Work Practices

This section presents the teacher daily practice, their practice in terms of their different subjects as well as their lives outside of the school as professionals. Initially the teachers’ everyday setting in the schools is described, see close-up Figure 7.2.2 (middle of Figure 7.2).

The majority of the teachers’ time in school is spent either in the classrooms or at their offices. All four teachers for both schools said that they shared an office with other colleagues. Only Teacher LF, had her own classroom, separate from the other classrooms, where she had made a small office for herself in connection to the classroom. The shared offices were standardized, almost all teachers were observed having the same office chairs, desks and space for their papers and books. The desks were usually too small for them, in terms of having an ergonomic working space. This issue was also mentioned by one of the teachers saying these types of offices and desk are heritage from the times when teachers went home after having their classes. Now however, the teachers have to stay in the school for administrative work.

The offices could at times have loud sound level partially due to colleagues discussing various tasks with one another and at one school due to window and glass-doors placement near the hallway where students have their breaks. In one school, the teachers discussed students’ progress and other specific issues with each other in their offices. Discussions concerning use of the digital technology also occurred, which could consist of frustration as well as assistance. The latter might include sharing positive examples about working with the students. At the other school, similar discussions could rather be observed in the lunch- and break room, in addition to talks within shared offices. An observation made was all teachers having a printed version of their
own schedule either in front of them or on the wall next to their desks. This has been illustrated at the top-left side of Figure 7.2.2. Even Teacher LF who did not use her desk at the shared office had printed versions of the schedules at her desk. When initially meeting with the teachers two of them send their schedules via email copying the schedule, or taking a print-screen of the online schedule, while one teacher asked the administrator on a different floor at the school to print number of copies of schedules for her, illustrated in the bottom-middle of Figure 7.2.2.

![Figure 7.2.2 The Everyday Setting](image)

The classroom settings at the two schools differed, as illustrated in the middle-bottom part of Figure 7.2.2. At School A, the furnishing of the desks was traditional, with two or more single benches next to one another. In front of the classroom, there was a teacher’s desk. Next to the interactive whiteboard in front of the classroom, a stand was mounted on the wall for teachers to place their iPads or laptops. They could then connect easily to the Internet and project onto the interactive whiteboard. In School B, the student benches were arranged in groups of four or six, and in front of the classroom, instead of a teachers-desk, a small tall table was installed next to either interactive or
traditional whiteboards. For some of the teachers, it was at times challenging to use the projector and the interactive whiteboard when they wished to also write additional notes or instructions on the whiteboards. Or the opposite was also observed: they had notes on the whiteboard that they wanted to keep but they also wanted to project something. The teachers would either have to turn the projector off and write or they had to erase what they had written on the whiteboard before turning on the projector. One classroom had a traditional whiteboard on a separate wall in addition to the interactive whiteboard in front of the class, enabling the teacher to write additional notes on the traditional whiteboard while projecting something else on the interactive whiteboard.

As for using the interactivity of the whiteboards, none of the teachers used the interactivity any longer since, as mentioned by one of the teachers, it is too slow and clumsy. Teacher LA said she would not connect her iPad or laptop, as illustrated in the middle of Figure 7.2.2, to the projector and whiteboard since it takes too long to get started and connected. Teacher LA expressed this by saying:

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\text{[...] it will be quicker if I just write something on the whiteboard with a normal pen then if I would launch a projector that takes three minutes to start, and then connect a computer that takes three minutes to connect with the projector.}
\]

In addition, it was observed that the teachers’ laptops would frequently go into sleep mode, which required that teachers had to once again sign-in to their computers. The inconvenience had prompted colleagues at one of the schools to look for alternative solutions. Also, the way teachers used the projector and computer would vary. One teacher used the freeze function of the projector while sending email to the students or doing other things, while another teacher would not have mirroring, but double screen setting enabling her to have one screen shown to the students and one screen for herself with other things she needed or did while projecting the computer. Out of the four teachers, Teachers MK did not use the projector and whiteboard at all, although the whiteboard was used a limited number of times as a traditional whiteboard. Teacher MK mentioned that she does not know how to start the projector and how to work with the computer connected to the whiteboard. An additional concern of this specific teacher was uncertainty about what she would do if technology would not work and she had planned her lesson based on a power-point presentation or other application. She said:
[...] I have no idea who to call. I do not know who can fix it. It takes easily more than 10 minutes to solve, ‘shoof’, and the lesson is ruined. Your intended plan for the class is ruined as well. Maybe you were going to show an incredibly exciting image, to have it as a starting point for your entire class. The entire class fails because you do not get the projector going. It has happened too many times in to order for me to connect [to the projector] like that.

The availability to power-outlets (illustrated in the bottom-middle of Figure 7.2.2) in the classrooms was also observed as an issue. Most classrooms, beside the classroom for natural science subjects, only had power-outlets on one single wall, which meant that those students who did not have charged devices (will be further described in section 7.5) would have to change their predetermined seats to sit closer to a power-outlet in order to charge their devices during classes. An additional issue observed in some classrooms was the bad air occurring after a few hours (illustrated as $O_2$ next to the classrooms in the middle of Figure 7.2.2). The oxygen level would decrease so the teachers had to open up windows to get some fresh air for five-ten minutes before the next class started. The sound level and high intensity of some lessons also drained teachers’ energy after some classes.

Part of teachers’ everyday practice is the subject matter they teach. Figure 7.2.3 illustrates the various subject content taught by teachers included in the research. Some teachers explicitly and others implicitly emphasized differences between the subjects, which were also observable during classroom sessions. The subjects taught by the teachers varied in terms of being theoretical or practical, but also in terms of status. Practical subjects are illustrated as tools drawn in the top of Figure 7.2.3. They typically produced louder classes. However, they were not necessarily chaotic or messy. Handicraft subjects, due to the use of various tools, produced more noise as students walked around to find tools and materials they needed and helped one another. In such a class, the handicraft teacher moved around between students for the entire class, and sometimes even a few minutes after a class in order to help some students waiting for her to get to them. In between classes, the teacher would re-organize tools and materials. She mentioned that using her time like this provided some time to reflect. A similar situation could also be observed for Teacher MK who taught both theoretical and practical subjects. During the practical classes, the teacher did not seem to be enough for the students in class and to help them with their concerns while in the more theoretical subjects she taught this was not observed. Troublesome and special needs students did of course also appear in these classes, however less visible.
Aside of the teachers’ practice at the schools many of them continued their professional roles as teacher outside of the schools, and their lives outside the classrooms would affect their everyday practice. Some of the teachers explained that they would continue to work at home and either do preparations or completing administrative work. Therefore, after finishing the working day, the teachers would take their computer and/or iPads home, illustrated as a house in the top of Figure 7.2.4. Further, all teachers in this research had social media accounts. The social media was used differently by the four teachers and the applications they used could include accounts on Facebook, Twitter, and/or Instagram. In addition, one teacher also recently started to use Pinterest. The teachers accounts could either be professional, when for instance they were in contact with their students (illustrated as dashed purple line in Figure 7.2.4 or see Figure 7.2 for the whole relation); or the account could be public but still based on their professional roles where they could be in contact with colleagues (illustrated at the top-right side of Figure 7.2.4); or their account was private where the teacher would only be contact with those she wished. These account were not necessarily mutually exclusive. An example of the varying social media accounts is Teacher LA’s

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66 In this dissertation, social media accounts are discussed which were either directly observed or mentioned by the teachers. This is not an exhaustive list, since some of the teachers may use several applications about which the researcher is unaware.

67 The Pinterest social community is a catalog of ideas where users can upload and organize their pictures/images and other media, referred to as pins, to various pinboards.
Twitter accounts. She has separate Twitter accounts, one professional-public for connection and communication with other colleagues, researchers or anyone interested, and one account specifically for her students for publishing material relevant for them and their classes and courses. In terms of using Facebook with the students, some of the teachers had created groups where the students also were included and where the teachers could give them information, send instructions, notes, and so forth. Teacher LA explained this could enable her to very quickly answer a student who needed help to move on, even when she was not at school. She described it as:

[…] this with social networks and social media opens new ways to communicate with students. So, at some point every day when I’m at home, I connect to my chats [chatting applications] and check: “Have I got anything?” I can provide direct input to students, when they have questions.

Teacher LF mentioned using Instagram to publish students’ creative work. The teacher would not follow specific students on Instagram, however, since the students would borrow the teacher’s iPad they could follow themselves and they would also upload pictures of their work. Teacher LF was fully aware of the students uploading pictures and would control what the students had posted so it would not be inappropriate. Further, having an open, however professional, profile on Instagram, Teacher LF mentioned even having parents following and “liking” what she published.

Privacy issues were also observed and highlighted by the teachers. Both Teacher LA and LF were very much aware of not taking or publishing pictures of the students’ faces. In classes by Teacher LF where more pictures and videos were taken, the teacher was extra cautious especially if the students explicitly mentioning not wanting the teacher to take their picture. The following was observed during one class:

*LF takes [her] iPad and starts to take pictures of the students’ work in progress.*
*One of the girls says “not me” and LF responds “No, but leave your hands”.*
*LF walks around and takes pictures of some of the students’ work, usually from behind or above (Field notes, 2015-05-29).*

Beside using social media to connect to students or to other colleagues, scholars, experts, etc., some of the teachers were interested and active in other activities directly related to their role and profession as teacher (illustrated in the top of Figure 7.2.4). Some of the teachers were active in following current, up-to-date research either in their own subject field and/or in the use of digital technology for education. A number of the teachers were also active in unions and political endeavors related to the further development of the Swedish school education. Others reported being part of groups and committees for development of national tests.
In the middle-left part of Figure 7.2.4, prizes and honorary distinctions have been illustrated as some of the teachers that have been awarded these either as part of their endeavors in their own subject fields or in relation to improvement of education using digital technologies. The acknowledgement of the teachers’ nominations or awards varies between the schools. One school leader argued accomplishments in technology is not acknowledged or rewarded, she said:

*No, it is as if I would reward anyone who uses Wings Teaching materials in English. So, no, everyone has…. no, it is a tool just as the pen and paper.*

While the other school leader urged acknowledgement and reward of teachers’ accomplishments in using digital technologies by saying:

*Yes, it is acknowledged in the end when we have the salaries revisions, because when someone who is very driven and… well it is about the development, showing that you want to be involved in developing this school. Therefore, it is obvious, it is like anything else which is about benefits for the students.*
None of the teachers, regardless if they have been nominated or won awards, perceived accomplishments in use of technology is specifically acknowledged in their school. This was perceived by some of the teachers as unfair and not right. Acknowledging driven teachers nominated or winning awards and using them to set examples were not something the Department of Education did either. However, the representatives from the Department of Education argued it was important for the schools do so. The Head of Department and Director of Education explained an organization, that provide in-service training and help schools and teacher in use of technology in their teaching and learning, that honor and acknowledge driven teachers who successfully use digital technologies in their teaching practices.

7.3 Combining Traditional and Digital Technologies

As evident in previous sections there is a variation in practice in terms of using the digital technologies. The teachers involved in this research combine digital and traditional technologies in their everyday practice, and this will be further presented and elaborated in this section.

In the right-top corner of Figure 7.2.5 (illustrated in the bottom-right side if Figure 7.2), traditional learning material, digital learning material and various applications and online resources are illustrated. Within a single lesson, it was common to observe the teacher and students using all these resources, sometimes also in combination with projection of the teacher’s computer or iPad. Examples could be observed at theoretical class, where the teacher had copied several maps on paper (different continents, the world map, etc.) and also provided the students with coloring pencils. The students were given a list of names and places they were supposed to learn. This list was published on the teacher’s webpage, on the class folder on Google Drive and also available as a paper copy in the front of the classroom (illustrated in the center of Figure 7.2.5). Going through the list, finding, coloring and learning the different places, the students could use either a traditional atlas or they could use their computers or iPads (or mobile phones if they for some reason did not have their computers or iPads). For some students, the teacher could recommend the Google Maps application, while those students the teacher didn’t notice could search for maps on an Internet browser. In addition, the students would search for images and photos, increasing their curiosity, which they would discuss with each other or with the teacher. For the language classes, the students could find information and type on their digital devices while using a traditional dictionary to find the words they needed. At one language class the following was observed:
The students speak English with each other. Two student fetches dictionaries from the bookshelf in the back of the classroom [...] the students write on their digital devices but aside they use a printed traditional dictionary. Most students fetch dictionaries. (Field notes, 2015-12-09)

The teacher asked the students to write and submit their short papers by hand and on paper. The reason for this was to practice handwriting. The teacher told the students, and later explained in an informal interview with the researcher, that the national exams may no longer be conducted on computers and digital devices if the Wi-Fi connection cannot be turned off during the exams. If the school is not able to ensure the Wi-Fi connection is turned off, the school will have to pay a high fine, and therefore the teacher was preparing the students to write by hand. The teacher explained that there are different skills needed (illustrated in the top-right corner of Figure 7.2.5) and used when writing a text by hand in comparison to writing it digitally. By this, the teacher emphasized that when writing a text by hand, students need to plan the task. It takes longer to write by hand. They do not have the possibility to copy and paste text and move chunks of text in the same way as on a digital device. In addition, the teacher also said that it is known that the quality of handwritten text to be lower than digital written text.

Teacher LF uses the traditional and digital material differently compared to the other teachers since her subject is practical and hands-on but also since there is no suitable learning material specifically aimed for that subject. So, as illustrated in the top-right side of Figure 7.2.5 next to the traditional material, the teacher created iBook material for her students, in addition to using Google Drive and laminated paper copies. For the iBook, the teacher recorded tutorial videos (using her iPad) and combined it with instructions and models. The teacher said, however, that she has not had the time to create as many as she wishes and further, currently the digital material is shared on her website and on Google Drive, while the videos are stored separately and locally on her iPad.

The use of digital and traditional means for providing the instructions and tasks to the students is illustrated in the middle of Figure 7.2.5. Google was used by Teacher DK, Teacher LA and Teacher LF. Teacher MK did not use any of these means but rather gave instructions orally, asking the students to write them down on their computers or iPads. The teacher did, however, use the digital interactive learning material provided by the school, in combination with traditional paper notebooks. The Google services used by the teachers varied. One of the teachers, Teacher DK, used Google Classroom and Google Sites combined with sending instructions and links to her students by email. Teacher DK also used Dropbox in her daily practice with the students. Teachers LF used Google Drive only, while Teacher LA used Google Drive with add-ons enabling her to assess and comment on the students’ assignments in real-time and increase the speed of her work. Teacher LA at one point
mentioned she would no longer work with Google Site since she conceived the system as hopeless. Teacher LA built a separate individual website, and would not use Google Site even when the school leader initially had asked her to do so (illustrated below the classrooms on the left side in Figure 7.2.5).

The teachers using various technologies came across different challenges in terms of structuring the folders and organizing the material on a central server, as well as the students’ lack of technology skills. An additional issue observed and mentioned by some of the teachers using Google applications was challenges with the students’ emails. The students needed to have a separate Gmail email account additional to the one provided to them by the school. At times, the students would provide wrong emails, misspelled email addresses or change email addresses and not notify the teacher. Then the teacher would have to solve the problem, sometimes in the middle of a lesson. At one occasion when students worked with assignments stored in Google Drive the following was observed:

Another student says that he cannot access Drive. [teacher] responds that it is because he has not given his email address. The student gives his email address and [teacher] adds the student.

/---/
[Teacher] helps another student who has problems with Drive. [Teacher] removes him from the list and adds him again. [Teacher] explains and shows the student that his document was stored in the wrong place.

In the end of the class [teacher] says to the whole class that because too many students either given the wrong email addresses or changed email addresses s/he have had to put half the class to take care of technology hassles instead of helping the students. [Teacher] tells how important it is to give her/him the correct information (Field notes, 2015-09-01)

In addition to Google, Teacher LA and Teacher LF also used QR-codes for linking to various assignments (illustrated in the middle-left side of Figure 7.2.5). Teacher DK used QR-codes as part of the students’ assignments and also submissions. In an interview with Teacher MK she expressed her wish to be able to use QR-codes referring to a colleague using QR-codes in her teaching. She said:

[...] whatever it is called, which looks a bit mysterious, one of those squares where you can click on it, take a picture of, and then it plays a video clip which s/he [colleague] recorded in the classroom. Of course those things are fascinating, and I’d…If I only can find a few things like this then I would like…I think that is what is my next step, that I learn one of these cool things [...]
then the students would keep their phones. The forbidding of mobile phones during class by collecting them in the beginning of each class was only implemented at one of the schools. The students would not always bring their laptops or iPads to the class, either forgetting them at home, had turned them in for service or not receiving them after vacations (those who had chosen to give the device back to the school over the holidays). In several instances when the students had forgotten their devices at home, the teachers would either tell the students to use their mobile phones or the students would do so themselves and then ask the teacher for approval or showing the teacher what they were doing or had accomplished. In a few cases, the teacher would lend her own iPad to the students. This occurred most frequently in the handicrafts class where the students would borrow the teacher’s iPad to look at instructional videos while the teacher was helping some other students. During one class with a 9th grade class the following was observed:

[teacher] takes his iPad to show the student how he should do his leather bracelet.

/---/

Another student has now taken over the iPad and follows a tutorial on it to see how he should do with his cabinet. He does not seem to need [teacher]’s help right now.

/---/

The leather bracelet-student, furthest away in the classroom, takes back the iPad.

/---/

Even the singing girls want to borrow the iPad but are not able to take it away from another student that is using it.

/---/

The iPad that somehow ended up with the girls goes back to the student with the cabinet.

/---/

After a while the girls take the iPad back and receive help from [Teacher] in person. (Field notes, 2015-05-28)

The travelling of the iPad could be observed during several classes, where the students would watch instruction movies made by the teacher and then concluding what they were supposed to until the teacher could help them. The travelling of the iPad also illustrated the teachers’ creative use of digital technology. A more expanded description of the teachers’ use of digital technologies is presented next.
7.4 Using Digital Technologies

All informants expressed having a positive fundamental attitude towards use of digital technologies in schools. In terms of the teachers’ use of the digital technologies, some examples have been presented above (e.g., combining paper based maps of maps using traditional printed atlases or Google Maps; writing language assignments on the computer as well as by hand). In this section, Figure 7.2.6 presents a specific use of a specific system, and Figure 7.2.7 presents the general use of digital technologies as observed or described in interviews with the teachers.

In order to report and log students’ grades and attendance the schools have been provided with a central server which can only be accessed within the school network. One of the teachers described and showed how teachers needed to access three different files and another system in order to fill in one document for one student. The teachers using this system were frustrated by the complexity of the system and the time it consumed to perform even the simplest activities. This central solution was only used by one of the schools, one school told the Department of Education that they won’t use this central solution since it is difficult and inflexible to use. In that school, the teachers have now started to use paper binders, as they did previously, to store records on the progression of the students. Within the school which uses the central system, teachers explained several challenges and drawbacks complicating their daily work. It is illustrated with the purple line in the middle of Figure 7.2.6 that the server is not always accessible and is lacking in usability. The teachers can not always access the server since it at times can be down for indefinite periods of time.

When accessing the server, the teachers face a large number of unsorted folders, each containing a variety of documents. The files 1, 2, and 3 above the folders illustrate the assessment of the students’ individual progress prior to parental-meetings. When one teacher opened one of the documents within a certain student’s folder (either a Microsoft Word file or a Microsoft Excel file), no other teacher can access that file because the file will be locked. Some of the teachers described situations when colleagues had opened a document but forgotten to close it, hindering other teachers’ access. One of the teachers mentioned a self-assessment part where the students are supposed to fill one file and in order to do this the teacher need to check with other colleagues so that she, together with each individual student, could fill that specific document during a class without someone else opening the document. To solve this problem one of the other teachers has created a QR-code linking to a copy of the file where the students go to fill in the form which the teacher later copies to the correct file. This teacher also uses a “making a copy” approach in order to be able to work at other places (illustrated with a dashed purple line at the right of Figure 7.2.6 and also in the top-left of Figure 7.2.6).
One of the teachers also described and showed how teachers needed to access three different files and another system in order to fill in one document for one student.

This system was also the foundation of a learning platform that the Department of Education decided to implement at the school which, due to its complexity - even for technology-knowledgeable teachers, was later decommissioned. Now only the grading and assessment part of the system is used. When asked why such systems were selected, one teacher said that negotiations and costs affect the decisions by the Department of Education.

In addition to teaching, the teachers at the schools act as IT-support for one another. This is illustrated with the dashed orange line in Figure 7.2.6. One teacher's workload assigned 10% of her duties to help colleagues with technology related issues. Either the colleagues could book an appointment with her at a certain time during the week or they could contact her and she would reply when she could. One of the school leaders mentioned appointing two of the teachers to be more in charge of the IT-related issues. Teacher MK who is uncomfortable with digital technologies mentioned she knew which colleagues to turn to and talk to anytime she needed help. The environment
among colleagues at both schools was supportive and helpful. As also mentioned previously, colleagues offered recommendations to one another in day-to-day conversations.

Aside of the central system the teachers use a variety of digital technologies. The teachers’ overall use of digital technologies, aside of the central system, is illustrated in the close-up Figure 7.2.7 (middle-right side of Figure 7.2). As mentioned in section 7.2 (Everyday Work Practice), the teachers either had their laptops, iPads or both with them when having lessons. However, usage of their digital devices varied based on the lessons and students. For instance, one teacher, Teacher MK, would bring her computer to the classes, but sometimes did not even start the computer. At other times, she would leave the computer running and the battery would be depleted. At other times, she used it for other work, e.g., replying to email, seeing which students submitted their assignments, or checking on a co-written exam. She occasionally also used a device to access the digital learning material. The teacher has a new iPad that she mentioned several times is in its box in a drawer at home. She has never used it, illustrated with a red cross and dashed purple line in middle-left side of Figure 7.2.7. Teacher MK, however, mentioned being a master when it comes to the use of teletext, knowing all the number for the various pages. For two of her classes, she had printed the result-table for some sport, handing it out to the students as part of the lesson as well as bonding with the students.

One of the fears of Teacher MK she mentioned was backing-up her laptop (illustrated in the middle of Figure 7.2.7). She said she has some of her planning and material in the laptop but she does not know how to do a back-up and she could not dare to think what would happen if her computer would crash. She said when she thinks about it she reaches a stage of denial and pretend that the problem does not exist or pretend that nothing could happen. During one interview Teacher MK expressed this fear and denial by saying:

I use this [laptop] and write all results and…everything is in the computer, you know. All grades and everything like that, so I’ve ... I’ve got my brain, and it [laptop] is sort of a hard drive to my brain. At the same time...so I feel a little, “What happens if my computer crashes?” I don’t know how to do such things. Back up. So I am like “Ahh la la la...”, “I hope it keeps”.

Illustrated in the right side of Figure 7.2.7, the range of lack of belief in digital technology is illustrated with a flash and a straggling circle. The instability, discomfort and complexity of the current technology, either devices or systems, was mentioned by most of the teachers, with Teacher MK holding the extreme position that technology has never worked and will never work either. Despite never having shown interest, engagement or effort, the teacher expressed a wish to learn to use digital technologies to produce something “fancy”. She anticipated that she needed to pass a doorsill (illustrated in the top-right side of Figure 7.2.7) to get started and get going with technology. The teacher explained at times feeling embarrassed by not having gotten
started and using the technology. Throughout an interview Teacher MK explained her thoughts on the digital technology as:

[...] I could also imagine using in it [digital technology] some cases. But it fails a bit because of my interest, that I do not ... I have not committed myself to have something like this, so that I can get it up and running super-fast and it’s sort of...I have a small doorsill as well, I...little as you saw here, as soon as...so...it gets a little overwhelming. I would like to get over the doorsill. The question is how much strength and energy it would require of me [...] I do not have time to get myself over the complex, gigantic doorsill. I have not managed to get over it yet because I do not know where to start.

[---]

[...] for one week, with one full-time employee and I could just do not care about teaching. I could almost sacrifice my summer vacation for a week, just because I know...I would like to avoid having to feel ashamed because I'm so bad at this.

[---]

Yes, I would simply like to use flashier, modern, gorgeous video clips, as [colleagues name] showed. [...] in a dream world, I would like to teach my students something no one else has. Only one thing.

Figure 7.2.7 Using Digital Technologies

Teacher MK mentioned also the feeling of shame in terms of sharing of resources, saying that she cannot borrow resources and material from other colleagues when she doesn’t have anything to give back in return. Previously, in the times of overhead-devices, she was able to reciprocate. But she has no materials to offer for today’s technology and does not wish to reach a point where people dislike her because she borrows materials and does not give anything back. Regarding the use of technology, the teacher stated that she prefers traditional technology for herself and digital technology for students.

In addition to the teachers’ philosophy and closely related to the teachers everyday practice using digital technologies is the students and their role in the complex situation.
7.5 Students and the Parents

Students and the parents include the fifth part of the representation of the situation, and the first part including actors external to the teachers. The close-up Figure 7.2.8 (right-bottom side of Figure 7.2) illustrates the teachers and the parents’ part of the situation.

The groups of students and dynamics of students within a group and/or class are mentioned by all teachers. Within a single class, several types of students can be identified: the ambitious students, the struggling students, the troublesome students, the students with impairments, the students with special needs in terms of language barriers, etc. One teacher described this by giving an example of her situation with the varying students:

In my class I have one that I can’t orally communicate with, [students name], because she speaks Arabic and I speak Swedish. She had no help last semester, she was just sitting there. I don’t know how to handle that. While I at the same time I have two students with double diagnosis with ADHD and Asperger, I have additionally two students who are on the 5th grade knowledge level, no passed grades at all. At the same time, I have three students who abused a disabled person…eh…this summer, so there is an ongoing police investigation […] and somewhere there I have the ambitious students that…and it is my role…I can never ever forget them either. But there you have the range, and then you are alone in a classroom, with all these and have to provide for everyone’s special needs.

All four teachers explained there are always varying needs among students in a class and the amount of resources needed, available, and absent for these students. In Figure 7.2.8 (bottom right side of Figure 7.2), the different types of students within a class of students have been illustrated with dashed dark blue lines in the middle of the figure. Below the illustrations of the classes of students, the students needing additional resources are represented. At one occasion one student was observed refusing at first to come into the class despite the teacher, her mentor and a resource personnel trying to convince her. The student eventually entered the class, a relatively calm class with calm students, and disturbed the rest of the class. At a different class, the same student attended the whole lesson and participated in the teacher review of the subject answering questions, correctly. The student could sometimes be loud but this specific class she would listening to the teacher. Additional students were observed not sitting calm and still during a class when having a resource personnel next to them, and the same students in other classes sitting the whole lesson with their mobile phones playing, listening to music and using social media. These students have in another class been observed sitting and doing the assignment like the other students, however with traditional books and paper and pencil in contrast to the other students using their digital
devices (illustrated in at the left of the troublesome students in the middle of Figure 7.2.8).

The resource personnel (illustrated on the bottom middle of Figure 7.2.8) are most often people, not always with a teaching background, employed to help in certain classes with more troublesome students or translators helping students that do not understand the Swedish language. These resource personnel do not participate in all lessons and are not always present for full lessons, sometimes leaving the teachers handling and dealing with these students by themselves. In this research, the teachers have mentioned, and it have been observed, that the teachers sometimes look past these students as if they do not exist, and sometimes they devote more effort and time to them, resulting in the teaching and lesson as a whole suffering from the teacher’s divided attention. It could at times be observed that one of the teachers would not care about one of the students sitting and playing with his mobile phone as long as the student would sit quietly and not bother the rest of the class. At one occasion the following was observed and after the class acknowledged by the teacher:

*The resource personnel follow the student to the [classroom] door and then leaves the class after being assured that the student is calm. The student sits with his mobile phone most of the time.*/ 

*/teacher* asks about the student and I tell about him. *teacher* says that there are those occasions where you just close your eyes and ignore them because it is exams soon and you have to focus on the other students. *(Field notes, 2015-09-16)*

It could also be observed at several occasions that if resource personnel were present, the student most likely did more work. Another incident observed was when a few of students from a different class removed one of the bathroom doors outside the classroom resulting in the teacher having to run out and deal with them, making the class lose their working momentum and especially bothering the students that had difficulties focusing and getting started in the first place. Similar happened another time when some students were rough on the Ping-Pong table, or yet a different situation when some students started to play with a football indoors. The teacher then rushed out to the hallway and, in this specific case, having one resource personnel, leaving the student she was supporting, that could to deal with those students and allowing the teacher to get back to her class. These personnel become an additional cost for the school leaders which the school leaders have to consider in establishing priorities for their school budget. Such prioritization challenges were also mentioned by the District Manager, who mentioned that school leaders should not have to choose between digital technology, student well-being, special needs, etc.

In the middle left side of Figure 7.2.8, a cloud with the text conservative is illustrated representing the worldview of some students in terms of school,
education, teaching and learning. Teacher LA said the students very often are conservative in thinking about how school ought to be. This is partially based on their backgrounds and partially based on the traditional image of the school. The teacher said that the students many times wish to sit in straight lines, read in books, write in notebooks and put their hands up when wanting to say something. The students have, according to the teacher, sometimes been those who have protested the most when she changed something, such as using digital devices or teaching methods. Teacher LA describe the conservative students in an interview by saying:

Students are conservative, that is, students want things to be as it always has been [...] some of them have for 6-7 years been sitting in straight rows and raised their hand, and read from a book, and wrote in a notebook...some of them. [...] I have experience of student groups that protested loudly when I wanted to use some stuff, digital technologies and such.

The school environment and the school as an organization is according to one of teachers and the Head of Department in general known as being conservative. The Head of the Department and Teacher LA said:

We are a quite conservative organization that have many demands on us [...] (Head of Department)

In many people’s beliefs, this is a fairly conservative workplace, there are many people...so, there is traditional view on the school (Teacher LA)

![Figure 7.2.8 The Students and the Parents](image)

Relatedly, the students possess limited technology skills, as illustrated as a diamond on the right side of Figure 7.2.8, as mentioned by three of the
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teachers and the District Manager. They argued that the general image of the young generation of students is that they are skilled in the use of digital technology. However, this is only valid in terms of familiarity with certain applications and media. Several of the informants asserted that students’ technological knowledge is limited. For example, an observed student did not know how to print a document from the teacher’s laptop and did not know about margins and landscape mode for a Word-document, yet he commented negatively on the teacher’s use of Internet Explorer.

The students’ access and use of digital technologies consist of either laptops or tablets lend to them by the school, as part of the 1:1 initiative. In addition, many of the students have their own mobile phones which they bring to class. At one of the schools, the teachers have received directives from the school leader that the mobile phones are to be collected prior to each lesson. This has been illustrated with a box at the top, right of Figure 7.2.8. This was observed, however, to be done only inconsistently. Some teachers in some classes collect the mobile phones, some did not, and sometimes the students themselves would put their phones in the box, usually placed on the teacher’s desk in front of the classroom. During observations, it could be seen that students that came late to the class would keep their mobile phones and the teacher would not say anything to them. Another example is when students chose to pretend to not have their mobile phones with them and would get away with not putting their phones in the box (this was observed as the students later during class would take their phones out of their pockets). For some classes, individual students not having their tablets or laptops for various reasons would ask the teacher if they were allowed to take their phones back and use it to do their assignments. The teacher would allow for this and, for some students, and would check after a while to make certain the phone was being used for the right purpose.

Another striking issue was the students’ handling of their devices which was observed and also mentioned by some of the teachers and the District Manager. The students often would come to class with their tablets and computers (even phones) uncharged and would have to change their seats in order to sit close to a power-outlet. A few times, it was also observed that the students did not have their chargers with them, so they asked other students or the teacher to lend a charger. The handicrafts teacher had solved this issue by having an additional charger that she would lend to the students, to avoid risking the disappearance of her own charger. The handicrafts classroom was the only room with sufficient, conveniently placed power outlets, given the number of students and devices in the class. The handicrafts teacher would also lend her iPad to students. While the other teacher had two iPads and would on special occasions lend out one of the iPads to the students, the handicrafts teacher only has her own tablet. On the tablet, the teacher had recorded instruction videos and the students would borrow the iPad, at times queuing for it or taking turns, to watch a video on how to do the next step and get instructions on what to do while the teacher was busy helping other
students. It could at times be observed that the teacher would lose track of where the iPad was and three groups or individual students would pass the iPad between them.

At the observed handicrafts classes, students displayed negligence in looking after or caring about their devices. The computers or iPads could be left on the table while a few centimeters away they would saw a piece of wood, getting wood dust on the devices. Some of the students could paint with their iPads nearby, risking getting color on them. An instance that was observed during one class:

Another student has put his computer under the benches and it is therefore drowned with wood dust. He stands on the chair and with his mobile phone he takes a picture of what he has made. He picks up the computer from under the bench and place it on the bench. He transfers and opens the image on his computer (missed how he did) and then puts the image in a Google Word document and adds some text (his current product differs from the original drawing and [teacher] have said they can write and explain changes instead of doing a new drawing). It looks like a well-structured document including of both images and text. He worked on the document for a little bit, took a new picture, added it to the document and updated the text. Then the computer is put under the bench on the floor again. After a while one of the clamps is suddenly loosen and falls straight down on computer, which does not get damaged. [teacher] says: “It is lucky that we have durable stuff”. (Field notes, 2016-05-27)

This was an observed issue not only in the handicrafts classes but also in other classes where the students would drop their iPads and think nothing of it. The District Manager also explained the students’ negligence, including seeing students using their tablet devices as Frisbees. The District Manager described this in her interview:

[...] they [iPads] are used for everything from Frisbees to Ping-Pong bats and things like that.

Bullying became also in focus in the research. An issue observed in the teachers’ office at one of the schools was a discussion between some teachers addressing a serious event of bullying via social media. A student had via social media been badly bullied, leading to the student seeking professional psychological help. The talk among the teacher colleagues recognized that, even if they were to remove the students’ mobile phones, bullying can occur with tablets, since student have the same applications on their tablets.

In addition to the varying student groups, the teachers have a relationship with the parents (illustrated in bottom left of Figure 7.2.8). In addition to the parents having direct influence on their children, either in a supportive way or in a less supportive manner, the teachers as well as the school leader have direct relationships with the parents. The parents do often question the
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teachers, their way of conducting their work, their grading and at times the importance of education in general. The curling\textsuperscript{68} and constant serving of the students are mentioned by several of the teachers. One of the teachers also explained that some children and families consider extra curriculum activities outside of school to be more valuable than the school curriculum. The teachers also mentioned encouraging and praising parents. One teacher referred to her colleagues but also explained in an informal interview that parents discuss and appreciate the access to the teachers’ webpage where information about what is happening in school can be gained. Some of the other teachers use email as a means of communicating with the parents and keeping them updated about the school.

In addition to the students, parents and resource personnel included in this section, additional actors have also contributed to the representation of the problem situation described in this research. The following subsections describes therefore the representatives from the CIO from the IT-unit followed by the Department of Education, the School Leaders and.

7.6 Centralized IT

The Centralized IT section presents and describes the central IT-support function. Figure 7.2.9 is a close-up of the top-left corner of Figure 7.2, which represents, the IT-unit and the perspective of the CIO of the IT-unit.

The central IT-unit supports the whole municipality, including over seven different departments and administrations, comprised of over 7000 employees (illustrated in the top-left of Figure 7.2.9), as well as approximately 200 different systems and 16 000 units, whereas 10 000 of the units belong to the schools (illustrated at the top of Figure 7.2.9). The total number of cases the IT-unit received during a year are approximately 30 000. The CIO of the IT-unit stated that approximately 33 percent of the cases is related to the schools and, specifically, to educational practice. However, according to a teacher in this study, the percentage is much higher, approximately 70 percent.

To left of middle in Figure 7.2.9, the IT-unit’s strategy is represented as the abbreviation TESA\textsuperscript{69}, which stands for transformable, economical, secure and accessible. This approach builds upon directives and national laws from, for instance, the Swedish Data Protection Authorities. It is uniformly applied in all departments within the municipality. It is the TESA-strategy that the CIO of the IT-unit refers to when stating that it is not possible for teachers to have

\textsuperscript{68} Curling is a concept used in Swedish closely related to the English terms cossetting. Curling refers to parents that increasingly interfere in their children’s lives and development. It refers parents that wait too much on their children. There are ongoing debates from several perspectives on the challenges this (could) raise for the children.

\textsuperscript{69} The actual abbreviation used by the IT-unit is different and in Swedish while this is a free translation of the concepts
their own solutions. Rather, they must follow the data protection laws. The teachers are aware of these laws; however, they still choose to use applications such as Google.

In the interviews the CIO of the IT-unit said that they can provide any solution to the teachers as long as the teachers and the school tell them what their needs are. The CIO explained:

We really can solve all your needs, but tell us how it looks in four years and we will help you with the solution that will last the longest. [...] they [the department of education] have to collect the needs, and they cannot be unique for different schools. If we have 100 schools, the goal achievements are the same.

The CIO however asks for one single solution for all teachers and wishes to know what the teachers need and want for couple of years ahead. This has been illustrated as a puzzle and cloud at the top of Figure 7.2.9. As illustrated further down on the figure with speech bubbles, the CIO is, however, not interested in having a direct dialog with the teachers. Rather, they wish instead to have a dialog with the employees of the Department of Education located in the municipality building. The CIO of the IT-unit said there is no need for her to have insight into teachers’ daily practice, because the teachers are those who are knowledgeable in what they do.

For the CIO of the IT-unit, the teachers are compared and considered no different than other employees of the municipality, as illustrated at the top-left
of Figure 7.2.9. However, the CIO mentions the support given to the teachers to be more limited than that provided other employees of the municipality. The teachers can currently contact the central IT-support for three problems as illustrated in the middle of Figure 7.2.9: printing, server access and personal employee account. The CIO explained this is due to budget concerns. However, when the school leaders mentioned the limited services, they argued that they are paying high amounts of money while not receiving needed IT support services. One School Leader explicitly said that the IT-unit considers itself as the client of the schools while the School Leader argued it should be the opposite: the schools and the teachers should be those who dictate the conditions.

Furthermore, few teachers contact the central IT-support, as illustrated by the orange dashed line, since there is a common assumption by teachers that competencies among employees of the central IT-unit is low, especially when dealing with Mac computers and other Apple products. Furthermore, the IT-support within the municipality is only available for the employees of the municipality. Therefore, support for the student devices must be provided locally, despite the fact that the devices are owned by the municipality and only loaned to the students (illustrated at the bottom-left side of Figure 7.2.9).

### 7.7 Department of Education & the School Leadership

Closely related to the IT-unit lie the Department of Education and the leaderships. Therefore, in this section the Department of Education and the school leaders and their leadership are described.

In the middle-left side of Figure 7.2, and the close-up Figure 7.2.10, the Department of Education is illustrated. All the informants from the different levels of the Department of Education (see Chapter 3.3) have a background as teachers and school leaders before their current positions as administrators on local authority level (see lower-left side of Figure 7.2.10). Their experience being active in schools teaching and the number of years they have worked as administrators, however, vary. The Department of Education consist of 100 schools and the mission of the schools is constituted by two equal parts: (1) pedagogy, and (2) exercise of authority, illustrated as a circle in the upper-left of Figure 7.2.10. Caring out the mission the schools have freedom in deciding on the "how"- question, which is embedded in the schools’ own culture and traditions. In the political documents and other steering documents, the ‘what’ to be done is stated, but the ‘how’ is up to each individual school leader and, each individual teacher to decide. This is mentioned by several of representatives of the department, as well as the CIO of the IT-unit. However, the level of importance of this freedom and cultural traditions of the schools is considered differently by the different informants.
The District Manager stated in the interview that it is important for the school leaders to have this freedom in their schools. In contrast, the CIO of the IT-unit said that the teachers think they know more than what they actually do about use of IT, so the culture of freedom in the schools is causing the current situation wherein each teacher has individual solutions.

Figure 7.2.10 Department of Education

In the middle-right part of Figure 7.2.10, the higher-level authorities i.e., the Swedish Government and the National Agency of Education are illustrated. These authorities develop and provide the School Act and the National Curriculum (illustrated as Lgr11 at the middle right side of Figure 7.2.10). These governing documents constitute the foundation for the work of the Department of Education strategy to develop young adults that are
Creative, Entrepreneurs, Curious, and Safe (CECS\textsuperscript{70}). The national governing documents also inform a yearly internal budget document advancing the objectives of the upcoming year for the municipality. In addition, the yearly internal budget is built upon the results of the quality assessment of the schools in the municipality, provided by the school leaders based on quantitative reports alongside with interviews and classroom visits (illustrated in the middle-right side of Figure 7.2.10). The District Managers and the school leaders also have frequent meetings and ongoing dialog, illustrated as a speech bubble at the left of the school leaders in Figure 7.2.10. The District Manager mentioned that from time to time she substitutes as a teacher or school leader in the schools in her district when school leaders need additional help and support. This has been illustrated with a dark-pink line between the District Manager and the school in Figure 7.2.3. The District Manager also said that this is not a common practice for all district managers.

Aside from the yearly internal budget addressing and prioritizing integration and use of digital technologies in varied ways, the Department of Education does not have a specific IT-strategy addressing how technology should be integrated and used in daily practice. As one of the school leaders and the District Manager mentioned, current investments in schools, either on the local authority level or the school level, are decided without any long-term vision, pedagogical plan or incentives concerning the use of digital technologies in the school. An IT-strategy is also lacking at the national level, although the Swedish Government has in 2015 proposed the development of a strategy by spring 2016, illustrated in the middle-left side of Figure 7.2.10.

The budget is an issue mentioned by the majority of the informants. In Sweden, as illustrated in the middle of Figure 7.2.10, the amount of money, school voucher, for each municipality is decided and provided by the national authorities. This money can vary from municipality to municipality within the country. The Department of Education, in this case the Head of Department and the District Manager, decide how much money is given to each school within the municipality based on the yearly strategy and plan for each school (illustrated at the left of the school leaders in Figure 7.2.10). The number of students in the schools does affect the amount of money allocated to school leaders; however, within each municipality there are ongoing discussions on how to equitably distribute the resources among the schools in an equal way. All informants on the authority level mentioned equity, since it is considered to be one of the most significant requirements in the national political steering documents. The informants from the Department of Education also mention being aware of the lack of equity among the schools in the municipality, but also within the country as a whole; lack of equity both in terms of general

\textsuperscript{70} The actual abbreviation used by the Department of Education is different and in Swedish. This is a free translation of the concepts by the researcher.
conditions and educational level but also relation to availability, adoption and use of digital technologies.

One issue mentioned by all the teachers and school leaders, as well as the Head of Department and the District Manager, was the municipal schools’ lack of a common learning platform (illustrated in the top-middle-right side of Figure 7.2.10). Several of the private schools and other municipal school in the country have a common platform; however, this is not the case for this municipality. This has led to the teachers in the schools having their own solutions, an issue mentioned by all informants in the study. One of the schools in the study tried to implement a learning platform for the whole school a few years ago, and they got started but left it aside after the Department of Education announced release of a learning platform which was later decommissioned. The learning platform, according to several of the teachers, two of them very knowledgeable and engaged in use of various digital technologies, was decommissioned because it was too complicated to use. Teacher LF said in an interview:

[...] two years ago we were told we were receiving a new system, and we tested it, and everyone went to training conferences and it was late evening work and everything. But then it was condemned because it was too advanced and clumsy. These things take so much more energy out of many who already think these things are difficult.

The Head of the Department mentioned in her interview, that two of the schools are participating in a pilot project using a specific learning platform; however, during discussions with the school leader and one of the teachers at this school, no mention of this was made. Instead they explained that they do not use that specific platform. By the end of 2015, after the interviews with the representatives from the Department of Education, a working group was convened by the Department of Education. Two of the teachers and one school leader told in formal and informal interviews that this group was charged with recommending a platform for all schools in the municipality, based on the needs of the teachers, during spring 2016. When asked, two of the teachers from the two schools in this study and one of the school leaders did not have any information on the composition of this group. They further commented that they had not been asked to participate, although teachers in their school had several times shown interest in issues related to digital technologies in the education. The school leaders who mentioned this said they can give their wishes and needs to this group; she had no more information than that. The two teachers mentioned that the Department of Education’s suggestion of a platform for the municipality was the one that teachers do not want to use. Teachers prefer services provided by Google, which they use in their daily practice (this is be described in section 7.3) for
cost-benefit and other reasons. Although they wish to use the Google version\textsuperscript{71} platform, they believe that the Department of Education suggests a different system. In general, some of the teachers as well as one of the school leaders, explicitly mentioned not feeling included and involved in the Department of Education decision making processes. Teacher DK explained it this as:

\textit{They do not ask us. They make procurements, but they do not ask us teachers what it is that we need. Usually we receive a presentation in the end, perhaps someone is consulted, but we don’t know who […] we are usually informed when everything is done. And they are currently doing something as well, something about a learning platform…}

\textit{another system is suggested for decision, which we actually do not want because it is too complicated.}

One school leader and one teacher mentioned that although their school early adopters in terms of digital technologies, no one from the school was asked or consulted. This is illustrated as a purple line in the middle-top of Figure 7.2.10. One teacher from the other school mentioned the same issue. She added that she has been invited to give inspirational talks at other municipalities but not in her own municipality.

As for the use of digital technology by municipality employees and school leaders in their daily work, they all agree they are unable to conduct their daily work without the use of their computers. As illustrated in the bottom-right side of Figure 7.2.10 they all use external computer monitors and external keyboards when working with their laptop computers, something that the teachers do not have; they work directly on their laptops. However, as explained by the District Manager, Department of Education employees do not even have digital technologies such as interactive whiteboards at their workplace. Besides emailing, the only technology that is used includes powerpoints and similar applications. In terms of the school leaders use of the digital technologies they mention their everyday use, however, the school leaders said the digital systems are limited in terms of them being able to easily conduct their administrative work. Discussing the teachers’ use of digital technology, both school leaders argued there is large variation in the level of use among the teachers. The Director of Education refers to the SAMR\textsuperscript{72} model and said they have teachers on all levels (see middle-left side of Figure 7.2.10), but there is an aim enable all teachers to eventually reach the highest level. She explained:

\textsuperscript{71} Google Apps for Education is a learning platform developed for educational purposes having different privacy and data integrity settings than the private Google accounts (e.g. https://support.google.com/work/answer/6056650 [Accessed: February, 2016]).

\textsuperscript{72} Substitution, Augmentation, Modification, and Redefinition model by Puentedura. See detailed description in Chapter 4.6.3.
today we have schools and teachers that are on all the four different levels. So the need is, again, to create equity so that everyone receives conditions to reach the top.

Several issues mentioned above are also relevant for the School Leaders. The close-up Figure 7.2.11 illustrated the school leaders’ perspective in more detail (this part is also found in the bottom left corner of Figure 7.2).

One of these issues is the network and infrastructure of the school, illustrated in the bottom of Figure 7.2.11. Among the duties the school leader has, one of the school leaders mentioned having to be aware of and handling issues such as work environment, parking and windows as well as allergy rounds, all along side with developing the organization and developing the teaching and pedagogy. Including these aspects of infrastructure within the school and the responsibility of the school leader the overall infrastructure and for instance network issues should be covered by the municipality, as mentioned by the District Manager. The limitation of the network is also mentioned by the teachers saying that not too many students and/or devices can be connected simultaneously to the network. The CIO of the IT-unit explained the network, saying that the media the students watch today with all their devices are HD-quality, arguing much of the internet capacity aimed for educational purposes is being used for those things. She said:

*Technically there is much infrastructure that needs to get out there. When you are at a school today, you can experience “oh so slow the wireless network is”. “Yes, it is”, because the internet consumptions in the schools keeps increasing. We can see it month by month. One reason is the children’s Youtube use on their mobile phones, and where Youtube and other streaming media now deliver HD quality, which consumes all...consume very much of the internet capacity available for teaching.*

However, she further argues major costly investments are being done to keep up with the rapid developments of media consumption and need of higher network capacity.

The resources, as illustrated in Figure 7.2.10 and Figure 7.2.11, should, according to the District Manager, be provided by the municipality and thereafter demands can be put on the schools, the school leaders and the teachers. The District Manager mentioned the high prices of the student devices. She expressed it as:

*We should manage connecting perhaps two hundred iPads on one network device at the same time. And then it requires investments in infrastructure. And it means that...you may think that a cost of 4000-5000 for an iPad that lasts three years is peanuts, but we have other overhead expenses which is much, much larger.*
As part of these costs the District Manager mentioned the students’ negligence with their devices, where she has witnessed iPads being used as Frisbees in the hallways. The students’ negligence or easy going in terms of taking care of their devices could also be observed during classroom sessions (this has in detailed be presented in section 7.5).

In close relation to resources and infrastructure costs, both school leaders mention remaining within the budget to be challenging (as illustrated above in Figure 7.2.11). One school leader stated her main concern is to provide the teachers with what they need to conduct their work, even if this means not being able to remain within the budget. This school leader bought more expensive devices for the students which were more in line with the teachers’ pedagogical approaches and needs. The school leader said:

[…] it is difficult to remain within budget […] We have tried iPads in the fourth grade, for cost reasons, and they [the teachers] are extremely dissatisfied with the difference between the Mac and the iPad. […] And when you have come far in your pedagogical thinking using the computer, then the iPad is not a pedagogical device to that extent you want it to be. We do not consider it that way, the teachers do not think that way.
The other school leader took the decision to replace traditional learning material with digital interactive material. She argued that the school does not have the yearly budget to update textbooks so, since they now have expensive devices, they need to be used somehow (illustrated in the right-bottom side of Figure 7.2.11). One school leader said that her teachers consider iPads to be digital reading-tablets and therefore she aims to buy laptops for the students. The other school leader argued for moving towards buying Chromebooks, since it is more economically beneficial for the school. As mentioned in section 7.6, the student devices are not supported by central IT and therefore, as illustrated in the bottom of Figure 7.2.11, one school has a person employed part time to handle IT-related issues for the students. In the other school, teachers are responsible for helping the students. For repair work, the student devices are sent to an external company.

Leadership, illustrated in Figure 7.2.11 just below the budget, is also considered to be a challenge. As one of the school leaders stated, having a degree in management and leadership, additional to her teaching degree, helps her to avoid a common administrator error of trying to solve all problems. In addition, she mentions the importance of having a reasonable number of employees to manage, which is the case currently and makes it possible to be a good leader.

Both school leaders in this study believed themselves to be well informed and well-grounded in their teachers’ daily practice. Visiting lessons (illustrated with a dark pink connection from the middle part to the right side of Figure 7.2.11) is one of the ways for school leaders to be informed and aware of daily practice although, as both acknowledged, it happens rarely due to other commitments. Both school leaders express a wish to visit the classrooms and the lessons more often. The rarity of visits is also mentioned by the teachers. One teacher said that her school leader usually announces when she is coming to observe a lesson, which will allow teacher to prepare for, (typically) 20 minute visits. Teacher LF, said she has never had a visit by the school leader despite asking for it at individual staff-meetings. Staff-conferences and meetings are another way for school leaders to become informed about the daily educational practice within their school. The staff-meetings vary between the schools. In School B, they have weekly meetings with the school leaders always attending and School A the teachers have their own meetings once per week and once per week the lead-teachers have a conference with the school leaders. At one of the schools, as illustrated at the right side of Figure 7.2.11, the notes from the staff-meeting are uploaded to Dropbox for all staff to access. In addition, a copy of the notes is also sent to the school leader via

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73 Chromebooks are thin laptops running the Chrome OS operating system. The Chromebook is primarily designed to be connected to the Internet for cloud based applications.

74 Teacher appointed by school leaders to further develop and evolve specific subject contents based on the needs of the school and specific knowledge of the teacher. Available: [http://www.skolverket.se/publikationer?id=3423](http://www.skolverket.se/publikationer?id=3423) [Accessed: February, 2016]
email, since she finds it easier to not having to search for it among the Dropbox folders. In addition to the classroom visits and the staff meetings and conferences, one school leader said the teachers usually talk to her about what is going on, anything work related but also private life related and hobbies. The school leader said listening to this information proves insightful as well. In addition, by listening to conversations between teachers in the staff room, she gains insight into issues which teachers are solving themselves, as well as other things of relevance, that in combination provide a better picture of the day to day practice of the school.

At one of the schools, the teachers had individual webpages connected to the schools’ main webpage. The individual webpage is represented in the middle-right side of Figure 7.2.11 and was required by the school leader of that school, for all teachers to have. The teachers were asked to use Google Sites to build their pages: however, Teacher LA talked with the school leader and obtained approval to build her own personal website anyhow she wished, which she had done. The teacher used her personal website both for communicating information to students and also for publishing and linking to Google Drive where her teaching material was hosted. She also used the website to keep interested parents up-to-date on what the students were doing in the classroom. One of the other teachers, Teacher MK, said she did not have her personal website running yet. She stated that she did not know how to create a website. She added, if someone would only sit one week with her, she would get the website up and running. Teacher MK also acknowledged that if her school leader would pressure her to create a website, she would become defensive. The teacher said she would first ask whether the website is important for the school leader and since the school leader most likely would say it is the teacher will ask why so. She further imagined that she would tell the school leader that she would still need time to develop the website and would also ask how she would find the time. In an interview Teacher MK explained this by having an imagined dialog with the school leader:

\[I\text{ am terrified of this, that I soon will be attacked:}\]
- “Why don’t you have a website?”
- “Because I cannot deal with it, I do not care. I don’t believe it is important.”
- “Well, isn’t it important that your students have structured education?”
- “Yes, but I do not think it is the technology that give the students structured education. They get structure, they get security. I am fair in the classroom. I think I…ehh…”
- “Well, but you do know that you must have a digital…you must get your website up and going” [school leaders name] could tell me.
- “Okay then I will. Tell me what I should remove?”
- “Ahh…” she cannot answer that. As soon as I get that question I will say “Is that important for you?” Then…I will ask that question. That day they ask, I will say “Why?”
So if [school leader’s name] would say that, it would have the reverse effect. Then I would get started and said “Then I wonder why you think that [school leader’s name]?”, And then she perhaps would say “Because everyone else is doing it and we’ve taken that decision together.” “Yes, yes…” …then I would get started and it would become a debate and…well…so. Although, actually, she has the right to tell me these thing.

In-service training has been illustrated as a purple cloud at the bottom left side of Figure 7.2.11. It is mentioned by most informants, in varying forms and to varying extents. The representatives from the municipality mentioned the importance of providing and enabling in-service training and mentioned an external organization providing training and education for the schools and teachers in the county. One of the school leaders referred to the same external organization, saying that her teachers believe the level of training session and presenter knowledge to be low. So the teachers prefer to use their weekly seminars or ask for an internal seminar where the teachers discuss themselves. All teachers mentioned the importance of in-service training. Three of the teachers had participated in some of the courses and trainings while Teacher MK said she had not participated, although she knew about the in-service programs.

The representation of teachers’ complex everyday practice using digital technologies has illustrated the teachers varying worldviews, their practice in terms of how they work with and use the digital technologies, and the challenges emerging using the digital technologies. Additionally, has the students, and the perspectives of the school leaders, representatives of the Department of Education and the CIO of the municipal IT-unit been illustrated. To summarize the complexity of the teachers’ situation and the issues of concern, two quote from two of the teachers will be used to illustrate this:

Do all teachers have to do things the same way when we are different as persons? [...] To have the same rules at a school is one thing, but to use…pedagogics…to…that this digital technology is supposed to be a way of working, why then…why should everyone use it in the same way when we are different as persons?

[...] we use the technology differently, and that is okay, and we have different conditions [pre-requisites]. [...] You as a teacher must believe in what you do, and know that learning is happening, and at that point we are all different.

Thus, these quotations illustrate the diversity among these teachers’ professionals. Despite the fact that they work in similar ways, they are different in terms of their beliefs, worldviews and preferences, and they are different in
Representing the Situation

terms of digital technologies usage in their everyday practice. In addition to the differences of the teachers, the empirical findings and situation representations illustrate that school leaders and the municipality representatives are also different from each other and different from the teachers, while exercising significant external influence on the teachers’ everyday practices.
CHAPTER 8
Soft Systems Analysis

In this chapter, further analysis of the empirical material is presented following Soft Systems Methodology’s Learning Cycle. As presented previously, the cycle consists of four phases: (1) finding out about the problematic situation, (2) creating purposeful activity models, (3) questioning the perceived situation, and (4) taking action for improvement. This chapter covers the second and third phase of the cycle whilst the first phase, finding out about the problematic life situation, has been presented in the previous chapter (see Chapter 7).

As presented in Chapter 5.2, Checkland and Winter (2006) and Checkland and Poulter (2006; 2010) make a distinction between two approaches for applying SSM; one referred to as SSM_P, i.e., the process, and one referred to as SSM_C, i.e., the content. For this study, a SSM_P analysis was initially conducted in order to find major focusing point for the SSM_C analysis and modeling. This chapter presents the SSM_P analysis followed by excerpts of the SSM_C analysis. The Purposeful Activity Models of the SSM_C analysis include 19 PQR statements and CATWOE models as well as 12 Activity Models that illustrate the multifaceted research situation. Additional SSM_C models can be found in Appendix L. The chapter concludes by a summary of the outcomes of the Soft Systems Analysis based on the research questions presented in Chapter 1.1.

8.1 The SSM Process Analysis
The SSM_P conducted for this research aims to identify the relevant focus for the SSM_C analysis. The models used in the SSM_P analysis consist of a Cognitive Map and several PQR statements. The Cognitive Map is

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75 For a full description and presentation of SSM Learning Cycle, see Chapter 5.2 and Figure 5.1.
presented followed by two Primary Task PQRs and thereafter a number of Issue Based PQRs.

The Cognitive Map, Figure 8.1, reflects the research aim and research questions of the dissertation. The map presents an initial understanding of the research based on collected empirical material and understandings gained from previous research and other literature (see Chapter 4). The SSM_P analysis enables finding a reasonable level of detail and abstraction for the SSM_C analysis as well as identifying which Purposeful Activities to further model.

In the top of Figure 8.1, the research aim is stated and, below that, three nodes are identified which contribute to achieving the research aim. These include illustrating the current situation of teachers’ use of digital technologies (represented at the left of Figure 8.1); illustrating and understanding teachers’ worldview in terms of teaching, learning and digital technologies; and identifying issues of concern adding to the complexity (represented at the right of Figure 8.1). These nodes are based on the research questions of this dissertation: What worldview do teachers in compulsory schools have in relation to use of digital technologies in everyday education? and What are the issues of concern that add to increasing the complexity of teachers’ use of digital technology in their everyday work practices?

Figure 8.1 SSM_P Cognitive Mapping

Each of the nodes consists of several nodes on a lower level. The lower levels include more detail about how the researcher understands achievement of a higher level node. For instance, illustrating the current situation of
teachers’ use of digital technologies in everyday practices’, presented at the right side of Figure 8.1, is based on the lower levels, such as ‘find out about the situation by making a Rich Picture which includes analysis 1-3’ and ‘describe the teachers changed status’.

Based on the Cognitive Mapping, PQR statements for the SSM analysis have been identified. Continuing on with this example, the translation of the Cognitive Map to a PQR statement is thus:

R (why) = illuminate and advance the understanding of the complexity of teachers’ everyday practice using digital technologies;
P (what) = illustrate the current situation of teachers’ use of digital technologies in everyday practice, and;
Q (how) = find out about the situation by making a Rich Picture and including analysis 1-3

It should be noted that the order of the PQR elements has been changed in the Cognitive Map. It should be read RPQ. The change has been made in order to find the correct relation between the what (P), how (Q) and why (R), as well as acknowledging that each higher level node can have several lower level nodes. This implies that each R (higher level node) can have several P’s (lower level nodes) which in turn can have several Q’s (lower level nodes). Further, it is possible for a P to become a R in a second PQR statement focusing on a lower level of detail. The combination and ordering of R, P and Q are chosen based on what is most central and relevant for the aim of the modelling and overall research aim.

Drawing upon the Cognitive Map above, the Primary Task for this research is to address the research questions as stated in the introduction chapter. The Primary Task can therefore be stated in two PQR statements:

\[
\begin{align*}
P & \text{ understand and illustrate the worldview and current situation of teachers’ use of digital technology in everyday education and teaching practices} \\
Q & \text{ by illustrating education and teaching situations to be individual and bound by context and tradition} \\
R & \text{ in order to illuminate and advance the understanding of the complexity of teachers’ use of digital technology in everyday education and teaching practices}
\end{align*}
\]

The first PQR statement is based on the two nodes at the top left side of Figure 8.1 and refers to the first research question: *What worldview do teachers have in relation to use of digital technologies in everyday education?* The research question and, therefore, the first Primary Task PQR aim to investigate teachers’ worldview and, specifically, how they perceive digital technology to
be intertwined with their role as teachers and their beliefs about teaching and learning. The second PQR statement below addresses the second research question: *What issues of concern increase the complexity of teachers use of digital technology in their everyday practices?* This question investigates issues of concern which add to the complexity of teachers’ everyday use of digital technology. This PQR is based on the node presented on the top-right side of the Cognitive Map.

\[ \text{PQR:} \quad \text{investigate different actors’ multiple and sometimes conflicting worldviews} \\
\text{Q:} \quad \text{by illustrating and describing the variety of worldviews} \\
\text{R:} \quad \text{in order to identify and present issues of concern adding to the complexity of teachers’ use of digital technologies in everyday education and teaching practices} \]

The major outcome of the SSM analysis is, however, the Issue Based PQR statements. Based on the Cognitive Map (see Figure 8.1), several Issue Based PQR statements were identified. Below five of the most relevant PQR statements are presented, according the Primary Task statements:

\[ \text{PQR:} \quad \text{demonstrate that there is ambiguity (lack of clear vision) about the objectives of education and the use of digital technology} \\
\text{Q:} \quad \text{by illustrating lack of clarity about central concepts and lack of agreement on common issues and, therefore, absence of shared meaning and common definitions (e.g., equity vs. equality)} \\
\text{R:} \quad \text{in order to advance understanding of issues of concern contributing to the complexity of teachers’ use of digital technology in everyday education and teaching practices} \]

\[ \text{PQR:} \quad \text{show that there are many opinions about and perspectives on other actors’ roles, responsibilities and missions} \\
\text{Q:} \quad \text{by illustrating lack of insight and understanding of different actors’ perspectives and objectives} \\
\text{R:} \quad \text{in order to advance understanding of issues of concern contributing to the complexity of teachers’ use of digital technology in everyday education and teaching practices} \]
In the following section, some of the PQRs are further modelled based on different actors’ perspectives. Additional models are included in Appendix L.

8.2 The SSM Content Analysis

Modeling in systems approaches aims to illustrate complex situations from multiple perspectives rather than drawing a blueprint of reality (Checkland, 2011). The models presented in this chapter are based on PQR statements, CATWOE and Activity Models illustrating the perspective of the four teachers, two school leaders, the District Manager of the Department of Education, Head of Department, Director of Education and the CIO of the municipal IT-unit. Additionally, each Purposeful Activity Modelling is briefly discussed in terms of their feasibility and desirability in comparison to the real world situation.

The Cognitive Mapping and Purposeful Activity Models presented are selected as relevant based on the collected research material represented in the Rich Picture. The teachers’ Cognitive Maps include two different colors: blue
representing the teachers’ philosophy of teaching\textsuperscript{77} and black representing the teachers’ perceptions towards the use of digital technologies\textsuperscript{78}. The PQR statements, similar to the SSM\textsubscript{P} analysis, are based on the Cognitive Map for each informant and represent the researcher’s understanding of specific actor’s worldview and how each actor perceives the situation. The CATWOEs and the Activity Models follow SSM modeling techniques and are based on what can be considered relevant for that specific worldview, with the aim to increase understanding about the complex situation.

The Purposeful Activity Models presented are based on the roles and perspectives of the actors rather than following specific themes or making comparisons among different actors’ varying perspectives. Further, the Purposeful Activity Models represent central aspects found in the empirical material. Initially the modelling of the teachers’ worldview is presented, followed by the District Manager of the Department of Education. Next, the Purposeful Activity Models related to the CIO of the IT-unit’s modelling is presented, followed by the Head of Department and Director of Education at the municipal Department of Education.

**Teacher DK**
Teacher DK has integrated the use of digital technologies in her everyday practice and at times actively chosen not to use digital technologies mainly due to its clumsiness, as expressed by this teacher.

Teacher DK is very much aware of the complexity of enabling and developing learning. Moreover, she believes in encouraging students’ analytic skill development and making them share their knowledge and skills. These have been illustrated as the top nodes on the left of Figure 8.2, which represents the Cognitive Map of Teacher DK.

Challenging students by making them talk, reason and argue is also relevant for Teacher DK. She believes that making students active in their learning enables them to achieve an effective education. In addition, represented on the left of Figure 8.2, a safe environment that allows students to make mistakes advances students’ learning and ensures that their education extends beyond merely correct answers.

The other line of thought in Teacher DK’s philosophy of teaching includes teachers’ changed profession. Adapting to students and changes in society as well responding to demands of higher subject knowledge are represented in the middle left side of the Cognitive Map (the right-side blue nodes in Figure 8.2). In terms of perceptions and beliefs about digital technologies, Teacher DK believes that using digital technologies allows her to gain more variations, which, in turn, make education more interesting for students, which results in achieving effective education (illustrated at the top of Figure 8.2).

\textsuperscript{77} See detailed description in Chapter 4.1.2.
\textsuperscript{78} See detailed description in Chapter 4.5.
The middle of the Cognitive Map illustrated by black nodes represents her awareness of how learning occurs and how that awareness, together with having the ability to combine technologies, allows her to advance different skills in her students. Furthermore, Teacher DK is acknowledging that digital technology is just a tool, just as any other technology, and digital technology is not always useful. The importance of having a pedagogical intention, to involve the teachers and to have an understanding of teachers’ role and interaction with students, is essential to incorporating digital technologies in education (illustrated in the bottom right side of Figure 8.2). Teacher DK also believes that proper conditions, adequate resources and in-service training, as well as IT-support and easy-to-use technologies are requirements for adoption and use of digital technologies (illustrated in the lower right side of the Cognitive Map, Figure 8.2). The perceived positive outcomes of using digital technologies, according to Teacher DK, are represented at the top right side of Figure 8.2 and include, e.g., increased professional productivity and effectiveness, heightened collegial collaboration and providing students the education there are entitled.

To advance the understanding of Teacher DK’s worldview of using digital technologies in her everyday practice, two Purposeful Activity Models are presented below (additional models are presented in Appendix L). The initial Purposeful Activity Model is based on Teachers DK’s view of the adaption and change of the teaching profession in order to achieve effective education.
The Customers (C) in this modelling is taken to be students. If the teaching is adapted to the current student group and is timely, the teaching is most likely better aligned with the students’ interests and backgrounds and, hence, enables achievement of more effective education.

Achieving effective education by adapting to current times and student groups is desirable since effective education indicates success which is important. In comparison with the perceived real world situation represented in this research, the Purposeful Activity Model is feasible and relevant. However, ultimately, feasibility may be limited due to teachers’ and school leaders’ unwillingness or lack of understanding of how societal changes affect student groups and themselves.

The second exemplifying Purposeful Activity Model is based on the worldview that digital technologies always have to be preceded by pedagogical intention. This, by Teacher DK, is believed to enable use of digital technologies in education. Purposeful Activity Model 8.2 is based on the nodes in the lower and middle right part of the Cognitive Map (see Figure 8.2).
Teachers are stated to be in the role of Customers (C) since the use of digital technologies are based on a pedagogical intention which builds on teachers’ varying pedagogical thoughts and intentions. This enables purposeful and natural use of digital technologies, which, in the long term, have benefits for teachers and students. Owners (O) that can stop this Transformation (T) are taken to be decision makers at the Department of Education. School leaders and teachers can also be modelled as Owners. However, that would require a different Purposeful Activity Model.

Five activities illustrate the Transformation. The activity to ‘create awareness of teachers’ and school leaders’ varying worldviews and pedagogical thinking’ is a key activity. The activity ensures that there will be a pedagogical intention to use digital technology, as well as to also identify and adapt digital technology solutions in order to, again, enable use of digital technologies.
Ensuing digital technology usage based on pedagogical intention and thought is desirable for all involved actors in educational practice as it will bring meaning to why digital technologies should be used and how it can be used to support teaching and learning. This is particularly relevant for teachers who, for instance, do not see benefit in the usage of digital technologies. In terms of feasibility, it is not possible to consider all varying pedagogical thinking of all teachers. However, being aware that teachers are shaped by their pedagogical thinking and their pedagogical intentions to digital technology use which teachers more easily can relate to.

**Teacher LA**

Teacher LA has significant experience and high interest in the use of digital technologies. She has to a large extent adapted and updated her pedagogics and administrative work to use digital technologies. The Cognitive Map below represents teacher LA’s philosophy of teaching (illustrated as blue nodes and arrows) and her perception of digital technologies (illustrated as black nodes and arrows).

As exemplified in the PQR statement below, Teacher LA places focus on the students. This is also illustrated in the lower middle left side of the Cognitive Map which presents Teacher LA’s belief in student centered teaching and education. Teacher LA focuses on students, which is evident in additional nodes stating, e.g., belief in dialog pedagogics (illustrated in the PQR statements).
statement below); focus on increasing students’ knowledge rather than increasing grades; and considering students’ varying needs. According to Teacher LA’s beliefs, this is enabled by allowing students to work in different ways (presented in Chapter 7.3, as part of the Rich Picture). The student focus in Teacher LA’s practice is also noted in the top left of Figure 8.3. Students’ feeling of accomplishment and her own feelings of managing challenges related to the students are central for her perceptions about the teaching profession.

Purposeful Activity Model 8.3 illustrates one perspective of Teacher LA’s worldview in terms of her beliefs about the teacher profession and about student learning:

| P | put the students in focus (student centered education) |
| Q | by considering students’ different learning styles |
| R | in order to increase students’ interests and motivations for learning |

| C | students |
| A | teachers |
| T | need to achieve a student centered education ➔ need met |
| W | student centered education will result in making students interested and motivated to learn |
| O | teachers |
| E | attitudes, capabilities (pedagogic and didactic knowledge), students’ different learning styles |

Purposeful Activity Model 8.3 Increase Students’ Interests and Motivations

In the CATWOE it could be relevant to assume that the Customer (C) is the students because learning and teaching are adapted to them and their varying learning styles. The Actors (A) are taken to be the teachers as they take a stance and approach to follow and to take the students’ varying conditions into consideration. The teachers are taken to be in the role of Owners (O). They decide whether they take a student centered pedagogic approach or take a different approach.

It can be noted that the students’ motivation to learn and to show interest in their learning is considered highly relevant for teachers as well as school leaders. The relevance can be related to Purposeful Activity Model 8.1 wherein adapting to varying student groups can be considered as one approach for a more student centered education. The Transformation (T), which meets a need for achieving a student centered education, can be regarded as feasible if the educational culture and ambitions include focus on students. However, limited pedagogical capabilities of teachers affect real world feasibility.
Increasing the students’ interest and motivation to learn is also connected to the use of digital technologies (illustrated with a black arrow from the ‘use digital technologies naturally in education’ on the lower middle right side of Figure 8.3 to the node ‘increase students interest and motivation for learning’ on the higher middle left side). It can be noted that Teacher LA has a belief in “natural” use of digital technologies in education in order to achieve a student focused and student adapted education. An example of how technologies, digital and traditional, should be used is stated in the second Purposeful Activity Model for Teacher LA. In order to reach effectiveness and productivity in education, proper technology should be used at the proper time and in the proper context. This can, according to LA, be achieved when varying situations and contextual conditions are taken into consideration. Additionally, Teacher LA thinks that teachers should be given the possibility to work according to their own preferences (represented in the middle right side of Figure 8.3) rather than having to use central common digital solutions limiting their everyday practice.

| P | use the appropriate technologies at the proper place based on own preferred way of working |
| Q | by considering and respecting contextual conditions |
| R | in order to reach effectiveness and productivity |

C teachers, students
A teachers
T need to use technologies according to preferred way of working  →  need met
W to achieve effectiveness and productivity, it is important to use the appropriate technologies at the proper occasion according to the teachers’ preferred ways of working
O teachers
E capabilities, attitudes, resources

Purposeful Activity Model 8.4 Reach Effectiveness and Productivity

Allowing to adapt the way of working, using appropriate technologies on proper occasions will benefit all teachers as well as all students, in terms of both effectiveness and productivity and is desirable by all teachers included in this research. Desirable reasons include: importance of specific situations and contextual conditions (illustrated in the middle right of Figure 8.3); varying student groups (illustrated in the lower left side of Figure 8.3, and Purposeful Activity Model 8.1); and student preferences (illustrated to the lower left of Figure 8.3 and in a PQR statement in Appendix L).
The Activity Model presented the continued Purposeful Activity Model 8.4 consists of nine activities that are carried out by the teachers.

Use of the “appropriate” technology at the “proper” time and occasion is both desirable and feasible, as illustrated in Chapter 7. The use of the proper digital technologies at the proper occasions also seems desirable and feasible if based on pedagogical thoughts and intentions, as illustrated in Purposeful Activity Model 8.2. However, the feasibility is based on different worldviews. From the perspective of Purposeful Activity Model 8.4, according to the teachers’ worldview it is considered feasible when the varying contexts are taken into account and respected. From, e.g., the CIO’s perspective, as illustrated in the Rich Picture in Chapter 7.6, it would be both feasible and desirable when the municipal IT-strategy is being followed (see Chapter 7.6 for description of their IT-strategy).

Further, it is noted that Teacher LA believes that using digital technologies in education have resulted in a change of the teaching profession and the role of the teachers (represented at the middle top right side in Figure 8.3). This change has also had implications for the mental well-being of teachers due to the critics and conflicts about choices of pedagogic approach which are often occurring with use of digital technologies (represented with the top right nodes of the Cognitive Map in Figure 8.3). However, also, the increased demands (e.g., subject knowledge, pedagogical knowledge, etc.) influence the teachers’ roles and hence their well-being (illustrated at the middle top of in Figure 8.3).

Additional aspects of Teacher LA’s perspective acknowledge the importance of in-service training, reliable and functioning digital technology, adequate resources and proper conditions, as well as involvement of teachers in issues related to digital technologies in everyday practices.
Teacher LF
Teacher LF is also one of the early adopters and innovators in use of digital technologies. LF is a digital technology enthusiast and as a teacher she has found her own solutions and ways of working using digital technologies. Below in Figure 8.4, the Cognitive Map represents Teachers LF’s philosophy of teaching (blue nodes and arrows) and her perception of digital technologies (black nodes and arrows).

![Teacher LF Cognitive Mapping](image-url)
Achieving a flexible education is relevant for Teacher LF, both in terms of her philosophy of teaching as well as her usage of digital technologies (illustrated in the middle of Figure 8.4 with a blue and black node). Teacher LF focuses significantly on the students, as evident in the middle top of the Cognitive Map (illustrated in the nodes above ‘have and provide flexible education’). In order to achieve a meaningful, enjoyable and challenging learning environment (illustrated in the middle left of in the Cognitive Map in Figure 8.4), Teacher LF is aware of the need to modify and update her own teaching (middle left of Figure 8.4), increase her own subject knowledge (lower middle of Figure 8.4) and feel joy when entering the classroom (illustrated below the learning environment node to the left of the Cognitive Map). Further, adapting to the students and their backgrounds and capabilities (represented at the node above the learning environment node in the left of Figure 8.4) is also central for her, in order to achieve a meaningful, enjoyable and challenging learning environment. This environment is additionally advanced by a flexible learning approach that combines traditional and digital technologies (black node on the right below the flexible education node in the Cognitive Map). This has been represented in Purposeful Activity Model 8.5 as:

\[
\begin{align*}
P & \quad \text{achieve flexible learning} \\
Q & \quad \text{by allowing use of combination of technologies (digital and traditional)} \\
R & \quad \text{in order to achieve a meaningful, enjoyable, challenging learning environment adapted to the students and their background, interests, etc.}
\end{align*}
\]

| C  | students                      |
| A  | teachers                      |
| T  | need to achieve flexible learning → need met |
| W  | flexible learning enables a learning environment that is meaningful, enjoyable and challenging while adapted to the students and their backgrounds, interests, conditions, etc. |
| O  | school leaders                |
| E  | resources, attitudes and capabilities |

Purposeful Activity Model 8.5 Achieve Learning Environment Adapted to Students

In this Purposeful Activity Model, the students are taken to be the Customers (C) since a flexible learning approach enables adapting to the varying conditions and capabilities of different student groups and individual students. The Actors (A) carrying out the activities making this Transformation (T) meaningful are the teachers. They could also be stated as the Owners that can stop this Transformation to take place, based on, for instance their attitude or
capabilities for combining technologies for purposefully achieving flexible learning environments. However, in this Transformation, the school leaders are taken to be the Owners (O) since they provide and acquire technologies as well as follow up the performance.

The continued Purposeful Activity Model 8.5 presents the activities to be carried out in order to achieve flexible learning.

The use of digital and traditional technologies has been grouped as the how (Q) of the PQR and is based on having the ability to combine use of various technologies in order to achieve flexible learning. To achieve flexible, learning, students’ varying backgrounds, interests and capabilities need to be taken into account. Additionally, the definitions of meaningful, enjoyable and challenging learning affect what flexible learning is as and what technology use it should include.

Concerning desirability and feasibility, to achieve a flexible learning by combining traditional and digital technologies is in line with how the teachers are currently working (see Chapter 7.3). Flexible learning also allows teachers to adapt to students’ varying needs and learning styles, which is considered desirable (see Purposeful Activity Model 8.1). Reaching a learning environment that is meaningful, enjoyable and challenging in terms of applying flexible learning is feasible to all actors since they hold students’ success and well-being high.

Achieving flexible learning necessarily includes use of digital technologies. For Teacher LF, the time to update her pedagogy, keep-up-to-date about digital technologies and also about subject knowledge is believed important, in
order to use digital technology well. Furthermore, having the time to learn and test the digital technologies is central to Teacher LF. These nodes are represented in the lower right side of the Cognitive Map in Figure 8.4. In addition, the importance of well functioning and “right and flexible” systems and technologies (represented in the bottom right side of Figure 8.4) are essential to successful digital technology usage.

In conjunction with the above reasoning, motivation for using digital technologies is believed important according to Teacher LF. This is illustrated in Purposeful Activity Model 8.6.

### Purposeful Activity Model 8.6 Use Digital Technologies in Everyday Education

Teachers are taken to be in the role of Customers (C). The assumption is that teachers advance their understanding of digital technology usage as well as further increase and develop their digital technology competencies. Owners (O) in this Transformation (T) are taken to be the decision makers at the Department of Education since they provide financial resources for the school leaders, which enables leaders to provide opportunities for their teachers.

Purposeful Activity Model 8.6 should be regarded desirable from the teachers’ perspective. In fact, several of them expressed a wish to become more knowledgeable about reasons to use digital technologies. Reaching a situation where digital technologies are used in everyday practices is also desirable by school leaders and municipal administrators. This support ambitions to keep up with the digitalization of society and also to achieve national objectives and directives (see Chapter 7.7). Furthermore, the Purposeful Activity Model is feasible as all involved actors claim to strive for use of digital technologies in
education. Providing possibilities for in-service training to enable teachers to develop their competencies requires financial resources allocated by the decision makers at the Department of Education. Further, the availability and level of in-service training is highly relevant to consider because training must be adequate to create understanding of reasons for using digital technologies.

Moreover, the use of digital technologies is considered by Teacher LF as making the everyday practice of teachers and students more effective (illustrated as the top black node on the right side of Figure 8.4). This perception is also connected to her philosophy of teaching in terms of connecting to the students’ everyday life (illustrated as a blue node in the higher middle part of Figure 8.4). Teacher LF believes that finding the individual trigger to activate learning for each student (illustrated in the higher left side of Figure 8.4) will move students in the right direction. It will make them interested to learning, which in turn will increase their self-esteem, creativity and analytical ability (illustrated in the top left side of the Cognitive Map in Figure 8.4).

**Teacher MK**
The final teacher is Teacher MK. She prefers traditional technologies rather than digital technologies. She at times struggles with the demands from authorities, and her own wishes about using digital technologies in her everyday practice. Teacher MK believes in human relationships and dialog with students rather than using digital technologies, as has been illustrated in the middle-left of the Cognitive Mapp below (see Figure 8.5). The Cognitive Map also represents Teacher MK’s belief in the use of digital technologies for the students and the use of traditional technologies for herself (represented in the middle of Figure 8.5). The blue nodes in Figure 8.5 represent Teacher MK’s philosophy of teaching and the black nodes represent her perception of digital technologies.

In terms of digital technologies, Teacher MK’s perception is that several issues affect her use. She includes understanding why to use digital technologies; the fear in how to handle challenges rising with using digital technologies; and her lack of trust in the reliability and stability of the digital technologies (illustrated as black nodes in the lower part of the Cognitive Map in Figure 8.5).
Teacher MK emphasizes that digital technologies permit students to create nice, neat documents and to keep the parents updated. This is illustrated at the top right side of the Cognitive Map. Teacher MK also wishes to use digital technologies in order to achieve credibility among colleagues and students. This is illustrated at the top right of Figure 8.5. This wish is accompanied by desire to not feel ashamed for not embracing and using digital technologies.

Teacher MK is aware of the directives of using digital technologies for education. However, in order to use digital technologies, why it should be used needs to be clarified. In addition, Teacher MK needs clarification on why those reasons are important. This has been represented in Purposeful Activity Model 8.7 based on the Cognitive Map (lower middle right side of Figure 8.5).

Teacher MK believes knowing about the reasons to use digital technologies is important because using digital technologies, as they are today, is more complicated and time consuming than not using them at all.

**P**

_to understand why invest time on the technology_

**Q**

_by answering why to use and why that is important_

**R**

_in order to use digital technologies in everyday education_
The Customers (C) of this Purposeful Activity Model are taken to be teachers. The Transformation (T) is particularly relevant for teachers who struggle with digital technologies and for any reason do not see or do not believe the value of using the technology, especially since it is perceived by them to be more troublesome than useful. The employees at the Department of Education, also in the role of Actors, should support the teachers’ in understanding why they should use digital technologies. Also school leaders and early adopting teachers can be considered in the role of Actors: school leaders, since they e.g., need to convey the message from the employees and decision makers at the Department of Education; and early adopting teachers since they have come far ahead in the use of digital technologies in education and can assist skeptical teachers to gain improved understanding of the why-question of using digital technologies.

The Transformation to be carried out by the Actors is presented in continued Purposeful Activity Model 8.7.
Similar to Purposeful Activity Model 8.6, this Purposeful Activity Model, which is based on the perspective of a more skeptical teacher, is desirable. It can also be considered desirable to create an understanding of why digital technology should be used because in the long run (R) this can influence and enable higher use of digital technologies. This is especially desirable for teachers who have the willingness and wish to use the digital technologies (E of the CATWOE) but have not reached the point of seeing why to change what is currently working properly. However, the Transformation of the model is not feasible if teachers lack the willingness to adapt and modify their philosophies and pedagogical approaches to include digital technologies. This is also relevant for the second Purposeful Activity Model of Teacher MK presented below.

It can be noted that the attitude and willingness of using digital technologies influences Teacher MK’s use of the digital technology (represented in the lower middle right side of Figure 8.5, below the use of digital technology-node). However, teacher MK also wishes to learn and use digital technology, as expressed in the lower right side of the Cognitive Map (Figure 8.5). She believes it is of importance to have appropriate support and help when learning to use digital technologies, as this will influence its uptake.

Purposeful Activity Model 8.8 is based on Teacher MK’s perception that in order to use digital technologies, attitude about and interest in digital technologies usage need to change. One way to change teachers’ attitudes and willingness is to assure them that the digital technology works as supposed to.

<table>
<thead>
<tr>
<th>P</th>
<th>change attitude to gain interest towards using digital technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>by assuring that the technologies work</td>
</tr>
<tr>
<td>R</td>
<td>in order to use the digital technologies in everyday education</td>
</tr>
<tr>
<td>G</td>
<td>teachers that have a reluctant or negative attitude towards use of digital technologies</td>
</tr>
<tr>
<td>A</td>
<td>school leaders</td>
</tr>
<tr>
<td>T</td>
<td>need to provide foundations for changing will and interest ➔ need met</td>
</tr>
<tr>
<td>W</td>
<td>having a positive attitude and an interest in using digital technologies will lead to actual use of digital technologies in everyday education</td>
</tr>
<tr>
<td>O</td>
<td>school leaders</td>
</tr>
<tr>
<td>E</td>
<td>capabilities, attitude and will, assure digital technologies are always functioning</td>
</tr>
</tbody>
</table>

Purposeful Activity Model 8.8 Use Digital Technologies in Everyday Education

The Actors (A) are taken to be school leaders while the Owners (O) are the teachers with lack of will, interest and/or attitude. Teachers with the will to
use the digital technology can gain a less negative attitude when being assured that the technology functions properly. The Activity Model illustrated activities relevant to increase teachers' will and interests in using digital technologies by ensuing the digital technologies to function properly:

The Activity Model consists of six activities wherein one of the activities includes two activities. The school leaders need to assure that IT-support is provided on a central level as well as on a local level to support the teachers and ensure that the digital technologies function properly. Assuring proper IT-support for increasing teachers' knowledge and skills about how to handle potential issues and problems with simple solutions can affect teachers' willingness and attitude. Further, it is important for the school leaders to assess and understand the teachers' reluctance towards the digital technology and, hence, take further action to enable teachers' to increase their willingness and interest towards using the digital technology.

In comparison to the real world situation, as perceived in the context of this research, there is a desire for changing teachers' attitude and willingness to use digital technologies as part of their education practice. There is also a strong desire for ensuring that technology functions properly. However, the Transformation (T) of Purposeful Activity Model 8.8 is not fully feasible as the proper function of digital technologies can never be fully ensured. The activities in the Activity Model, e.g., increase teachers' knowledge and skills as well as provide local IT-support, make the limitations of digital technologies less disturbing and, hence, contribute to change and increase of willingness and trust in using digital technologies.
In the upcoming sections, the Purposeful Activity Modelling related to the school leaders’ perspective is presented. The school leaders show a tendency to be close to the line of thought of the teachers. Initially the modeling of School Leader 1 is presented and thereafter School Leader 2.

**School Leader 1**

School Leader (SL1) has been working as a school leader for six years and she has experience being a school leader at various schools. In addition to being a teacher, SL1 has completed leadership and management programs and completed a school leader program at the university.

SL1 is very much aware of her leadership and for her the main objectives are to achieve her governmental mandate and to guarantee the students’ rights. This has been illustrated as a node in the top left side of the Cognitive Map presented in Figure 8.6. To achieve these objectives, SL1 believes in following the internal budget provided by the Department of Education and to be able to lead her own school. Combining the ‘freedom of how’ together with leadership training, SL1 believes that she is good leader and decisions maker. Additionally, she also considers listening to the teachers and have awareness of what goes on in the school as important contributions to her leadership. This is represented in the nodes at the lower left side of the Cognitive Map in Figure 8.6.

![Figure 8.6 SL1 Cognitive Mapping](image-url)

In terms of her leadership also including adoption and use of digital technologies, SL1 believes in the importance of providing opportunities and
adequate conditions. This enables the teachers to teach and not become overstressed. This has been represented in the middle and left side of the Cognitive Map (Figure 8.6). Purposeful Activity Model 8.9 addresses this issue:

<table>
<thead>
<tr>
<th>P</th>
<th>use what we need to use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>by ensuring adequate conditions and resources exists</td>
</tr>
<tr>
<td>R</td>
<td>in order to enable teachers to teach (avoid overstressed teachers)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C</th>
<th>teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>school leaders</td>
</tr>
<tr>
<td>T</td>
<td>need to enable use of the technologies that are needed ➔ need met</td>
</tr>
<tr>
<td>W</td>
<td>to use what is considered needed (regardless if traditional or digital) enables teachers to teach</td>
</tr>
<tr>
<td>O</td>
<td>school leader</td>
</tr>
<tr>
<td>E</td>
<td>resources, capabilities, limited insight into everyday practice</td>
</tr>
</tbody>
</table>

Purposeful Activity Model 8.9 Enable Teachers to Teach

The teachers are taken to be the Customers (C) since they are given adequate conditions to use what they need in order to conduct their teaching. The Actors (A) and Owner (O) in this Purposeful Activity Models are taken to be the school leaders since they are those who are the leaders in the schools and have the responsibility to ensure the teachers can perform their teaching. However, on a different level, the decision makers at the Department of Education can also be considered as Owners and Actors. It is relevant to also consider the decision makers at the Department of Education as Owners since they are those who provide, enable and decide on several issues influencing the school leaders’ ability to take decisions and provide conditions for the teachers. That would, however require a different Purposeful Activity Model.

The activities that the school leader needs to perform in order to achieve the Transformation (T) is illustrated in the Activity Model presented in continued Purposeful Activity Model 8.9:
This Purposeful Activity Model can be considered relevant and desirable for all informants based on the perceived understanding of their situation and worldviews. Comparing this model to the teachers’ worldview, the teachers express a need to be able to work according to their own preferred ways of working (see Purposeful Activity Model 8.4). However, in terms of feasibility, due to the current situation, adequate resources cannot be provided to school leaders in order to achieve the Transformation as illustrated in Purposeful Activity Model 8.9 (the challenges with, e.g., finance and budget have been described in Chapter 7.7).

In addition, SL1 also believes that providing adequate conditions and opportunities affect and enable maintaining and providing a healthy environment for teacher and student growth (illustrated at the higher middle left side of Figure 8.6). Focusing on the students and allowing for the teachers to carry out their profession create, according to SL1’s perception, pride in the individual person, which is another of SL1’s main objectives with her mission as a school leader.

Additionally, SL1 emphasizes the importance of pedagogy as the motivator for use of digital technologies, not the technology per se. This is illustrated in the lower middle right side of the Cognitive Map and represented in Purposeful Activity Model 8.10. The PQR statement shows SL1’s understanding of the current situation while the CATWOE represents a desirable situation.
acknowledge that digital technologies are the drivers, not the pedagogy

by acknowledging the lack of a clear IT-strategy which includes pedagogical vision

in order to create awareness in how digital technologies should be used in education

teachers, students
decision makers at department of education, school leaders

need to ensure pedagogy is the drivers for digital technology use need met
to create awareness of how digital technology should be used in education the pedagogy needs to be the driver

school leader

resources, lack of IT-plan

Purposeful Activity Model 8.10 Enable and Maintain Environment for Growth

Ensuring pedagogy is the driver for technology use in education is similar to Purposeful Activity Model 8.2, and is also similar in terms of being desirable. In terms of feasibility, the ‘freedom of how’ is an issue to consider. The school leaders have the freedom, according to the School Act, to make decisions concerning their own internal organization while the decision makers at the Department of Education can make decisions contradicting the visions or pedagogical drivers of the schools. Hence, this can result in a potential clash.

The lack of an IT-strategy which includes pedagogical vision can be considered to contribute to digital technologies becoming the drivers for technology use in the schools rather than having pedagogy as the driver. To use digital technologies in educational practice, SL1 considers several additional issues as relevant. These are represented in the lower right side of the Cognitive Map illustrated in Figure 8.6 and include awareness of the drawbacks of the digital technologies, need of proper IT-support, training and education and ability to purchase digital technologies, while keeping within the budget – one of the concerns of the school leader.
School Leader 2
School Leader 2 (SL2) has been working as a school leader for six years and prior to her position as school leader she has been working as teacher and vice-school leader.

The main objectives of SL2, as illustrated at the top of the Cognitive Map in Figure 8.7, is to develop the creativity and increase the feeling of responsibility and self-esteem for each student and therefore help the students to reach their full potential. To do so, maintaining students’ motivations as well as following the national directives are considered contributing issues (illustrated in the top of Figure 8.7).

As exemplified in Purposeful Activity Model 8.11, SL2 believes that to reach a situation where digital technologies become a natural part of education, the schools need to be given possibilities to decide on their own digitalization initiatives. Further, in order to be able to take their own decisions, the schools and the school leaders need to have adequate conditions and ‘freedom of how’.

| P | be able to take sides and decide in terms of digitalization |
| Q | by having the possibility and conditions, as well as freedom to be able to take decisions |
| R | in order for IT to become a natural part of the education |
Customers (C) for this Transformation (T) are taken to be the school leader and teachers which can decide for the digitalization of their own practice. In the longer perspective, the students can also be considered as Customers. Actors (A) conducting the transformation are taken to be school leaders. The decision makers at the Department of Education are in the role of Owner (O) since they are those who can allow and enable the school leaders to have the needed freedom and needed conditions to decide on digitalization.

The continued Purposeful Activity Model 8.11 illustrates the Activity Model of this Transformation:

As for the desirability of this Purposeful Activity Model, it can vary according to the perceived real worlds of the different actors. In order for school leaders to enable natural use of digital technologies in their school, the consideration of context, tradition and culture of each school organization is needed (e.g., Purposeful Activity Model 8.4). The Transformation and the activities can be

<table>
<thead>
<tr>
<th>C</th>
<th>school leaders, teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>school leaders</td>
</tr>
<tr>
<td>T</td>
<td>need to decide and take sides for digitalization ➞ need met</td>
</tr>
<tr>
<td>W</td>
<td>conditions and freedom of how to decide on digitalization enable digital technologies to become a natural part of the education</td>
</tr>
<tr>
<td>O</td>
<td>decision makers at the department of education</td>
</tr>
<tr>
<td>E</td>
<td>limited insight into everyday practice</td>
</tr>
</tbody>
</table>

Purposeful Activity Model 8.11 Reach Use of Digital Technology as a Natural Part
considered relevant since it has been noted that school leaders and teachers work in different ways and have different worldviews in relation to education. Further, the school leaders’ freedom of how is also stated in the national School Act which make it even more desirable to achieve. However, in terms of feasibility, the level of freedom and definition of schools needed digitalization are subjects for further discussions and investigations. The limited resources as well as directives and objectives on national and local levels need to be considered in order to make this Purposeful Activity Model feasible.

Closely related to SL2’s thought on freedom of school leaders, SL2 also addresses the variety of teachers’ adoption and use of digital technologies. This has been illustrated in the lower, middle part of SL2’s Cognitive Map (see Figure 8.7), and represented in Purposeful Activity Model 8.12.

In this Purposeful Activity Model, the Actors (A) are taken to be school leaders. Having awareness of and insight into everyday practice and, hence, having understanding and awareness of teachers’ varying adoption and use enable school leaders to work towards reaching a point where digital technologies are used as a natural part of education.

Taking Purposeful Activity Model 8.12 in relation to the current perceived situation, school leaders and representatives are aware of the broad variety of adoption and use of digital technologies in education. However, having insight into everyday practice itself is insufficient to reach use of digital technologies as part of everyday education. As illustrated in other Purposeful Activity models (e.g., Purposeful Activity Model 8.3, Purposeful Activity Model 8.9), additional
aspects such as pedagogical intention and adequate resources seem to be equally important to meet the R of this PQR statement.

Further, in the belief of SL2, regardless of time allocated, teachers’ attitude has a strong influence in their use of digital technologies (illustrated in the right side of the Cognitive Map in Figure 8.7). SL2 also believes stricter leadership and directives will have a negative influence on teachers’ uptake of digital technologies (illustrated in the right side of Figure 8.7).

**District Manager**

The District Manager included in this research has been working as school leader and teacher for over 30 years prior to her current position. The Cognitive Mapping in Figure 8.8 presents the District Managers’ perceptions and worldview towards use of digital technology in education.

**Figure 8.8 District Manager Cognitive Mapping**
The District Manager is noted to have a worldview close to the school leaders and the teachers. The students’ knowledge and skills in using digital technologies contributes to taking advantage of the possibilities brought by digital technologies. Further, using digital technologies appropriately is also believed to be important. These nodes are included in the middle left side of the Cognitive Map in Figure 8.8.

In the Cognitive Map, at the lower middle and right nodes of Figure 8.8, the District Manager’s concern and understanding of the practice is represented. In the node at the bottom right side of the Cognitive Map, the District Manager’s understanding of the infrastructure costs is noted. Additionally, the importance of providing the school leaders with the conditions they need in terms of, e.g., economic resources, is represented. The District Managers’ understanding of the practice includes that school leaders need to lead their own internal organization since the ‘how’ is a pedagogical matter (represented in the right side of Figure 8.8). This has been represented in Purposeful Activity Model 8.13:

<table>
<thead>
<tr>
<th>P</th>
<th>building on the local needs and wishes of the personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>by allowing for the ‘how’ to be solved at each school (pedagogical matter)</td>
</tr>
<tr>
<td>R</td>
<td>in order to make use of the possibilities brought by digital technologies</td>
</tr>
<tr>
<td>C</td>
<td>school leaders, teachers</td>
</tr>
<tr>
<td>A</td>
<td>school leaders</td>
</tr>
<tr>
<td>T</td>
<td>need to use digital technologies based on local needs and wishes ➔ need met</td>
</tr>
<tr>
<td>W</td>
<td>to make use of the possibilities brought by digital technologies, the use of digital technologies needs to be built upon the local needs and wishes</td>
</tr>
<tr>
<td>O</td>
<td>decision makers at department of education</td>
</tr>
<tr>
<td>E</td>
<td>conflicting worldviews of different actors</td>
</tr>
</tbody>
</table>

Purposeful Activity Model 8.13 Make Use of Possibilities

For the ‘how’ to be solved based on the local needs and wishes of the personnel of each school, the decision makers at the Department of Education can be considered as those who enable this possibility (O) while the school leaders (A) are those who carry out the Transformation (T) and build the use of digital technologies based on their needs and wishes. The Customers (C) in this CATWOE are taken to be school leaders and the teachers since the use of digital technologies is based on their needs and further based on the pedagogical ‘how’ of the school.
Similar to previous Purposeful Activity Models (e.g., Purposeful Activity Model 8.4) which address the local conditions and the ‘freedom of how’, the desirability of this Purposeful Activity Model is high among the varying actors, despite contradictions which can be identified in other worldviews (see upcoming Purposeful Activity Model). The feasibility is, however, limited in terms of it not being possible to have complete freedom – there are always directives that may constrain choices. The constrains can also be due to limited resources, and challenges of maintaining and supporting a high variety of digital solutions. Despite the high desirability, depending on the situation and context, it is not always feasible to make use of all possibilities brought by the digital technologies.

Another essential influence on making use of the possibilities brought by digital technologies is to find the right forms for use of the digital technologies by, for instance, increasing teachers’ knowledge level through providing in-service training (illustrated in the middle of the Cognitive Map in Figure 8.8). Further, it is essential that the users (i.e., mainly the teachers) do not get tired of using the digital technologies. To avoid that, there is a need for simplicity in the use. In terms of finding simplicity in the use of digital technologies, the District Manager contrasts herself and her belief in school leaders’ and teachers’ freedom of how: finding simplicity in use of digital technologies can be achieved by minimizing the possibility to step outside a pre-decided boundary of how, for what and which digital technologies to use. This has been stated in Purposeful Activity Model 8.14:

| P | minimize the possibility to step outside system boundaries and find own visions |
| Q | by deciding the system that is to be used |
| R | in order to find/make a simplicity in the use of the digital technology |
| C | teachers |
| A | decision makers at the department of education, CIO and employees of the IT-unit |
| T | need to minimize possibilities to find own visions and step outside systems boundaries ➔ need met |
| W | simplicity in use of digital technology can be achieved by minimalizing the possibility of stepping outside the system’s boundaries |
| O | decision makers at the department of education |
The teachers have been stated in the role of Customers (C). However, a distinction can be made here in terms of teachers that have difficulties using digital technologies and do not have any particular vision. These teachers will most likely benefit by this Transformation (T); these teachers can be considered positively affected by the outcome of the Transformation. Teachers that are the opposite and have their own visions, ideas and approaches for using digital technologies in their everyday practice are also affected. These latter teachers may most likely be limited in terms of not being able adopt the digital technology to their specific pedagogical approaches. The decision makers at the Department of Education, as well as the CIO and the employees of the IT-unit (A), are to carry out the activities of the Transformation, as illustrated in the continued Purposeful Activity Model 8.14.

The decision makers at the Department of Education and the CIO of the IT-unit are taken as Actors deciding what system is to be used and hence minimize the possibility to step outside the system’s boundaries. In the
Transformation, the freedom and the varying worldviews of the school leaders and the teachers, the everyday practices, but also, on a higher level, the varying conditions of the different schools need to be taken into account. Laws and regulations, and the students’ needs are also essential to take into account when suggesting digital technologies to be used.

Purposeful Activity Model 8.14 can, in comparison to the understanding of the real world situation, be considered desirable among municipal representatives. In contrast, school leaders emphasize leading their school and adapting the digital technology use based on their own needs (e.g., Purposeful Activity Model 8.9). This is also a desire shared by the teachers (e.g., Purposeful Activity Model 8.4). In terms of feasibility, due to the formal power of authorities, in this case the local municipal authority, a system can be decided upon and introduced to the school. However, whether teachers and school leaders decide to use the system, or find creative work arounds (e.g., described in Chapter 7.4), is uncertain and, hence, can raise questions about the feasibility of the Purposeful Activity Model.

CIO IT-Unit
The Chief Information Officer (CIO) of the municipal IT-unit has been working at her current position as CIO for three years and prior to that has been working for 15 years in the private sector. The IT-unit of the municipality is a supporting department for all departments within the municipality, including the Department of Education and the schools.

To the CIO of the IT-unit, the IT-strategy adopted for the whole municipality is highly relevant. The TESA strategy, short for Transformable, Economical, Secure and Accessible, is represented in a node in the upper middle part of the Cognitive Map of the CIO in Figure 8.9. As illustrated in the middle of the CIO’s Cognitive Map, the CIO has high beliefs that the municipal IT-unit can provide for all the schools’ needs. Despite acknowledging that school leaders should decide on and provide the needs to the Department of Education, the CIO of the IT-unit is only interested in a dialog with representatives from the Department of Education, and not the teachers or school leaders (illustrated at the middle left of the Cognitive Map in Figure 8.9).
The CIO believes that the schools should be considered similar to any other department of the municipality (represented in the bottom right side of Figure 8.9). However, the CIO acknowledges that the teachers are not being provided the same support as other employees of the municipality (represented in a node at the lower right side). According to the CIO, one aspect contributing to teachers not receiving entitled support is economic reasons. She believes if the economic issues of schools would be solved, they can cover the costs of recruiting additional IT-employees to support the teachers.

The CIO of the IT-unit believes that if the schools provided the IT-unit with their needs, the IT-unit will be able to provide the schools with the solutions that will last the longest (illustrated in the middle of the Cognitive Map in Figure 8.9). The IT-unit’s objective, according to the CIO, is to support the digital development of the organization and to provide the underlying infrastructure. To do so, the CIO of the IT-unit has two strands of...
thoughts: one is acknowledging the school leaders are those who need to decide the needs (illustrated in the middle left side of Figure 8.9), and the second is to have dialog with the decision makers of the Department of Education (illustrated at the middle lower side of Figure 8.9).

To reach the objectives of the school in terms of the digital technologies, the CIO has a firm belief in a coherent IT solution which contributes to developing the Department of Education as a whole. The line of thought of the CIO is that a single digital solution for all schools contributes to reaching the national and local objectives of using digital technologies in schools (illustrated in the top left side of Figure 8.9). This has been exemplified in Purposeful Activity Model 8.15:

| P | have a common solution for all |
| Q | by changing the school culture |
| R | in order to reach a wholeness that is coherent |
| C | teachers |
| A | decision makers at the department of education, employees at the IT-unit |
| T | need to have a common digital solution for all ➔ need met |
| W | in order to reach wholeness that is coherent, it is important to have a common solution for all |
| O | CIO of the IT-unit |
| E | freedom of ‘how’ according to school act, long history and solid culture and traditional foundations of schools |

Providing and enforcing a common solution will affect teachers (C) who have their own solutions, high visions and ambitions in use of digital technologies. Teachers that have not yet developed their own solutions or lack their own visions could be affected positively by enforcing a common solution as it could simplify the use of the digital technologies.

The Transformation (T) illustrated in the continued Purposeful Activity Model 15 includes ten activities. The decisions makers at the Department of Education and the employees at the IT-unit are taken to be Actors (A) carrying out the activities to meet the need of a common digital solution. The activities include: evaluate current practice, take into account objectives addressing digital technologies in schools, and define the needs in order to suggest a common solution.
Having a coherent wholeness by having a common solution for all is desirable among municipal representatives while it may not be desirable for teachers and school leaders who wish to adapt the digital technologies use based on their conditions, needs and preferences (e.g., Purposeful Activity Model 8.4). The desirability of this Purposeful Activity Model is similar to Purposeful Activity Model 8.14 representing a worldview of the District Manager. Purposeful Activity Model 8.15 suggests the Transformation is to be carried out by changing the culture of the school. This can be considered reasonable and desirable in terms of digital technology use per se, however, it is questionable if this Transformation would be feasible. Further, the feasibility of this Purposeful Activity as a whole can be questioned because a coherent whole in terms of a common solution is not possible due to: teachers varying philosophical beliefs and pedagogical approaches (the blue nodes in the teachers’ Cognitive Maps); varying subjects and their different nature (presented in Chapter 7.2); varying school leaderships; and varying context and conditions of different schools.

Such coherent wholeness can, in the belief of the CIO of the IT-unit, contribute to reaching equity. Equity, emphasized in national guidelines and in the perception of the CIO of the IT-unit, contributes to nurturing and educating the future work force (represented in the top left of Figure 8.9). However, according to the perception of the CIO of the IT-unit, in order to reach equity, the same solutions should be given to all schools and all teachers.
**Head of Department**

The Head of the Department of Education has a background working as a teacher and a school leader prior to her current position. To the Head of the Department, creating a safe and thriving environment is one of her main objectives. Such an environment provides opportunities for the students to realize the purpose and meaning of their education, which will add value to their future (represented in the top left side of the Cognitive Map in Figure 8.10). This idea also relates to her additional objective of preparing the students to become ready to participate in the modern society.

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**Figure 8.10 Head of Department Cognitive Mapping**
To reach her ambitions, the Head of Department believes achieving the governmental mission and increasing students’ achievement of learning objectives implies providing good and sufficient conditions to the schools including handling limited resources and addressing lack of competencies (represented in the left side of Figure 8.10).

In terms of use of digital technologies (illustrated as a node in the top middle of Figure 8.10), it can be noted that the Head of Department considers digital technologies to influence students’ learning environments (the node represented at the top left side of the Cognitive Map). Use of digital technologies also enables the teachers to carry out their administrative and pedagogical mission (illustrated at the top of Figure 8.10). In order to achieve use of digital technologies as a functional tool, the Head of Department has two somewhat contradicting perspectives. The first is based on the worldview that the ‘how’ in each organization needs to be based on their specific conditions (represented in the middle right of Figure 8.10), and is represented in Purposeful Activity Model 8.16.

<table>
<thead>
<tr>
<th>P</th>
<th>use IT as a functional tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>by allowing the ‘how’ to be different based on local conditions</td>
</tr>
<tr>
<td>R</td>
<td>in order to enable teachers to perform their pedagogical and administrative duties</td>
</tr>
<tr>
<td>C</td>
<td>teachers</td>
</tr>
<tr>
<td>A</td>
<td>teachers</td>
</tr>
<tr>
<td>T</td>
<td>need to use IT as a functional tool → need met</td>
</tr>
<tr>
<td>W</td>
<td>IT should to be used a functional tool in order for teachers to perform their pedagogical and administrative duties</td>
</tr>
<tr>
<td>O</td>
<td>decision makers at the department of education</td>
</tr>
<tr>
<td>E</td>
<td>‘freedom of how’, different ‘how’, teachers’ capabilities, pedagogical models, resources</td>
</tr>
</tbody>
</table>

Purposeful Activity Model 8.16 Enable Teachers to Perform their Duties

The teachers are taken in the role of the Customers (C) of this Transformation (T). The teachers are also the Actors (A) carrying out the Transformation in order to perform their pedagogical and administrative duties. The Owners (O) are taken to be the decision makers at the Department of Education as their steering and decision making determine the level of ‘freedom of how’ for the teachers.

The continued Purposeful Activity Model 8.16 presents the activities relevant for this transformation:
The desirability of Purposeful Activity Model 8.16 is in line with what is perceived relevant and purposeful for the school leaders (e.g., Purposeful Activity Model 8.11) and the teachers (Purposeful Activity Model 8.4).

The second perspective relates to reaching equity for everyone (students and schools). Then using digital technologies as a functional tool should be based on a common, minimum frame of reference (illustrated at the lower middle part of Figure 8.10). This is presented in Purposeful Activity Model 8.17.

| P | use IT as a functional tool based on a common frame of reference |
| Q | by catching the essence on where and why to use the digital technology |
| R | in order to enable equity for everyone |

| C | teachers |
| A | decision makers at the department of education, CIO of the IT-unit |
| T | need to use IT based on a common agreed upon frame of reference ➔ need met |
| W | reach equity for everyone in terms of digital technologies in education |
| O | decision makers at the department of education |
| E | resources, attitude and capabilities, laws and regulations, varying reasons and ways to use digital technologies |

Purposeful Activity Model 8.17 Enable Equity for Everyone
Teachers are taken to be the Customers (C) of this Transformation (T). To have a common frame of reference using the digital technologies as functional tools can be beneficial for teachers currently having difficulties in applying and using digital technologies. They will then know what to relate to and the minimum level of use. However, teachers with their own visions and higher ambitions can be held back by a common frame of use or by having to adapt their visions and approach to the decided directives.

The desirability and feasibility of this Purposeful Activity Model is similar to previous Purposeful Activity Models where the same contradictions can be found, that is, ‘freedom of how’ versus common solutions. This, for instance, can be noted in District Manager’s Purposeful Activity Model 8.13 and Purposeful Activity Model 8.14.

Having a common frame of reference and a minimum level of use, the Head of Department, believes will decrease the negative attitude and experiences of digital technology use (illustrated in the middle lower part of Figure 8.10). Additionally, the Head of Department emphasizes that a common agreed on frame of reference for using digital technologies decreases the possibility of individual solutions (represented as nodes ‘islands’ and ‘1000 flowers’ on the lower right side of the Cognitive Map in Figure 8.10), which is considered undesirable. Clear and strong leadership, as represented in a node at the middle bottom of Figure 8.10, is also considered to contribute to decreasing a multitude of solutions and, hence, contributing to reaching equity.

**Director of Education**

The Director of Education at the Department of Education has the highest level of authority next to the Board of Directors. The Director of Education has been previously working as an administrative officer at the Department of Education and has been also working as a teacher and school leader.

Educating for the future so that students can manage and cope in society, and become part of that everyday society is what the Director of Education wishes to achieve with school practices. These ambitions have been represented by the nodes in the top middle and left of the Director of Education’s Cognitive Map in Figure 8.11. In order to achieve these ambitions, the Director of Education believes in the use of digital technologies, and that it should be used in a natural way (represented in the higher middle right side of the Cognitive Map). She also acknowledges the importance of equity, represented in the higher middle part of the Cognitive Map. These two nodes will be addressed later in this section.
The first exemplified Purposeful Activity Model from the Director of Education’s perspective illustrates one of the main objectives and is represented at the top left of the Cognitive Map (see Figure 8.11). This objective includes reaching equity, which is also addressed as an essential objective in national policies and steering documents. Purposeful Activity Model 8.18 is based on the employees from the Department of Education ensuring that the right things are being done:

- **P** ensure doing the right thing according to the school act
- **Q** by fulfilling and meeting the objectives and strategies of the board of education
- **R** in order to reach equity for all
- **C** students
- **A** employees at the department of education, school leaders
- **T** need to ensure the right things are done according to the school act ➔ need met
Students are taken to be in the role of Customers (C). The Actors (A) in this Transformation (T) process are stated as the employees at the Department of Education and the school leaders, as the activities require a collaboration and exchange among both actors. The activities are presented in continued Purposeful Activity Model 8.18:

This Purposeful Activity Model can, in comparison to the perceived real world situation, be considered desirable by all actors. In this perspective, equity is reached by following local and national directives and steering documents. However, whether all actors perceive and appreciate this Purposeful Activity Model is a question for further discussion. It can be assumed that, based on varying worldviews, the different parts in this Purposeful Activity Model have different meanings for the teachers, school leaders and the representatives from the municipality. Further, this Purposeful Activity Model can be considered feasible as it can be assumed that all actors in this research directly or indirectly involved with educational practices are striving towards achieving the objectives and reach equity.

Further, focusing on equity in terms of digital technologies, the Director of Education believes that in order to reach equity, everyone’s needs should be
accommodated (represented in the higher middle right side of the Cognitive Map in Figure 8.11). However, to accommodate all needs can be regarded as a contradiction in the belief that schools should not work in different ways (illustrated with a node in the middle right of Figure 8.11). Further, digital solutions should be in line with the IT-structures of the municipally (illustrated in the bottom left of Figure 8.11). To explore this further, Purposeful Activity Model 8.19 illustrates one of the Director of Education’s lines of thinking.

| P   | ensure digital solutions are in line with the IT-structure of the municipalities |
| Q   | by IT-unit providing what exists and what can be chosen from based on identified needs |
| R   | in order to use digital technology as a natural way of education |
| C   | teachers |
| A   | representatives from the IT-unit, decision makers at the department of education |
| T   | need to ensure that digital technologies are in line with the municipalities’ IT-structure → need met |
| W   | digital technology can be used as a natural way of education by following the IT-structure of the municipality |
| O   | decision makers at the department of education |
| E   | capabilities of the IT-unit, resources, freedom of how |

Purposeful Activity Model 8.19 Use Digital Technology as a Natural Way

Teachers are taken to be the Customers (C) of this Transformation (T). The teachers who will benefit from this Transformation are teachers that struggle using digital technologies and have no clear pedagogical approach. On the contrary, teachers who have their own solutions and, due to their high ambitions and skills, have developed their own pedagogy will be limited if this Transformation based on this worldview would be realized. The Activity Model presented in continued Purposeful Activity Model 8.19 illustrates logical activities representing the PQR and CATWOE above. Those who can stop this Transformation are the decision makers at the Department of Education (O). However, representatives of the IT-unit could also be considered as owners since they provide the digital solutions.
This Purposeful Activity Model can be considered desirable for the employees of the municipality, including the Department of Education as well as the IT-unit. However, for school practitioners, the desirability is rather to use digital technologies that, for instance, are in line with their pedagogical intentions (e.g., Purposeful Activity Model 8.2) and are adapted to their varying contexts (Purposeful Activity Model 8.4).

In addition to equal access to tools and digital competencies, digital technologies need to be provided to ensure natural use of digital technology in education. Further, it can be noted that the Director of Education considers the frustration reported among teachers using digital technologies as an influencing issue affecting the use. In order to decrease the frustration, illustrated in the middle bottom of Figure 8.11, the Director of Education believes in the need of clearer leadership as well as the need for increasing the communication and concretizing new ways of working within the department.

Similar to the other representatives from the Department of Education, the Director of Education is aware of the varying competences, attitudes and ambitions of digital technology use among the teachers. SAMR\(^79\) is mentioned by the Director of Education as describing the teachers’ varying adoption and use of digital technologies. She also relates to this model as a means for reaching higher levels of digital technology adoption and use (illustrated in the middle of Figure 8.11). The Director of Education acknowledges the importance of enabling and providing good conditions as well as increasing

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\(^79\) Short for Substitutions, Augmentation, Modification and Replacement. See detailed description in Chapter 4.6.3.
awareness of the different levels of digital technology use, as represented in the SAMR model.

In addition to the natural use of digital technologies and equity, the Director of Education acknowledges the need for organizational and cultural change in schools and within the educational system (represented in the middle left of Figure 8.11). In relation to this and improvement of students’ achievement of learning objectives, the economical recourses are highly influential and relevant.

To conclude, this section illustrates various perspectives of actors involved in this research in relation to digital technologies in education. The Purposeful Activities Modelling relevant to the different perspectives have identified a number of issues. The most striking and overarching are: varying philosophies and worldviews in terms of teaching and student learning; different and contradictory worldviews between the involved actors and within the same actor; limited insight and/or understanding of the everyday practices; varying organizational and leadership issues; and ambiguity in central concepts. These issues are recapitulated in the upcoming section.

8.3 Summary

The outcomes of the Soft Systems Analysis are summarized and presented in this section, drawing upon the Purposeful Activity Models and the Cognitive Maps presented in previous sections as well as the representation of the situation in Chapter 7.

One outcome of the empirical analysis shows the different approaches and daily practice of the teachers. These differences are found to be influenced by the teachers’ worldviews and perceptions towards education and digital technologies. For instance, based on the empirical material, both when representing the data in the Rich Picture (see Chapter 7) and in the Purposeful Activity Modelling, it can be noted that the teachers have either a more student-centered approach, a more teacher-centered approach or a combination of both approaches. These approaches influence teachers’ use of digital technologies in education. Student centered teachers are innovative, gadget enthusiasts and highly interested in digital technologies. Teacher centered teachers, however, do not have high faith in the proper functioning of digital technologies and have more negative attitudes towards its use.

Throughout the representation of the empirical material (Chapter 7), and especially in the Purposeful Activity Modelling, the concept of equity was mentioned and considered highly relevant. Equity is stated as one of the important objectives in the school act. Those actors referring to this concept, equity can be achieved by “accommodate all needs” (e.g., Purposeful Activity

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80 See Appendix L for additional models.
Model 8.18) or by provide the same for everyone (e.g., Figure 8.11). This illustrates a contradiction within the same actor. A contrast to the same-solution-for-all Purposeful Activity Models (e.g., Purposeful Activity Model 8.17) is being able to adapt the teaching and education to specific conditions and circumstances (e.g., Purposeful Activity Model 8.4). Further, the modelling illustrates teachers’ need to have pedagogical intention and thought on which to base their use of digital technologies. Moreover, the importance of freedom of how, which enables teachers to adapt the use of digital technologies to their teaching, have been addressed by all informants. However, the actors of this research perceive the ‘freedom of how’ statement in various ways. Representatives from Department of Education state that it is important for school leaders and teachers to be enabled to adapt the ‘how’ based on their local condition in order to achieve and reach various objectives. However, the representatives from the Department of Education most often contradicted themselves. Allowing for the ‘how’ to be different contradicts with statements such: as deciding upon common solutions in line with the municipal IT-structure (Purposeful Activity Model 8.19); a common base of reference (e.g., Purposeful Activity Model 8.17); and the same solution for all (e.g., Purposeful Activity Model 8.15).

The ‘freedom of how’ is part of the schools’ culture and context which, throughout the representation and analysis of the empirical material, has emerged as an important issue to consider because it affects the adoption and use of digital technologies. The importance of context is illustrated, for instance, in the Cognitive Maps of Teacher LA, and the Director of Education (see respective Cognitive Map, Figure 8.3 and Figure 8.11). Closely related to the varying context and situations, the students’ learning styles, individual needs and group dynamics, are issues of relevance. In, for instance, Purposeful Activity Model 8.3, varying student group and varying students’ needs and learning preferences are presented.

Resources and economy are yet two other organizational issue of importance. Proper conditions and resources are mainly mentioned by the teachers and school leaders. However, the District Manager who recently left a school leader position also notes limited resources. There is a clear lack of sufficient resources in the schools (e.g., Purposeful Activity Model 8.9), not only in terms of devices and up-to-date equipment but also in terms of conditions and capabilities to adopt and use the digital technologies. Access and availability of IT-support has been mentioned as a resource issue by the teachers, school leaders and the CIO of the IT-unit (e.g., Figure 8.5 and Figure 8.9).

As concluding remarks, in the next chapter, these issues are discussed in the light of the research question of this dissertation. Additionally, the outcomes of the Soft Systems Analysis are discussed in relation to previous research.
CHAPTER 9
Teachers’ Complex Daily Practice Using Digital Technologies

If a doctor, lawyer, or dentist had 40 people in his office at one time, all of whom had different needs, and some of whom didn’t want to be there and were causing trouble, and the doctor, lawyer, or dentist, without assistance, had to treat them all with professional excellence for nine months, then he might have some conception of the classroom teacher’s job.
Donald D. Quinn

The quote above can be considered to be an exaggeration or it can be considered as provocative questioning how someone without a teacher profession can state such a statement? But it can also illustrate the complexity of a classroom situation from a different profession. The complexity of teachers’ practice includes multiple complex and intertwined issues, including varying student groups, varying students with their individual needs within a group, and demands from all directions, e.g., school leaders, local and national authorities, general society, without any substantial assistance or support, which affects everyday practice.

This chapter aims to discuss the findings of the dissertation research to illuminate and advance the understanding of the complexity of school teachers’ everyday work practices using digital technologies, together with the research questions: What worldview do teachers have in relation to use of digital technology? and What issues of concern increase the complexity of teachers’ use of digital technology in their everyday practices?

The chapter is divided into four sections. The first section explores the outcomes of the empirical analysis discussion in relation to previous research, literature and theoretical models presented mainly in Chapter 4 but also Chapter 2 and Chapter 5. Thereafter, a summary of issue based activities found in the analysis and discussions, which has implications for further
discussion, is presented. This is followed by a discussion of the development of the Technology Enhanced Learning Challenge Domain model, based on the results from this research. The chapter ends by presenting the conclusions based on both research questions stated above.

9.1 Discussing the Complexity of Using Digital Technologies

Educational practice is very complex and includes multiple, varying and contradicting worldviews, as has been evident throughout this research. This finding was noted and identified in the empirical investigation and also mentioned by various scholars in previous research literature and other theoretical models. Due to the extensive amount of empirical material and literature, the discussion revolves around the main central aspects identified in empirical material and in relevant theory. What has been presented in other chapters and not addressed in this discussion provides context and foundational understanding of the research focus and, hence, this discussion. The structure of this section is based on the research questions stated above which focus on the teachers’ worldview in relation to digital technologies and their professional role as teachers. In the following discussion the identified issues of concern, findings will be presented which illuminate the complexity of teachers’ everyday practice.

9.1.1 Teachers’ Worldview of Education, Teaching, Learning and Digital Technologies

The everyday practice of four teachers from two different schools have been explored. The exploration illustrated how the four teachers’ worldviews in relation to digital technologies are different but are also similar; how the digital technologies are intertwined with the involved teachers’ everyday practice and their beliefs related to teaching and learning.

During the passing of time, the teaching profession has changed, not only in terms of the profession as such and its mission, but also in terms of its status. This transformation has also had implications for teachers’ day-to-day activities because digital technologies is now a prevalent part of contemporary school environments. The teachers, as illustrated in the various Cognitive Maps, have to adapt to the changes in the society (e.g., Figure 8.2), the various and new demands from authorities (e.g., use of digital technologies in education as stated in Lgr11) and the decreased status and respect from students as well as their parents (described in Chapter 7.5). The changes identified in this research are also discusses in previous work, e.g., by Jarvis
(2006) and Kennedy (2008) who both state that the traditional image of the teachers has changed.

The findings of this research show that, due to profession changes as well as ubiquitous technologies, higher demands are placed on teachers. For instance, there is a need for teachers to have higher and deeper subject knowledge (e.g., Cognitive Mapping Figure 8.3) since, as stated by Jarvis (2006), the availability of the digital technologies allows students to gain knowledge from various other sources. This also implies that the teachers need to be up to date both in terms of subject knowledge but also in terms of digital opportunities.

The general and ultimate objective of the teachers’ worldview related to their students’ learning is to help and enable the students to become successful, knowledgeable, functioning human beings prepared to live and contribute successfully to the future society. This has been evident and illustrated, e.g., in the Cognitive Mappings of the teachers’ philosophy of teaching (e.g., Figure 8.3 and Figure 8.5). However, to reach this objective, the teachers expressed various worldviews and teaching philosophies, e.g., that student should be active, discuss and collaborate with each other, or as a teacher have good relationship and interaction with the students. Liberg (2014) argues that the choices that teachers make serve to enhance certain aspects of teaching while moving other aspects to the background or completely removing them. These decisions are based on how teachers perceive and think about their practice and their students’ learning. For example, Goodyear and Allchin (1998), Korn (2003) and Kenny (2008) discuss teachers’ philosophies of teaching, i.e., their beliefs, values and approaches as teachers. This research illustrates the variance in teachers’ beliefs and also that these beliefs influence teachers’ daily activities. In addition, the outcomes reveal that teachers who believe strongly in collaboration and dialoging between students and place themselves in the background (e.g., Purposeful Activity Model 8.3) tend to apply a more student centered approach. Furthermore, the findings also indicate that those teachers who believe in a dialog with the students, or who explicitly show awareness of higher status as a teacher compared to students, tend to have a more traditional and teacher centered approach (e.g., Chapter 7.1).

The teachers’ pedagogical approach appears to also have an impact on how digital technologies are used. Teachers who apply a more student centered approach tend to use the digital technologies more extensively compared to those who use a more traditional teacher centered approach. A more student centered approach seems to also imply that digital technologies are used more innovatively (as described in Chapter 4.4). These findings have also been reported in previous research where scholars such as Tondeur, et al. (2008) have found that teachers with a higher constructivist teaching philosophy are frequent users of digital technologies while teachers with more traditional approaches are lower level users of digital technologies. This has also been pointed out by an OECD report (2015b), which stated that teachers’ beliefs about how learning should be carried out affect their teaching methods.
Thus, teachers with higher constructivist beliefs are more likely to use digital technologies more actively. In addition to the pedagogical worldviews affecting and influencing teachers’ use of digital technologies, their attitude and perception towards digital technologies has also been found to affect how digital technologies are intertwined with their overall worldview. This research has also showed that teachers tend not to use these technologies if they do not see any added value to integrating digital technologies in their practices. This has, for instance, been illustrated in Purposeful Activity Model 8.7. These outcomes have also been discussed by, e.g., Ertmer and Ottenbreit-Leftwich (2010) who state that teachers tend to use technologies that they judge valuable to achieving the goals that they believe to be important. Furthermore, Ertmer and Ottenbreit-Leftwich (2010) also include teachers’ self-efficacy as a factor in their uptake of digital technology. This finding has also been identified as important in this research when, for instance, teachers feel uncertain about how to handle situations in which digital technologies do not work as planned (e.g., represented in Chapter 7.4).

Further, time was noted to be important to enable teachers’ adoption and use of digital technologies (e.g., Rich Picture in Chapter 7.4). Also previous research has addressed this issue (Gaffney, 2010; Salavati, 2013; Jensinger, 2014; BESA, 2015). However, Tallvid (2014) showed that lack of time for teachers to adopt digital technologies is rather attributable to their heavy workload, which made it difficult for teachers to focus on integrating digital technologies into their teaching. This research also found that teachers’ workload was a contributing factor to their lack of digital technology adoption. An additional important factor is though, teachers’ attitudes and willingness to adapt and use digital technology (e.g., Rich Picture in Chapter 7.7).

Due to the varying worldviews of the teachers (both in terms of pedagogy as well as their attitude and perception towards the digital technologies), the ways in which they adopted and used digital technologies in their everyday practice varied. This was evident throughout this research, as represented in the Rich Picture (see Chapter 7.3 and Chapter 7.4). Teachers would find creative ways to employ digital technologies or they would simply use digital technology as a replacement for traditional technologies. In their elaboration on adoption and use of digital technologies, Hughes, Thomas & Scharber (2006) advance the RAT replacement, Amplification and Transformation. model and Puentedura (2006) proposes the SAMR Replacement, Amplification, Modification and Redefinition model. Both models distinguish different levels of digital technologies’ role in education. Within the context of these two models, teachers participating in this research have been identified according to their varying digital technology usage, i.e., as either Replacement (RAT model)/Substitution (SAMR) or Transformation (RAT)/Redefinition.
(SAMR). On one end of the spectrum, teachers have been using digital learning materials as straight off replacements for the traditional printed book. Students have read assignments on their iPads and replied in traditional paper based notebooks. On the other hand, some teachers have used digital technologies innovatively by, for instance, finding work arounds. These innovative ways of working have transformed the teaching and learning, and achieved improved efficiencies in professional practice as well as enabled students to become more active in their learning processes (see detailed description in Chapter 7.4).

The awareness of the RAT and SAMR models has been noted both for some municipal authority administrators (e.g., Figure 7.2.10) as well as for some teachers (e.g., see examples in Appendix L). These express an aim to strive towards Transformation (RAT)/Redefinition (SAMR) level. However, the question is whether municipal authority administrators are aware of the varying pedagogies, classrooms practices, and learner characteristics when expressing a wish for teachers to reach the models’ higher adoption levels? Hamilton, Rosenberg and Akcaoglu (2016) that these factors, as well as the dynamic nature of educational practices, are ignored and not included in these models (referring mainly to the RAT model). The contextual aspects such as, e.g., infrastructure; resources and different types of support; individual and collective student needs and capabilities; and teachers’ knowledge and attitude are important to have in mind when striving for adopting and using digital technologies more than merely as Replacement/Substitution of traditional technologies. In this research, the contextual aspects have been found influencing all teachers’ practice. Some of these aspects have been illustrated in the Rich Picture included in Chapter 7 and in, e.g., Purposeful Activity Model 8.3, Purposeful Activity Model 8.8, and Purposeful Activity Model 8.9.

The empirical findings in this research indicate that there is a balance between the three domains: subject, pedagogy and adoption and use of digital technologies, including taking the context into account. The balance between these domains has also been reported and discussed by Mishra and Koehler in their TPACK framework (e.g., 2006). The dynamic convergence and interaction between these domains have been evident in the empirical findings for this research as well. This research has also shown how teachers have adapted their pedagogy based on their subject as they considered and integrated purposeful use of digital technologies (e.g., difference between theoretical and practical subjects and classes is described in Chapter 7.2). The balance of subject, pedagogy, and technology can also be evident at various levels of the RAT and/or SAMR models.

The findings reported in this section, relate to the understanding and appreciation of the teachers’ multi-dimensional professional practice. This is one of the two dimensions, which Gaffney (2010) has identified, that comprise the complex nature of teachers’ adoption and use of digital technologies. The
second dimension includes external influences which in this research are referred to as issues of concern. These are presented in the upcoming section.

9.1.2 Issues Adding to the Complexity of Everyday Practice

Educational practices are complex and messy, as has been illustrated throughout this dissertation both through research results and also by other scholars (e.g., Gaffney, 2010; Cuban, 2013). In this dissertation, the Rich Picture and several Purposeful Activity Models illustrate the perceived real world in this light - as both complex and messy. This section discusses a number of the most essential issues identified that contribute to this complexity, based on the empirical representation and analysis of four teachers, two school leaders, three administrative representatives from the municipal Departed of Education and the CIO of the municipal IT-unit. The discussion is framed within the context of previous research and other theoretical frameworks.

Using Soft Systems Methodology terminology, there is a limited clarification of “why”, i.e., the R of the PQR\(^3\) statement, digital technologies should be adopted and used in everyday educational practices. In this research, it has been identified that the focus of introducing and integrating digital technologies lies in “what” (P) to do and “how” (Q) to achieve that aim. The identified ‘why’s are often multiple and also ambiguous. For example, while it is evident that digital technologies should be used in education (what), according to representatives of the municipality, this should be achieved by using the same digital solutions for all schools (how) built on the argument to reach equity (why). However, in this case, there is no clear definition and understanding of what equity is or should be; should equity be considered as access to exactly the same digital solutions (Department of Education perception, e.g., Purposeful Activity Model 8.17) or should it be related to the outcome of education and learning (school practitioners’ perception, e.g., Purposeful Activity Model 8.3)\(^3\)? This issue of concern can also be related to the lack of national and local strategies and steering documents (e.g., Figure 8.6 and Figure 8.7). The significance and interpretation of national documents was also earlier identified by Ottestad (2013), though in a Norwegian context. In a Swedish context, the lack of understanding about how instructions stated in national documents are to be applied has been, for instance, explained by the Swedish National IT policy (Näringsdepartementet, 2011a; b).

A further major issue of concern that is closely related to the above mentioned issues is the school leaders’ and teachers’ ‘freedom of how’; there is a tradition that teachers decide how to perform teaching in their classrooms,

\(^3\) What (P), How (Q) and Why (R). See detailed description of the technique in Chapter 6.4.1 and see Chapter 8 for PQR statements found in this research.
and school leaders decide how to manage their school. This research shows the importance of and need for providing the ‘freedom of how’ to school leaders and teachers in order for them to adapt the everyday practice according to varying situations, context and needs (e.g., illustrated in Purposeful Activity Model 8.3 and Purposeful Activity Model 8.9). This freedom is also acknowledged in the Swedish School Act (2010:800) and in the Swedish National IT policy (Näringsdepartementet, 2011a; b). School leaders’ rights to lead their schools and, specifically, to enable an encouraging environment for use of digital technologies, is also reported by Jensinger (2014) and in the British BESA (2015) report. Jensinger (2014) argued that when strong external limitations are placed on IT usage, it becomes impossible for schools to successfully adopt digital technologies. As a consequence, IT departments will make decisions affecting teachers’ everyday practice using digital technologies. These tendencies have also been identified in this research, illustrated in the IT department’s viewpoint (e.g., Purposeful Activity Model 8.15). This view is also shared by representatives on municipal authority level (e.g., Purposeful Activity Model 8.19), which also present contradictory ideas in validating the importance of the ‘freedom of how’ (e.g., Purposeful Activity Model 8.16). The conception that enabling ‘freedom of how’ for schools ensures viewing digital technologies in education as a pedagogical rather than a technological issue, is found both in the empirical material (e.g., Purposeful Activity Model 8.2) and in previous work (e.g., Jensinger, 2014).

The varying understandings, perceptions and worldviews about adoption and use of digital technologies are also an essential aspect which adds to the complexity of digital technologies in everyday education. Varying perceptions and worldviews present contradictory and clashing viewpoints among and between actors in this research. Conflicting worldviews about and perception of digital technologies are clearly revealed through the Soft Systems Analysis. For instance, authoritative administrators believed that educational practitioners should have the freedom to adapt the use of digital technologies according to their local conditions (e.g., Purposeful Activity Model 8.16) while they, at the same time, desired the same solutions for all schools (e.g., Purposeful Activity Model 8.17). This clash between authoritative administrators and school practitioners, who believed that their practices should be based on local needs adjusted to varying contexts (e.g., Purposeful Activity Model 8.4 and Purposeful Activity Model 8.11), is also identified in the work of Cuban (2013) and Grönlund (2014).

One reason for these conflicting and clashing worldviews is limited insight and understanding of practitioners’ everyday practice. Similar to arguments by Cuban (2013), this empirical research has revealed that administrative personnel believe that they are well aware of everyday practice realities, while, however, this may not be the case. For example, the Rich Picture (Chapter 7.7) illustrates that municipal representatives believe that the
systematic quality work and conducting single interviews provide them an insight in the school practices while this is not the perception of the school practitioners (e.g., Chapter 7.7). Furthermore, it is questionable if local authority representatives are aware of teachers’ complex everyday practices, including the nuances of how digital solutions may or may not be appropriate for various contexts, situations, and worldviews. To further complicate the situation, teachers are typically not included in discussions concerning the integration and adoption of digital technologies in schools, which produces limited insight into classroom realities. This is also pointed out by Cuban (2006). The situation of excluding teachers from occupational group involvement is illustrated – by virtue of their exclusion – in the IT-unit’s interest in having a dialog with the municipal employees of the Department of Education and not the teachers (described in Chapter 7.6 and illustrated in the Cognitive Map illustrated in Figure 8.9).

Moreover, students are an essential aspect of teachers’ complex everyday practice usage of digital technologies, all the more so because students are a heterogeneous group of individuals. The students have individual needs and conditions (e.g., Chapter 7.5 and Purposeful Activity Model 8.1). They differ also in terms of social constellation and group dynamics. The different ways of learning are also represented in the works of, e.g., Christensen, Horn and Johnson (2008), Boström (2011) and Bates (2015).

In these two sections, the influence of context on adoption and usage of digital technologies has been emphasized, as has the significance of differing roles. Varying students and student group dynamics (e.g., Purposeful Activity Model 8.3), varying school leaders’ leadership styles (e.g., second part of Chapter 7.7), varying classroom practices (e.g., Chapter 7.2 and Chapter 7.3), and varying schools (Chapter 3.1 and Chapter 3.2) illustrate different contexts. Rosenberg and Koehler (2015), Ertmer and Ottenbreit-Leftwich (2016) and Hamilton, Rosenberg and Akcaoglu (2016) explicitly mention the importance of context as an essential aspect of digital technologies usage in everyday practice. As stated by several scholars, such as Boström (2011), Säljö (2014a), Ertmer and Ottenbreit-Leftwich (2010), Hamilton, Rosenberg and Akcaoglu (2016), there is no single or unified digital solution for learning. Therefore, digital technology use should not be reduced to one single technique or method favored above others. This has also been verified in this research by teachers, students and leaders within varying contexts and situations.

To summarize the outcomes of this research, the following section will present a model, which includes major issues of concern discussed in this section as well as additional issues found in this research.
9.2 Implications for Teachers’ Everyday Use of Digital Technologies

Emerging from the discussions above, a Summarizing Issue Based Model has been illustrated in Figure 9.1 as a suggestion for further discussion. This model is inspired by the work of Wilson (1990) and his Consensus Primary Task Model. The model enables continuing the discussion in terms of future implications for the real world complexity of teachers’ use of digital technologies in their everyday practice.

![Figure 9.1 Summarizing Issue Based Model](image)

The Summarizing Issue Based Model, as perceived from teachers’ perspectives, suggests guidance on issues to reflect on and further discuss to find out what could lead to potential improvements. Additionally, the simplicity of the model needs to be taken into account, meaning that not all connections and relations are included in the presented model in order ensure ease of readability for the model, so it is not made fully complex and messy. These additional connections are described in the upcoming paragraphs.

The why (R of the PQR) of educational practices are to educate the younger generation. This is illustrated in the bottom right side of Figure 9.1. In addition to national objectives, central and important concepts such as, e.g., ‘equity’ and ‘natural use of digital technologies’, need to be defined and

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84 See Appendix M for a larger figure.
clarified in order for all actors to achieve accommodation on what is meant and aimed for. This should also be done for national and local objectives and strategies.

Further, digital and traditional technologies need to be employed to support everyday practice in order to achieve the ‘why’ (illustrated at the left the ‘why’ activity). In addition, to enable use of various technologies (digital and traditional), several activities are relevant. One overarching activity is to understand teachers’ various worldviews (illustrated at the top of Figure 9.1). Thus, both innovative/successful/interested teachers, as well as skeptic teachers with fears and doubts to use of digital technologies, contribute to more holistic understanding of teachers’ practices and needs. The teachers, both “digital technology engaged” and “digital technology sceptics”, are suggested for inclusion in the process of choosing and purchasing technologies which are both needed and purposeful. The research has shown that, currently, teachers are not involved in these activities.

Understand the varying worldviews and identify teachers with different perceptions and attitudes towards digital technologies allows better identifying the needs of teaching and educational practices. Such inclusive considerations can inform choice and purchase of digital technologies to be used in schools, as illustrated at the middle right side of Figure 9.1. In this figure, needs are partially identified based on understanding teachers’ various worldviews, but also identified based on assessing, defining and understanding current use of the digital technologies. Identifying the current use may best be done by collecting quantitative and qualitative data from a broader and more holistic perspective than how it is collected currently. Now information is mostly quantitative, with limited consideration of particular circumstances and contexts beyond numerical outcomes. This finding suggests that further understanding of everyday practice is also relevant for the leadership on both municipal level and school management level. The municipal and school leadership is illustrated on the bottom left side of the figure and is further presented later in this description.

Providing adequate IT-support to enable use of digital technology in everyday practice also emerged as essential in this research. IT-support, illustrated on the right side of the Summarizing Issue Based Model (Figure 9.1), needs to be provided both on a central level and also on a local level. Providing local IT-support ensures closer and easier access to the everyday needs and contexts of teachers and practice. In order to provide IT-support to schools, the capabilities and skills of the IT-employees need to be assessed and advanced. The IT personnel also need to have an understanding of the education system. They must appreciate that schools are different than most other organizations in terms of complexity, which includes everyday practice, varying needs, local culture and school traditions. Each school setting reflects varying situations and contexts, as well as diverse actors with various roles and accompanying worldviews, mindsets and beliefs. Local and central IT-support activities are,
therefore, important for the leaders on municipal and school management levels to address and further.

Moreover, understanding teachers’ various worldviews also informs interpreting assessments of the variance in knowledge, attitudes and willingness that exist among teachers in regard to use of digital technologies. Such understanding enables the possibility to provide for a more positive attitude and feelings toward use of the digital technologies (illustrated in the middle of Figure 9.1). Furthermore, the reliability and stability of the technology is also considered to be highly important in order to create positive attitudes and receptive feelings about digital technology use among teachers. In addition, creating an awareness of opportunities and benefits of the digital technologies (e.g., why to use it) and also highlight the difficulties and problems that might occur and how these could be handled will aid adoption and usage.

Awareness of the opportunities and challenges for digital technologies can be advanced by, e.g., in-service training. In-service training at various levels of difficulty should be provided because teachers have varying levels of knowledge and skills. This implies a need to assess teachers’ knowledge and skills in adopting and using digital technologies. Models such as SAMR and RAT86 and/or TPACK87 could be used to create an understanding of levels of adoption, use and knowledge with the teachers’ worldviews and contexts as a foundation (see top of Figure 9.1, below the understanding of the teachers’ worldview activity, on the left).

These activities are closely related and integrated with providing the possibility of individual development for the teachers. This has been illustrated in the middle higher left side of the Summarizing Issue Based Model. Enabling teachers’ individual development, both in terms of digital technology and also in terms of professional development, requires understanding teachers’ various worldviews. Throughout, freedom of how, as illustrated in the middle-left side of the Summarizing Issue Based Activity, is needed. Whether they are using digital or traditional technologies, teachers should be allowed to determine ‘how’ according to their worldviews as teachers, i.e., flexibility is needed to allow use of varying technologies educating the younger generation for the future they are about to enter.

Within a larger context, school leaders must also be allowed to determine the ‘how’ in their leadership. School leadership, as illustrated at the bottom left in Figure 9.1, has also briefly been addressed in the Summarizing Issue Based Model. In order to enable and allow digital technologies to be used in everyday education an effective and strategic school leadership is considered essential. This may be achieved by providing school leaders with local and national strategies

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85 Substitution, Augmentation, Modification and Redefinition. See detailed description in Chapter 4.6.3.
86 Replacement, Amplification and Transformation. See detailed description in Chapter 4.6.2.
87 Technology, Pedagogy and Content Knowledge framework. See detailed description in Chapter 4.6.1.
and guidelines, and also providing leadership education. Leadership education is suggested because even after long careers as teachers and considerable understanding of schools, leaders require additional competencies and capabilities to manage complex organizations. Additionally, attention to school culture is needed for effective and strategic school leadership, since the cultural context as well as specific traditions varies among schools. School leaders’ varying worldviews and backgrounds also influence their leadership approaches. Additionally, classroom visits are recommended to increase awareness of the everyday practice as well as offer additional qualitative information necessary for clear and strong leadership. For municipal leadership, clear objectives and strategies on mainly national but also local levels are crucial (illustrated in the bottom left side of Figure 9.1). The consideration of the schools’ different contexts and cultures and, as presented throughout this section, understanding of teachers’ varying worldviews and capabilities is also suggested to enable a stronger and clearer municipal leadership.

The students are also included in the Summarizing Issue Based Model. Assessment and acknowledgement of students’ knowledge and skills regarding digital technology is suggested (at the bottom middle of Figure 9.1). This is considered beneficially in terms of enabling use of digital technologies since their levels of knowledge are not always as sufficient as might be expected.

As a final point, varying issues represented in the different activities, such as, ‘assessing’, ‘understanding’ and ‘taking into account’ cannot be based on individual level. There should be a balance in covering the varying nuances of the real world situation.

9.3 Contribution to Technology Enhanced Education

The original Technology Enhanced Learning (TEL) Challenge Domain model consists of the following domains: learning, social and cognitive; technology and engineering; design and interaction; (Kurti, 2009). This model was extended by Salavati (2013) to include political; organizational; resources; and society. The outcomes of this dissertation have in turn further developed the TEL model.

First, the outcomes extend the understanding of the learning, social and cognitive domain. In addition to various ways to learn, the students have also been identified as having varying needs and capabilities in terms of learning with and also using digital technologies. These needs are different compared to their learning preferences as it, for instance, can require additional support and personalized assistance during classes. Further, the research has also revealed that students have different worldviews and understandings when it comes to educational practices. For example, the conservative nature of some students has presented difficulties to teachers who are applying and using digital technologies. This finding has been further enriched by noting the
influence of different student groups as well as the different dynamics of different groups in different contexts.

Second, the organizational domain has also been developed. In this research, it became obvious that the influences of culture, leadership and the importance of ‘freedom of how’ must be included in the organizational domain. In addition, it became clear that leaders (on school and administrative level) must both have insight into teachers’ everyday practices as well as organizational complexity. These factors are both major influences on leadership as well as on the use of digital technologies in education. Salavati (2013) included resources as a separate domain. However, due to results in this dissertation, resources are included in the organizational domain.

Moreover, the outcomes of this research have extended the design and interaction as well as the technology and engineering domains. These two domains have been identified as more closely related to, and more influenced by, one another than the other domains. The flexibility of using and combining digital technologies has also been noted as important for the use of digital technologies. As a part of the design and interaction, pedagogical intentions and thought, and the pedagogy and didactics as such has been observed as important in order to find purposeful and suitable uses for digital technology. These issues are combined with the trustworthiness, ease of use and reliability of digital technology. Further, the importance of central as well as local IT-support has been identified as an issue in the technology domain affecting technology enhanced educational practices.

The fourth insight gained in this research concerns the political domain. The further development of this domain include leadership as it has been found important based on the outcome of this research. Strategy documents and pedagogical visions, plans and incentives have been highlighted as important for introduction of digital technologies into education.

Additionally, in this research the importance and influence of teaching and context have been highlighted. These issues are not included in the TEL model but they add yet another dimension to the model; as illustrated in a new model in Chapter 11. These aspects were observed to affect the everyday practice of teachers’ use of digital technologies. Other issues of relevance are teachers’ philosophy of teaching and their varying worldviews, which affect and influence their pedagogical and didactical practice. These issues can be more directly related to teachers’ design and delivery of teaching and learning activities. An additional issue is the teachers’ skills and knowledge related to the subject and pedagogy and didactics as it affects their adoption and use of digital technologies.

Sixthly, the overarching society has been extended due to the outcomes of this research. In addition to issues such as the blurring of the private, public and professional roles has been noted. The development and evolution of the society in terms of digitalization has also been made explicit as an outcome of this research.
Finally, analysis and discussion of the empirical material resulted in a suggestion to modify the Learning in the TEL model with an Education. Technology Enhanced Education (TEE) is proposed because ‘education’ includes both learning and teaching. Furthermore, the domains are no longer defined as challenge domains since the identified issues of each domain can be general issues of relevance affecting technology enhanced education rather than only being problematic challenges.

9.4 Concluding Summary

This dissertation has aimed to illustrate the complexity and issues of concern adding to the complexity of compulsory school teachers’ everyday practice using digital technologies. This has been done by applying a Soft Systems Approach which builds upon understanding of humans’ purposeful activities within a social context. The empirical exploration focused on the teachers’ everyday practice and how digital technologies were intertwined in their day-to-day practice, including teachers’ perceptions and beliefs about digital technologies and how these were translated into practice. Further, in this empirical exploration, external factors such as varying worldviews, leadership, directives, steering documents and context influence and affect teachers’ everyday practice. The major issues found to add to the complexity of teachers’ everyday practice of using digital technologies include: limited clarification and ambiguity in core objectives and relevant concepts; differences in how the situation is understood by different actors because different actors have multiple and sometimes conflicting worldviews; limited understanding about the realities of daily education and teaching practices; as well as the influence of students and the overall importance of context and situation adopting and using digital technologies.
PART IV
Conclusion
CHAPTER 10
Learning by a Methodology-informed Approach

A researcher who possesses methodological knowledge can apply that knowledge, including its methods, to a specific perceived situation in order to make sense of that specific real world situation. Apply this knowledge to that specific problematic situation generates new learning and experience for the researcher, as well as new insights about the applied methodology (Checkland, 2000). In order to reflect on the learning achieved from applying a certain methodology, Checkland (2000) developed the LUMAS model based on his learning using SSM. LUMAS is an abbreviation for Learning for a User by a Methodology-informed Approach to a Situation. LUMAS is based on the user, the methodology and the situation as perceived by the user.

In this dissertation, the main methodologies were Soft Systems Methodology (e.g., Checkland, 1999) together with the Focused Ethnographic approach (e.g., Knoblauch, 2005). Ethnography and Soft Systems Methodology (SSM) were combined with the aim to illuminate and advance the understanding of the complexity of teachers’ everyday practice using digital technologies. The ethnographic approach was used to collect data in a natural setting, i.e., educational practices, whereas SSM with its techniques enabled rich illustration of the complex situation and, hence, made discussion possible for learning for further action. This chapter includes reflections on experiences and learnings gained through the use of SSM and Focused Ethnography. The chapter follows the LUMAS model (presented in Chapter 5.2.2). The first section describes the perceived real world situation, followed by a reflection on the methodologies. The chapter ends with the Methodology-Informed Approach, i.e., the adaption of the methodology for the research by the researcher.
The real world problem situation of this research has consisted of teachers’ complex everyday practice using digital technologies. Two schools, several classrooms, four teachers, two school leaders, three representatives from the Department of Education and the CIO of the municipal IT-unit have constituted the empirical real world research context. This section discusses and reflects upon the experiences and learnings gained about the teachers’ everyday real world problematic situation. Initially the empirical setting is discussed followed by the significance of the informants involved in this research.

The Empirical Setting
The empirical setting of this research has been two schools, one larger 7-9th grade school with approximately 650 students and 66 teachers, and one smaller preschool to 9th grade school with approximately 230 students and 27 teachers. Although schools in general have common history and traditional background, each school has its own culture, tradition and context. Each individual classroom and each individual school is one part of a bigger whole and in this research parts of this bigger whole have been studied. Further investigations are recommended, which would to add to the understanding of this complex whole.

One learning gained in the empirical setting concerned the sensitivity in addressing and asking questions about digital technologies and their adoption and use. The sensitivity could be noticed immediately in the my initial contact with the schools, and also subsequently with my contact with the Department of Education at the municipality level. Sensitivity about digital technology use in education was especially pronounced with the teachers. I could often perceive that teachers did not want to be judged or criticized by someone from the outside about how and what they should and should not do – which has never been the purpose of this research. As was clearly stated in initial contacts with any potential informants, the research aim of the observations was not to criticize the teachers but to understand their daily practice.

This learning that it usage of digital technologies in education was a sensitive topic came mainly when I was presented as a researcher to colleagues of the teachers involved in my observations – the shadowed teachers. The colleagues would either open-up or become more distant. When I was present in a school for some time, a few colleagues that were hesitant in the beginning became more relaxed and less constrained when they understood that the aim of the observation was to appreciate and understand their daily practice.

The empirical setting in this research has focused on the everyday practice of the informants, mainly the teachers. It is important to acknowledge that classrooms and schools are the main setting where teachers and school leaders work, but these are not the only places. The teachers, and presumably the
school leaders, work from their homes and during their leisure time, which again illustrates that the school is one part of a bigger whole. However, the teachers’ work outside of school has not been covered within this dissertation.

The empirical setting has enabled gaining knowledge of the real world situation, and also increased knowledge and insight in the world of the actors in schools and education. The actors in this research have been selected as informants in order to gain the insight and knowledge available in the empirical setting. The informants are reflected in the upcoming section.

**The Informants**

Four teachers and two school leaders from two different schools as well as three representatives from the Department of Education and the CIO of the municipal IT-unit constitute the informants of this research.

The teachers included in this research have a reputation as being good teachers. One of the teachers in this research had been suggested to me by an external institution involved in school education, due to the teacher is known to have a good reputation in terms of use of digital technologies in education. The school leader of that specific teacher’s school was contacted and additional teachers from that school were also asked to participate in this research. At the other school, the school leader helped to convince one of the teachers to participate in research observation and interviews. According to the school leader, this teacher is known to be a teacher from whom much can be learned, especially when the focus is on how teachers use digital technologies in education.

The aim of this research has not been to reach a general understanding of all teachers’ worldview in relation to digital technology in education, but rather to illustrate the adoption and use by four individual teachers. The teachers expressed a variation in interest in using digital technologies: two teachers had a very strong interest in digital technologies, one teacher had less enthusiasm about digital technologies, and one was skeptical about digital technologies. One of the two teachers with high interest in digital technologies expressed enthusiastic interest in this research, due to its focus. The second teacher with high interest in digital technology was the teacher suggested by the external institution. At the other end of the spectrum, one participating teacher was not the least interested in digital technologies. This teacher explained before the second interview that she lost interest in being interviewed as soon as the aim of the interview was mentioned – to focus on the use of digital technologies, but she wished to do the interview anyhow. This specific teacher got interested in being involved in this research as a result of my observation of another teacher at the school. The teacher expressed a wish to show “the other side” and that one can conduct good education and teaching without “fancy, flashy presentations”, i.e., without the use of digital technologies. The teacher emphasized that human relationships are more important rather than digital technologies. This teacher and the teacher which
was neither too enthusiastic, nor skeptic towards use of digital technologies, brought nuanced variation to this research, which enabled wider understanding of the variety of worldviews concerning use of digital technologies in everyday education practice.

Although my research has shed light on various worldviews, it is still important to emphasize that the number of varying worldviews, mindsets, beliefs and perceptions related to education and teaching, and further related to the use of digital technologies, are as numerous as the number of teachers. In addition to the teachers, there are other actors in the surroundings who have their own worldviews and perceptions that directly or indirectly are involved in educational settings and impact the everyday practice of education using technologies – digital and/or traditional. This research offers insight into four teachers’ everyday practice and their use of digital technologies at two different schools. Even though the research has illuminated the complexity of using digital technologies in everyday education from multiple viewpoints, the outcome indicates the need for further research including more and different actors and worldviews.

In addition to the teachers, two school leaders have been interviewed. Similar to the teachers, understanding has been gained about each of the school leaders and their understandings, perceptions and worldviews. Both school leaders’ everyday leadership and use of traditional and digital technologies, are influenced by their worldviews and perceptions. No doubt, additional and/or different school leaders could have contributed other perspectives to this research. This is particularly true if deeper investigations, such as observations, had been conducted with the school leaders.

Deeper insight into the complexity and struggle of the school leaders was gained as an outcome of the interviews with two school leaders. This research revealed that one school leader was very much aware of her own power and authority and very much aware of her own teachers’ practice, while one school leader gave the impression of being more in line with, and more strictly following, the authorities’ guidelines.

The informants from the municipality brought yet another level of understanding. The informants did not only contribute with their own worldview and perspectives; they also extended understanding of teachers’ and school leaders’ viewpoints. Once again, having a deeper investigation rather than single interviews would have increased the understanding of the complex problematic situation even more. This is specifically true for the District Managers since only one of the several contacted agreed to be interviewed.

In terms of my bias as a researcher my own experiences as a teacher in higher education has no doubly affected my research. To compensate for that, I chose ethnographic approach which allowed to gain rich data and, hence, limit my own bias.
10.2 The Methodology: Ethnography and Systems Thinking

The methodologies applied to the perceived complex real world situation of teachers has been Focused Ethnography, Soft Systems Methodology and Cognitive Mapping. The experiences and learnings gained using these methodologies is presented in this section. Initially Focused Ethnography, used for collecting empirical data is presented. Next, Soft Systems Methodology and Cognitive Mapping is described. Cognitive Mapping has been used as one data representation technique, in addition to its own techniques.

Focused Ethnography

In order to acquire a deeper understanding of the complexity of teachers’ use of digital technologies in their everyday education and teaching practices, an ethnographic methodology was employed, including observations and interviews. The daily practices of four teachers were explored for a couple of days up to a week, which enabled acquisition of profound insight into their everyday practice and their worldviews. The real world perspective and an actual everyday context, did not only confirm the findings of the previous research of Salavati (2013) but it resulted also in additional knowledge about the complexity and richness of the everyday practice. The school includes more actors than solely teachers and students, and using ethnography has made possible the inclusion of other actors, such as, administrators, paraprofessionals, resource personnel, parents, IT-technicians, etc. who formally and informally influence classroom experiences. The interactions and socialization occurring as parts of the everyday practice of teachers has contributed to the overall and more holistic understanding of teachers’ complex everyday practice using of digital technologies.

A focused ethnography made it possible to, in a short time, intensively gain first hand understanding and knowing about teachers’ lives and experiences in school settings. One of the characteristics of focused ethnography is short-term field visits, which was well suited for this research since teachers perform their professional role primarily during certain hours of the day and certain days of the year, even if they often do some work from home and are influenced by their lives outside of school. An additional characteristic of the focused ethnography is the possibility to select informants since the aim of this research and the problem in focus were pre-formulated.

Further, both the emic and the etic perspective of ethnographic research are used in this research. The emic perspective, i.e., the participants’ perspective, has been applied in the data collection and the first steps of the data analysis where the informants’ wordings and formulations were used. The etic perspective, i.e., the researchers’ perspective, has been applied throughout
the entire research based on the ambitions of this research to illuminate and advance the understanding of teachers’ complex everyday practice using digital technologies. This was enacted during observations of the teachers and also when the observations and interviews were transcribed. Notes were added to the original material with reflections of the researcher, and in the analysis the research questions and the intentions of the researcher were in focus. However, the difficulty of applying both emic and etic perspectives was sometimes to keep them apart. The difficulty was to not allow etic (researchers’) thoughts and understanding to be included in the emic (participants’) understanding. However, by consciously addressing and highlighting the etic perspective, my research contributes to the whole picture rather than claiming this research is purely based on the emic perspective, and hence the reality of the participants (cf. Madden, 2013).

On the counter part, the limitations of applying an ethnographic approach have been both the interpretation and bias of the researcher, and also the question of how close the observed reality is to the actual reality of the teachers. An additional limitation of applying focused ethnography for this particular research has been the limited hours of observation in one single day, i.e., the teachers have only been observed and shadowed at their workplace at the schools. Many teachers continue to perform their professional roles as teacher after their working hours as they often conduct work from home, and even if the teachers would talk about working at home during the observations, it did not provide the same insight as understanding from first hand observation.

Observations and interviews were carried out to collect data. The observations used for this research consisted mainly of shadowing, and this enabled the researcher to become invisible and focus on taking notes in the classroom and asking questions when alone with the teacher. However, it is not possible to be fully invisible, even though I was mostly standing in the back of the class. During most classes, the teacher introduced me to the students and thereafter the teachers and the students would carry on with the class. For the classes where the teacher did not introduce me, the students had already meet me in a different class. Since several classes were observed the same student groups were observed but in different classes and it could be noticed that the level of ‘invisibility’ increased as the students, and at times the teachers, forgot about the ‘outsider’. The students eventually ignored the researcher, in contrast to the first and/or second meeting when the students were curious about who the person is and could be nervous as if they were being evaluated. In terms of colleagues and other people at the school, the researchers’ identity and role was either fully presented or hidden. This was very much based on the context and setting, and whether the teacher observed presented me or gave space for me to become known.

The observations were performed without an observation guide, which permitted observing what was happening without being limited by specific
frameworks which could cause missing other issues that could be of relevance. However, it should also be noted that my background and preconceptions to a large extent have influenced what has been observed. A limitation of the observations in this research is the absence of video recordings, which is a feature suggested in the focused ethnographic approach. The argument for not recording any observations is based in ethical considerations: neither students nor colleagues of the observed teachers had not given their consent. It was not possible to ask for consent from all students in the various classes, nor for consent from all colleagues in all contexts. In a few rare cases, when observing a specific teacher, certain talks or meetings would occur with colleagues, and oral consent was requested and given by the colleagues for that specific occasion. Since no recordings were done, the limits of memory in terms of note taking and transcription was an additional challenge and issue to consider. The extensive notes taken during observations could many times become messy.

Interviews of teachers were carried out, in addition to the observations and shadowing. The interviews were based on two frameworks: Philosophy of Teaching and Unified Theory of Acceptance and Use of Technology. In addition to formal interviews, informal interviews were conducted to clarify specific situations. These questions were aimed at gaining a more detailed understanding of situations. Such casual talks and informal interviews were mostly carried out after a class or after the observed teachers communicated with colleagues.

The formal interview questions for the school leaders and the representatives from the municipality were a modified version of the interviews with the teachers and with inclusion of some additional questions based on what had been observed in the schools. These formal interviews enabled a general understanding of their worldviews. A learning outcome of this research is that formal interviews are much more limited in comparison to observations. The outcome of the observations and informal interviews and talks with informants were sometimes perceived different compared to what was told during the formal interviews.

The knowledge and learning gained by the ethnographic study is in line with what Randall, Harper and Rouncefield (2007a, p.180) state: that conducting ethnographic studies does perhaps not necessarily require massive amounts of education, however, it certainly is not “simply hanging around”. The outcome of this ethnographic study methodology is massive amount of data, transcription and analysis works, and – if done well – massive amounts of knowledge.
Soft Systems Methodology and Cognitive Mapping

In addition to Focused Ethnography used for data collection Soft Systems Methodology (SSM) and Cognitive Mapping have been used for the representation and analysis of the empirical material. Soft Systems Methodology, has enabled exploration and representation, in a structured manner, of the complex and messy situation of teachers’ use of digital technologies. Further, SSM has enabled handling the vast amount collected empirical material in a structured manner. Cognitive Mapping enabled to map and represent how a person thinks about a problem, situation or issue, which was beneficial for bridging the representation of the empirical material and the analysis.

SSM includes two approaches for carrying out a study, SSM_P and SSM_C. SSM_P focuses on the process of the study, addressing the “carrying out” part of the study with the researcher’s own situation and activities to be carry out. The other approach is SSM_C and it deals with the content and tackling of the problematic situation. In this dissertation, both approaches have been applied. The SSM_C analysis carried out was based on an SSM_P analysis and use of Cognitive Mapping. This section reflects upon the SSM_C approach, whilst the SSM_P approach is presented in the next section (see section 9.3). The reflections are presented in the order of how the SSM_C analysis has been carried out, i.e., representing the situation through the empirical material; modelling chosen issues and perspectives using various SSM techniques; and finally discussing the real world situation in comparison to the models built.

For this research, SSM_C, from this point on only referred to as SSM, has been used to contribute to advancing the understanding of a complex real world situation rather than investigating and understanding for improving a situation. The aim of using SSM has been to illuminate and understand the perspective of various actors, and hence highlight underlying perspectives influencing the complexity of teachers’ everyday practice using digital technologies.

One of the major challenges of carrying out empirical research in complex real world situations, is representing rich and extensive data. SSM Rich Picture technique enabled, in a simple and comprehensive manner, to capture and richly represent the complexity of the real world situation, including several actors and their worldviews. The ideal of Rich Pictures is to provide an easily understandable overview and insight into the complex situation. However, for this dissertation a high detail-level was chosen in order to be as close as possible to the perceived real world situation. Next, the modelling of the empirical material represented in the Rich Picture was carried out using SSM modelling techniques and Cognitive Mapping.

Cognitive Maps were developed for each informant in order to illustrate how that specific informant thought about the situation. Using Cognitive

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88 See detailed description in Chapter 5.3.
Mapping simplified the SSM process both in terms of identifying a balanced level of abstraction and detail and simultaneously staying within the scope and aim of this research.

The initial SSM modelling technique (PQR) was based on the Cognitive Maps, and was descriptions of the informants’ reality, as perceived by the researcher. The second technique used (CATWOE89) identified features of what could be considered purposeful rather than purely descriptive. The Customer of the CATWOE models has been based on what is considered purposeful and meaningful for the problematic situation given its declared Transformation (T and Worldwide (W). These two latter was usually based on the so-called reality descriptions of the informants’ (i.e., the PQR), which in turn, was based on the Cognitive Maps. Further, the final technique (Activity Models) was based on logical activities to carry out the stated Transformation rather than being blueprints of reality.

An issue of concern and a challenge using SSM modelling to illuminate and understand the situation from different actors’ perspectives was the tendency of models to become more descriptive of the real world (the collected material) rather than logical representation of purposeful activity, according to Checkland’s recommendation (e.g., Checkland & Poulter, 2006).

Since the aim of the SSM modelling has been to advance the understanding of the complexity as well as represent the complexity in a structured manner a large number of models have been built. However, only a limited number of models have been included in the dissertation in order to exemplify the research process and provide arguments for the conclusions of the research.

The SSM modelling techniques, Root Definitions and three E’s, have not been included. The Root Definition provides a comprehensive statement on which to base the Activity Model. However, for this research the PQR statement combined with the CATWOE elements provided a well enough understanding for building Activity Models. Applying the Measures of Performance according to the three E’s was challenging. As an alternative the relevance and the plausibility of the Purposeful Activity Models according to the SSM concepts of cultural feasibility and systemic desirability were adopted.

Combined with the modeling and analysis of the empirical data the questioning and discussion of the real world situation, as represented in the Rich Picture, were carried out using the concepts of desirability and feasibility. These concepts enabled a more holistic perspective when discussing the relevance of the SSM modelling.

One outcome of those discussions is the Summarizing Issue Based Model (see Figure 9.1) which depicts issues from the teachers’ perspective that are

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89 Customer, Actors, Transformation, Worldview, Owner, Environmental constraints. See detailed description in Chapter 6.4.1.
Learning by a Methodology-Informed Approach

important to address. The model can be used to support further discussions on integration of digital technologies in education.

Yet another limitation and challenge while carrying out the SSM analysis is the semantics of the language. The empirical material was spoken, recorded, and transcribed in Swedish and has then been translated into written English. It has proven very challenging to translate some of the Swedish words and concepts into equivalent English terms and phrases.

The outcome of using SSM can be expressed as gaining new insights and enriched appreciation of the methodology. It can also be expressed as more nuanced understanding of the complexity of applying the methodology. SSM allowed modeling various peoples’ worldviews and perspectives of the problematic situation, without diminishing the complexity of their experiences in the real world. It also allowed to reflect and discuss the desirability and feasibility of the various perspectives in relation to the real world, as perceived by the researchers. Moreover, using SSM for this research, modelling and analyzing a complex real world situation, was enabled by carrying out an SSM\textsubscript{P} analysis. The experiences of using SSM\textsubscript{P} is presented in the upcoming section.

10.3 The Methodology-Informed Approach: SSM\textsubscript{P}

SSM\textsubscript{P} is the approach of SSM concerned with the process of carrying out an SSM study. For this research SSM\textsubscript{P} has enabled me to think about, plan and decide how my SSM\textsubscript{C} analysis should be carried out, and what the focus of the SSM\textsubscript{C} analysis should be. My heightened appreciation for the complexity of the real world situation, and the messiness and volume of empirical material, required an SSM\textsubscript{P} analysis. In addition, this approach guided limitation of the scope and clarification of relevancy for an SSM\textsubscript{C} analysis based on the aim and research questions of this research.

The SSM\textsubscript{P} analysis was simplified by use of Cognitive Mapping. The Cognitive Map was developed in order to identify what was considered relevant and why it was relevant. The Cognitive Map was based on the initial understanding of the collected empirical material.

Cognitive Mapping and SSM\textsubscript{P} enabled to design the focus and emphasis for the SSM\textsubscript{C} analysis – i.e., avoid becoming too detailed or too abstract in the modelling. Carrying out an SSM\textsubscript{P} analysis, simplified the SSM\textsubscript{C} process tremendously, and it also made clear for me, as the researcher, what I was doing and what I needed to do, and how to proceed in order to achieve the research aim for this dissertation.

As a final reflection, one of the biggest strengths of SSM, in addition to serving as a structured way to represent, analyze and describe complex, messy situations, is its foundation in Systems Thinking, and more specifically the
notion of emergent properties⁹⁰. The Systems Approach enabled me to not only see a number of the parts in isolation within the “digital-technology-in-education whole”, but also the relationship between the parts and the properties emerging when looking at the situation as a collective whole. The Systems Approach and the emergent properties also enabled a deeper understanding of the literature and specifically theoretical frameworks and associated models which contributed to the discussion and understanding of the situation.

⁹⁰ See detailed description in Chapter 5.1.
CHAPTER 11
Conclusion

This chapter presents conclusions of this research in the first section followed by its contribution to Technology Enhanced Education theory. In the next section, contributions to methodology are presented, building upon commentary in Chapter 10. The chapter concludes with suggestions for future work.

11.1 Conclusions

The research conclusions build upon discussions in Chapter 9 which explains the research aim, i.e., illuminate and advance the understanding of the complexity of compulsory school teachers’ everyday work practices using digital technologies. To achieve the aim, two research questions have guided this research:

- What worldview do teachers in compulsory schools have in relation to digital technologies in everyday education and teaching?
  - How do the teachers perceive their professional role in relation to education and teaching?
  - How do the teachers perceive student learning?
  - How are the use of digital technology intertwined with the teachers’ perceptions of teaching and learning?

- What are the issues of concern that add to increasing the complexity in teachers’ use of technology in their everyday work practices?

A Soft Systems Approach has been undertaken for the research as a whole, further enriched by ethnography which guided observations and interviews. Four teachers from two schools, their school leaders, three representatives from the Department of Education, and the CIO of the IT-unit at the
municipality participated in the research. Soft Systems Methodology (SSM) guided both the research process and also the research analysis and outcomes discussion.

The following conclusions are organized according to the two research questions.

**Teachers’ worldview of digital technologies intertwined with the perception of everyday education:**
Teachers’ worldviews in relation to use of digital technologies in everyday education differ due to a range of factors. Teachers, based on their backgrounds, experiences, and social and personal environments, have certain beliefs and values in how they view their professional role as teachers, and how they view their students and their learning. The outcome of this research illustrates that with passing of time and with new and deeper understanding, knowledge and experience, these values and beliefs modify and change. This influences their everyday practice and how they use digital technologies. This research also reveals teachers who have a worldview wherein they are actors in the background while the students and their learning is set in higher focus, tend to use digital technologies to a wider extent. They also tend to use digital technologies more innovatively. Another outcome is that it seems that teachers who have a ‘traditional’ teacher centered worldview, although still concerned with students’ needs, tend to use digital technologies in a more limited way. Despite partial wish to use digital technologies in their practice, innovative use of digital technologies does not correspond to their values and beliefs about teaching and learning.

The teachers, in addition to their worldviews and philosophies, are also influenced and affected by external factors. These external factors, or issues of concerns, add to the complexity of teachers’ everyday practice and are presented in the upcoming section.

**Issues of concern adding to the complexity of teachers’ everyday practice:**
The identified issues of concern that add to the complexity of teachers’ use of digital technologies are wide spread, ambiguous, and multi-faceted. The main issues are identified and summarized below:

- Limited clarification of the ‘why’, the R⁹¹, for central statements and for reasons to adopt and use the digital technology. The limited understanding why digital technologies should be adopted and used is a major issue adding to the complexity of teachers’ everyday practice. This especially affect teachers who are struggling with digital technology use. The research shows that providing in-service training is inadequate for

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⁹¹ The R of the PQR statement. See detailed description of the technique in Chapter 6.4.1 and see Chapter 8 for PQR statements used for this research.
convincing teachers to use digital technology. This is especially so if it requires a change of pedagogical philosophy and teacher’s worldview, and if the technology often times experience to be inflexible, clumsy and malfunctioning. In addition to the limited understanding of why, the research also showed there are central concepts, such as, equity and natural/functional use of digital technologies, which are unclear and multiple ambiguous. The ambiguity depends on which stakeholders’ or actors’ perspective that is taken into consideration. Due to the identified ambiguity uncertainties in how to understand these central concepts, and how they should be translated into practice are found. Furthermore, different actors sometimes attribute conflicting or contradictory meanings to the same concepts.

- National and local steering documents, which often exclude the voices of the teachers.

The importance of local strategies has also been identified as part of the outcome of this research. However, at the time this research was being conducted, a national strategy was commissioned to the Swedish National Agency of Education, out of recognition that Sweden lacked a national strategy addressing digital technologies in schools. Another related outcome is that teachers are often not included by local authorities in the development of steering documents. Due to the non-involvement, they feel excluded. Excluding school practitioners from influence have additional implications, such as, furthering limited insight and hence limited understanding of the current reality of teachers everyday practice among administrative authorities. This has been shown both by practitioners as well as scholars.

- School leaders’ freedom, according to the School Act, leading to different leaderships styles.

School leaders have the freedom to lead and make decisions for their own school. This is stated in the Swedish School Act. In this research, the freedom to decide how to lead a school has been shown to be crucial as it allows adaption to the culture, context and conditions of a specific school. It also permits leaders to provide what the teachers need in particular situations in order to, in this case, adopt and use digital technologies. However, school leaders’ freedom has also been shown to produce variations which, in the opinion of some practitioners, leading to inequity among schools.

- Limited finance, economy and resources.

Limited resources affect both school organizations and teachers’ everyday practice. Finance and economy issues, for instance, influence choice of digital devices and availability of technology infrastructure. In addition, restricted resources influence the time available for teachers and school leaders to learn about digital technology, modify their pedagogy and apply it into educational practices.
• Teachers’ freedom in how to plan, conduct and carry out their teaching in their classrooms within the frame of student achievements.

In educational practices, there is a tradition of teachers’ freedom in planning and conducting their teaching. As identified in this research, teachers’ freedom adds to the complexity of educational practice since each teacher is free to define her/his own professional role and establish students’ learning outcomes within her personal worldview and teaching philosophy. Such freedom also allows digital technologies to be adopted and used in different ways. Similarly, school leaders’ freedom can become an issue as it may lead to inequity. It can also produce additional administrative work for the central municipal IT-unit.

• Varying subject based philosophical and epistemological foundations and traditions that affect pedagogical approaches and teaching practices.

Each subject has its own philosophical and epistemological foundations and traditions which the teacher needs to consider when planning her teaching. Whether for theoretical subjects or practical courses, teachers need to adapt their pedagogy, including use of digital technologies, for the subject in focus. The varying subjects lie in convergence with certain suited pedagogical approaches and certain suited digital technologies. However, achieving a balance between subject, pedagogy and digital technology is challenging, especially since a shift in one requires a change in the other.

• Significant variation in worldview and perception surrounding teachers’ adoption and use of digital technologies in everyday practice.

This research shows that each one of the actors included in this research, but also additional stakeholders outside of educational practices (e.g., IT software developers, parents, etc.) have their own worldviews and understandings of digital technology in education. These conceptions are often ambiguous and contradictory and they affect teachers’ everyday practice in different ways. An example identified in this research concerns local and national politicians and administrative officers who have certain opinions on how digital technologies should be adopted and used, which may contradict a teacher’s chosen pedagogical approach or her/his subject traditions. Furthermore, this research revealed contradictions in local authorities’ beliefs that the teachers and school leaders should be able to adopt the use of digital technologies according to their own organizational circumstances while also believing in the same solutions for all. From a systemic viewpoint, this complexity is increased by consideration of the variance among all participants, with varying influences, in terms of their worldview and perception of digital technologies usage.

• Varying worldviews in terms of backgrounds, beliefs and values, experiences, and capabilities: for teachers, school leaders,
authority representatives as well as any other who wishes to have a say in education.

The underlying reasons for varying worldviews for different actors and stakeholders further elaborates on the previous issue of concern, which recognizes considerable variation among actors, based on diverse backgrounds, beliefs, values, experiences and capacities. Whether teachers, school leaders or authority representatives (e.g., administrative officers or national politicians), different worldviews affect the choices that they make and hence influence the practice of teachers.

- Limited insight in the everyday reality of teachers’ practice among those with significant influence on teachers’ practice.

A further outcome of this research is recognition of the influence of persons with limited insight into teachers’ everyday reality. For instance, administrative decision makers at the Department of Education, on the basis of their personal worldviews and limited understanding about educational practice and, in this case, digital technologies, take decisions that affect teachers’ practice. This research has shown that these worldviews and understandings oftentimes contradict teachers’ worldviews and understanding. This is more so the case for those actors outside of the schools such as representatives and decision makers at the Department of Education, in contrast to school leaders who have a better insight.

- Varying student backgrounds, learning capabilities, learning styles, classroom dynamics and other aspects related to students.

All students in school have their own backgrounds, interests, motivations and styles of learning, which a teacher need to consider when teaching. Within a class with many students, even if the students have similar learning styles, their interests or capacity may vary. This research has shown that it is a challenge for teachers to find a proper balance, in terms of pedagogy, especially regarding use of the “right” digital technology. In addition, group dynamics among students vary from one classroom to another. Therefore, the constellation of students also affects teaching situations. The students’ attitudes toward digital technologies are another issue identified in this research. For instance, lack of concern about whether digital devices’ batteries are charged - or whether devices are even brought to school - is an issue that a teacher needs to manage when using digital technologies as part of everyday practice.

- Limited IT-support, centrally at the municipal level and locally at the school level.

The limited availability of and access to meaningful and sufficient IT-support is an issue identified in this research that challenge teachers’ use of digital technologies. Current IT-support is insufficient in terms of what is both offered and also available to teachers. Therefore, this research shows an important need for both central and local IT support. Relatedly, this raises the issue of
additional costs for school leaders with limited budgets. One example of this current situation is limited and low-level in-service training, which adds to the teachers’ complex everyday practice.

- Digital technologies in general, including its inflexibility, clumsiness and limitations. Digital technologies, per se, are highlighted as contributing to the complexity of teachers’ everyday practice. The inflexible, limited functionality and even incompatibility of the technologies with other digital technologies used by the teachers has been emphasized. Additionally, given rapid evolution of technologies, it is challenging for schools to keep up with these developments due to limited funding for new purchases and teacher training. This research has also shown that the processes for selecting, purchasing and introducing digital technologies into the schools are often not well aligned with teachers’ worldviews and teaching philosophies.

- The overall importance of context, culture and tradition. Context, culture and tradition of educational practice have been identified in this research as overarching issues of concern, which significantly add to the complexity of teachers’ everyday practice. In addition to teachers’ differing worldviews, the context, culture and tradition of each educational situation affect – and can modify and change – the worldview of each individual teacher with time and with practice. That said, each school is different and so is each classroom and each class, even if taught by the same teacher.

In the spirit of systemic analysis, each of the issues presented above typically consists of additional issues with varying levels of abstraction and detail, which further affects the overarching issues and, hence, the complexities of the situation as a whole. Some of these additional nuances have been touched upon in the short descriptions. However, additional elements will be considered below. In addition, a number of these issues will be further described in the section presenting the contributions of this research to the field of Technology Enhanced Education.

11.2 Contributions

In addition to contributing to the area of concern as presented above, the contributions to theories in the field of Technology Enhanced Education and to the use of Soft Systems Methodology are presented in the upcoming sections.
11.2.1 Contribution to Technology Enhanced Education

The theoretical contributions emerge from the previous research by Salavati (2013), wherein seven domains were identified as relevant to the field of Technology Enhanced Learning (TEL): learning, social and cognitive; technology and engineering; design and interaction; political; organizational; resources; and society. However, the findings of the present research suggest a modification and redefinition of these domains in relation to adoption and use of digital technologies in education. The modified model is illustrated in Figure 11.1, titled Technology Enhanced Education (TEE), which encompasses the complexities and challenges of learning and also teaching, i.e., of education in general.

Figure 11.1 Technology Enhanced Education Domains

Similar to the domains in Salavati (2013), the Technology Enhanced Education model consist of seven domains, each of which includes issues
which emerged from this research. The domains are: learning, social and cognitive; teaching and practice; digital technologies; organizational; authority and political; and society. It should be noted that although the domains have been illustrated separately, they are all influenced by one another and are in constant dependent interaction. Each domain is briefly explained below.

The learning, social and cognitive domain, illustrated in the middle top of Figure 11.1, concerns issues related to the students. In this research, additional relevant issues are identified within this domain which influence Technology Enhanced Education. Among these issues are social aspects such as students’ relationships with teachers and with each other, in terms of, for instance, group dynamics. Additional issues include the varying mindsets of the teachers as well as the students’ varying capabilities and needs.

The domain teaching and practice is a new domain identified in this research. It focuses on the teachers and their everyday practice as professionals. The domain is illustrated on the top-right side of Figure 11.1. Among the issues identified in this research is teachers’ varying worldviews and teaching philosophies, as well as how they perceive their teaching profession and their students’ learning. These worldviews and beliefs are shown to influence and affect teachers’ pedagogy and didactics and, hence, their everyday practice. In terms of digital technologies, the teachers’ philosophies and pedagogies are also found to influence their adoption and use of the digital technologies, both for their own practice but also for their students’ learning. The profession’s working assumptions, as well as the changing status of the teaching profession, are additional issues included in the teacher and practice domain, which affect technology enhanced educational practice.

Design and interaction is illustrated in the middle of Figure 11.1. This domain has been modified and enhanced through this research. This domain concerns interaction with and impact of digital technologies in design of everyday teaching and learning. Flexible integration of digital and traditional technologies is included among issues found relevant to educational design and interaction. In addition, flexibility in using digital technologies to design teaching and learning practices and interaction is explicitly connected to the digital technology domain aspects of ease, stability and reliability. In turn, educational design involving traditional and digital technologies and pedagogy is directly connected to teachers’ philosophies of teaching and knowledge of pedagogy and technology, within the traditions and pedagogies of their subjects.

Digital technologies represent a modified domain that includes digital technologies and related issues. This research produced added understanding about the absence of pedagogical intensions to inform procurement and introduction of digital technologies in schools. These issues are found to be essential to the design and use of the digital technologies, according to teachers’ and students’ different needs. Additionally, the availability, ease and reliability of digital technologies are issues which influence this domain.
Absence of IT-support is another crucial issue identified as relevant for technology enhanced educational practice. This includes IT-support both locally available at schools but also centrally available at municipalities.

On the middle-bottom of Figure 11.1, the organization domain is illustrated. The organization domain is yet another domain within the context of this research, which has modified and enhanced findings from Salavati (2013). This domain recognizes the school and educational system as an organization. Issues identified in this research and added to this domain include school leadership style, resources, and in-service training and the traditional culture of ‘freedom of how’, which is also stated in the school act. Additionally, this research found that the size of the organization, in terms of number of teachers and students, is a challenging issue for a school leader in a large school, if she is expected to be involved in everyday practice including classrooms visits.

The final domain in Figure 11.1 is the modified authority and political domain. Issues added as an outcome of this research include leadership in municipalities and their pedagogical visions, plans and initiatives which affect both organizations and school leaders and, hence, the teachers and their everyday practice using digital technologies. On the municipal level, this research also discovered finance and economic issues to be relevant, since those resources are allocated among the schools and thereby affects local day-to-day practice.

Finally, society represents the overarching domain within which the above mentioned domains are embedded. The society domain in Figure 11.1 is illustrated outside of the dashed line that includes the challenge domains related to Technology Enhanced Education. The major challenging issue identified within the context of this research is the constant development and evolution of society, especially in terms of digitalization, whereby certain societal knowledge and working skills are considered crucial for further societal development and human welfare. These digital society developments were also found to influence the everyday life of teachers and students. For students, the presence of digital technologies includes access to information and knowledge at all times as well as online bullying. For teachers, digital experiences influence their private, public and professional lives. In addition, digital technologies raise pedagogical skill and subject knowledge expectations and challenge traditional roles and professional status assumptions.

Despite the challenges included in this section, it is also important to acknowledge identified possibilities and opportunities brought by digital technology integration into educational practice. This research has, for instance, illustrated the flexibility and adaptability of digital technologies for diverse teaching approaches and learning conditions. Contrasting teachers’ increased workload, use of digital technology has shown to reduce teachers’ workload. For instance, an iPad loaded with instructional videos can serve as a temporary teacher while the teacher is helping someone else. It naturally
follows that, while digital technology can add complexity to everyday educational practice, it might also enable opportunities and benefits to teachers’ complex educational practice.

11.2.2 Contribution to the Methodology

With the aim to gain an advanced understanding of the research situation in focus, the main contribution to Soft Systems Methodology is combining the SSM techniques with Cognitive Mapping. In this research Cognitive Mapping have extended the linkage and bridging between the first phase of SSM (representing the situation) and the second phase of SSM (building Purposeful Activity Models). Using PQR statements identified through Cognitive Mapping has allowed identification of relevant levels of modeling as well as creation of more holistic understanding about how varying systemic models are interconnected.

Given the usefulness of this Soft Systems Methodology application, it follows that this approach could also inform other research studies about digital technology use in education. Suggestions for further work using Soft Systems Methodology as a research methodology and analysis methodology are presented in the next and final section.

11.3 Future Work

This research has demonstrated that there is no simple unified solution for enabling purposeful use of digital technologies in everyday education, teaching and learning practices. The diverse usage patterns highlighted in this research emerge from multiple- and sometimes conflicting - worldviews and perspectives held by, not only different actors, but also by persons with the same role. As Checkland (2011) recommends, improvement of complex local situation and contextualized professional practice – in order to reach a feasible accommodation – will require further research.

The main suggestion for future work is to widen and deepen the investigation by conducting a full SSM Learning Cycle. Not only teachers but also all other actors involved in the complex situation of digital technologies integration into everyday education should be included in a future study. Conducting a full SSM Learning Cycle will necessarily engage multiple actors and catalyze stakeholder collaborations. Such a study would further illuminate multiple different perspectives and also create shared participant understanding and, ideally, common vision. This deeper investigation might first be implemented within a municipality or county level before being applied at a macro or national level.

A second suggestion for further work is to present and discuss the outcomes of this research – and especially the Summarizing Issue Based Model (see
Figure 9.1) – with, initially, teachers, school leaders and municipality representatives included in this research and, thereafter, with additional stakeholders, such as, researchers, ICT pedagogues, and local and national politicians. Discussion with the diverse actors involved in delivering outcomes reflected in the Summarizing Issue Based Model may facilitate further enhancement of the Purposeful Activity Models and also inform practical measures for improving the current situation using digital technologies in everyday practice. Through this two-fold approach, real world improvements would be achieved through implementation of the SSM Learning cycle and including reconsideration of the Technology Enhanced Education domain.
The more I learn… the more I stay in this profession, the less it feels that I understand [it] somehow. Sometimes at least.
Teacher LA, autumn 2015

The quote above illustrates that even an experienced teacher continues to learn, and continues to be amazed by the everyday education and teaching practices. The words also express the pervasive complexity and eternal variations in educational practice that make it challenging to fully grasp the real world situation. Educational practice includes complex relationships that are contextually bound and involve diverse people: school leaders, teachers, and students in the classrooms. In addition, policies and approaches for achieving learning objectives vary. Hence, comprehensive study of the Swedish educational environment is both difficult and also impossible. Therefore, this research has not explored or examined the whole complex educational world. Rather, the aim has been to shed light on the complexity of a number of teachers’ everyday practices in relation to their use of digital technologies. To understand their life-experience, some attention has been given to contextualizing forces, including school colleagues and municipality officials. The intention is not to conduct an exhaustive study of these influences but rather to offer some systemic insights into local circumstances.

At the end of this dissertation, it is natural to once again turn to Professor Peter Checkland, the originator of Soft Systems Methodology (SSM). In two different discussions with Professor Checkland, he guided my research by asking the following questions:

“What is the research question(s)?”
“What is that worth researching?”
“How will you research it?”
“Why this approach?”
“How will you know this research is a) finished? b) successful?”

These questions guide the following discussion of the relevance, performance and outcome of my research.

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92 Summer course in Lugano, Switzerland in 2012, and my licentiate defense in January 2014.
The Research Questions
In the prologue, two perspectives were presented in order to illustrate the variation in how digital technology can be perceived. The first perspective is based on a dialog between Plato and Phaedrus about writing. If the word ‘writing’ were replaced by the phrase ‘digital technologies’, the quote could be interpreted as suggesting that digital technologies enable the creation of hollow humans with no true knowledge. It is merely a tool to help them access knowledge when needed. In a second quote about digital technologies, Peck and Dorricott (1994) offer a contradictory perspective. They recognize opportunities to be gained or lost, depending on whether technologies are used as they could and should be used. These two perspectives, which contradict one another, illustrate two extremes. On the one hand, the usage of digital technologies is creating humans with no true knowledge since the digital technologies enable ready access to information and knowledge anytime and anyplace. On the other hand, the use of digital technologies can enable reaching levels of knowledge and quality of life not thought possible previously, however, only if implemented and used in the right way.

Within both the educational classroom and the national society of which it is a part, digital technologies are increasingly ubiquitous. There is a wide range of understanding about the multiple ways that digital technologies can be used in education. Therefore, using digital technologies ‘in the right’ way include high complexity, multiple ambiguity and different stakeholders and other actors with varying perceptions, worldviews and ambitions. Consequently, in order to further the natural integration of digital technologies into everyday practice, advanced understanding is needed about the current practice. Therefore, this research has focused on the teachers and their work practice using digital technologies. As stated in the two questions for this dissertation, research addressed what worldviews the teachers have in relation to use of digital technologies in their everyday practice, and what additional issues of concern add to the complexity of the situation.

The Worth of the Research
The worth of this research, that is, illuminating and contributing to understanding of the complexity of teachers’ everyday practice using digital technologies, has been well documented in the literature, and has also been mentioned by everyday practitioners. The highly dynamic contextual situation and tradition bound educational practice is not only complex, but it is also messy, involving several actors and multiple conflicting perspectives. There are also additional issues of concern adding to the complexity, issues that themselves are complex and multifaceted.

In today’s society, the effect that digital technologies have on everyday life and human welfare cannot be underestimated. The challenges and complexity that digital technologies bring to educational institutions and their actors, who are involved in everyday practice, cannot be ignored either. To reach a
situation where digital technologies are more of a natural and functioning part of the everyday practice of teachers, we need to understand the teachers’ multi-dimensional profession and also the external influences. These results are not new or unique; however, this research sheds light on the complex situation using an approach less common in education and teaching and with a heavier focus on the teachers.

The Research Methodology and Why this Approach
Soft Systems Thinking and Soft Systems Methodology (SSM), together with ethnography, have made it possible to gain a more holistic and dynamic understanding of the teaching and education practices. In addition, these combined approaches enabled understanding the whole, its parts, and its emerging properties. The Systems approach also enabled me to see the world through the eyes of another – in this case, the teachers – and thereby better appreciate the issues related to adoption and usage of digital technologies in schools. To see the world through the eyes of various actors fosters improved understanding of the complexity associated with different pedagogical approaches and tools, digital or traditional, or a mixture of both in the contemporary classroom. Soft Systems Methodology has enabled both illustration and representation of the complexity of teachers’ everyday practice. It also structured interpretation of the actors’ perspectives within real world situations, making analysis grasable.

Throughout, the aim of this research was to appreciatively explore variation in teachers’ worldviews related to their use of digital technologies in everyday practice. Research methods sought to reveal how teachers perceive their profession as teachers and how they perceive their students’ learning, and, furthermore, how digital technologies are intertwined in varying ways for various teachers. While some similarities in preferences, worldviews, and beliefs might be found, the research never intended to identify an ultimate and/or perfect ‘answer’ to the complex and messy situation of teachers’ adoption and use of digital technologies. The beauty of Soft Systems Approaches, and specifically Soft Systems Methodology, is that it allows exploration, description and understanding of the variation in humans, i.e., teachers’ lives. It does not seek to provide the answer and solution. SSM is therefore well suited to advancing overall understanding of teachers’ everyday practice using digital technologies.

How to know if the research is successful?
In terms of the success of this research, results have illuminated and shown that teaching practices are complex and that complexity increases when digital technologies are involved. This complexity has been illustrated by observing the everyday practice of four teachers in great detail, as well as studying the worldviews of closely related actors who influence the everyday practice of adopting and using digital technologies in education.
Although a Rich Picture is traditionally supposed to illustrate a problematic situation in a simple comprehensive way, the Rich Picture in this research was a messy picture with many details. In addition, a number of Purposeful Activity Models were built which illustrate conflicting worldviews between actors and within the same actors. Potentials, issues, concerns and implications for improving actions in relation to use of digital technologies in teachers’ everyday practices have been illustrated and presented. Therefore, this research can be considered as a significant effort to use a Soft Systems Approach to explore educational practices. The richness of the results suggests the efficacy of the methodological approach.

**How to know if the research is finished?**

The aim of this research has been to illuminate and advance understanding of teachers’ complex everyday practice using digital technologies, following the SSM Learning Cycle. The final phase, taking action for improvement, has not been carried out, as it was not the aim of this research. However, suggesting implications for future action have been discussed. This first iteration, this first step, is finished.

The research intention to illuminate and further understanding of complexity in educational practice related to digital technologies is thereby fulfilled. In addition, the rich results hold considerable promise for new studies within the field of Informatics as well as within the field of Technology Enhanced Education.
Bibliography


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93 Referenced by Mingers (1980).


94 Ministry of Enterprise, Energy and Communications


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95 The Swedish School Inspectorate.
96 The National Agency of Education.


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*97 Ministry of Education and Research.*


Appendix C: Definition of UPUT Constructs

The Unified Use and Perception of Ubiquitous Technologies (UPUT) is a modified version of Venkatesh, et al.’s (2003) Unified Theory of Acceptance and Use of Technology (UTAUT) and Venkatesh, Thong, and Xu’s (2012) UTAUT 2. The model was an outcome of the licentiate thesis presented by Salavati (2013). UPUT is based on the seven constructs that influence the Use Behaviour of digital technologies (see Figure 4.3 in Chapter 4.5). The definitions of the seven constructs are based on Venkatesh, et al.’s (2003) and Venkatesh, Thong, and Xu’s (2012) original models and are presented in the table below.

Table C. 1. Construct definitions (adopted from Salavati, 2013)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Expectancy</td>
<td>“The degree to which an individual believes that using the system will help him or her to attain gains in performance” (Venkatesh, et al., 2003, p. 447).</td>
</tr>
<tr>
<td>Effort Expectancy</td>
<td>“The degree of ease associated with the use of the system” (Venkatesh, et al., 2003, p. 450).</td>
</tr>
<tr>
<td>Social Influences</td>
<td>“The degree to which an individual perceived that important others believe he or she should use the new system” (Venkatesh, et al., 2003, p. 451).</td>
</tr>
<tr>
<td>Facilitating Conditions</td>
<td>“The degree to which an individual believes that an organizational and technical infrastructure exists to support [the] use of the system” (Venkatesh, et al., 2003, p. 453).</td>
</tr>
<tr>
<td>Hedonic Motivation</td>
<td>“The fun or pleasure derived from using a technology” (Venkatesh, Thong, &amp; Xu, 2012, p. 161).</td>
</tr>
<tr>
<td>Experience and Habit</td>
<td>“Experience […] reflects an opportunity to use a target technology and is typically operationalized as the passage of time from the initial use of a technology by an individual. […] Habit has been defined as the extent to which people tend to perform behaviors automatically because of learning” (Venkatesh, Thong, &amp; Xu, 2012, p. 161).</td>
</tr>
<tr>
<td>Voluntariness of Use</td>
<td>“The degree to which [the] use of the innovation is perceived as being voluntary or of free will” (Venkatesh, et al., 2003, p. 431).</td>
</tr>
</tbody>
</table>
Appendix D: Philosophy of Teaching Interview Guide

The first interview conducted with the teachers addressed the teachers’ worldview as teachers. The interview questions were adopted from the questions presented by Goodyear and Allchin (1998) and Kenny (2008). The questions, originally in English, have been translated into Swedish as presented below.

1. Varför har du valt att undervisa? *(Why do you teach?)*
2. Vilket angreppssätt har du för din undervisning? *(What are your teaching approaches?)*
   - Vilken är din undervisningsstil? *(What is your teaching style?)*
   - Vilka undervisningsstrategier förlitar du dig främst på? *(What teaching strategies do you most often rely upon?)*
   - Varför? *(Why?)*
3. Vilka är dina standards eller kriterier för effektiv undervisning? *(What are your standards or criteria for effective teaching?)*
4. Vad anser du är givande när det gäller undervisning? *(What do you find rewarding about teaching?)*
5. Vad är unikt med din undervisning? *(What is unique about your teaching?)*
6. Vilka egenskaper beskriver en effektiv skolinlärningsmiljö? *(What characteristics describe an effective school-learning environment?)*
7. Vilka är dina styrkor och skickligheter som en lärare? *(What are your strengths and skills as a teacher?)*
   - Vilka strategier har varit särskilt effektiva när det gäller elevernas lärande och engagemang? *(What strategies have been particularly effective in terms of student learning and engagement?)*
8. Vad har du lärt dig om dig själv som lärare? *(What have you learned about yourself as a teacher?)*
   - Har dina clever, kollegor eller chefer bidragit med direkt feedback? *(Have your students, peers or the instructor provided direct feedback?)*
9. Vilka undervisningsuppgifter anser du vara mest utmanande? *(Which teaching tasks do you find most challenging?)*
10. Vilket är din stoltaste undervisningsögonblick? *(What is your proudest teaching moment?)*
    - Varför? *(Why?)*
11. Vilket undervisningsögonblick är du mest missnöjd med? (What teaching moment do you feel most dissatisfied about?)
   • Varför?

12. Vad motiverar dig att lära dig om det ämnet du undervisar? (What motivates you to learn about the subject you are teaching?)
   • Varför skulle du motivera andra på likande sätt? (Why would you motivate others similarly?)

13. Vilka är möjligheterna och begränsningarna under vilka du och andra lär? (What are the opportunities and constraints under which you learn and others learn?)

14. Var förväntar du dig att slutresultatet av din undervisning ska vara? (What do you expect to be the outcomes of your teaching?)

15. Vilken är elev-lärare relationen du strävar efter att uppnå? (What is the student-teacher relationship you strive to achieve?)

16. Hur vet du när det du har undervisat har varit framgångsrikt? (How do you know when you have taught successfully?)

17. Vilka vanor, attityder, eller metoder kännetecknar dina mest framgångsrika pedagogiska prestationer? (What habits, attitudes, or methods mark your most successful teaching achievements?)

18. Vilka värderingar vill du förmedla till dina elever? (What values do you impart to your students?)

19. Vilka tema(n) genomsyrar din undervisning? (What theme(s) pervade(s) your teaching?)

20. Vilka egenskaper hos lärare vädersätter du och sedan uttrycker i din egen undervisning? (Which characteristics in teachers do you value and then express in your own teaching?)
   • Varför värderar du dessa specifika egenskaper? (Why do you value these certain characteristics?)

21. Vad skulle du säga att du gör i din undervisning som gör skillnad i andras liv? (Why does what you do in your teaching make a difference in the lives of others?)
   • Varför är detta relevant? (Why is it relevant?)

22. Varför utvecklar du lärandemiljon(erna) och förhållandet du har med eleverna? (Why do you develop the learning environment(s) and the relationship with students that you do?)

23. Vilka är dina favorit uttalanden angående undervisning? (What are your favorite statements to make about teaching?)
   • Varför är dessa dina favoriter? (Why are they favorites?)
Appendix E: Perception and Use of Digital Technology Interview Guide

The second interview conducted with the teachers were adopted on the UTAUT framework presented by Venkatesh, et al. (2003) and Venkatesh, Thong, and Xu (2012). These interviews addressed the teachers’ perceptions and attitudes toward the use of digital technology and were based on the quantitative questions provided by the authors. The framework and questions were, however, used in a qualitative manner, similar to the method in which they were used by Salavati (2013). The questions, originally in English, have been translated into Swedish as presented below.

Performance Expectancy (prestation/utförande)
1. Hur användbart anser du att teknik är när du utför ditt arbete?
   - Produktivitet
   - Effektivitet
2. Överlag, hur stödjande anser du att tekniken är när du utför ditt arbete?
   - Tid
   - Kvalité
3. Föredrar du traditionell teknik (White board-tavlor, papper, etc.) eller digital teknik (Interaktiva Digitala-/Smarta tavlor, datorer, plattor, etc.)
4. Anses du ha högre kompetens (vara mer kompetent) ifall du använder dig (ännu mer) av teknik?
   - Av kollegor
   - Av arbetsledning
5. Belönas användning av teknik på något sätt?

Effort Expectancy (ansträngning/insats)
6. Hur är tekniken/systemen att använda? Enkla/Svåra?
   a. Data- och informationshantering (vad menar jag?)
   b. Flexibilitet (i relation till vad?)
7. Skulle du säga att det skulle vara/är enkelt för dig att lära dig och bli skicklig på att använda tekniken ni har idag?
   a. Hur lång tid tog det för dig att lära dig? // Hur lång tid skulle du säga att det skulle ta?
8. På en 5 gradig skala hur kompetent och skicklig skulle du säga att du är på användning av teknik, generellt sätt?
   a. 1 = Inte alls
   b. 5 = Expert
9. Var och när använder du dig av tekniken? Så som (exempel)
Appendix E

- **Klassrum – undervisning**
- **För- och efterarbete – undervisning**
- **Administrativt arbete**
  - Dokument delning?

**Social Influence (sociala inverkan/påverkan)**

10. Anser du att personer i din omgivning som påverkar dig och ditt dagliga arbete påverkar eller tycker att du bör/ska använda teknik i ditt dagliga arbete (främst undervisning)?
   a. Vilka personer är det? (roll/funktion/relation)
      - Chefer
      - Kollegor
      - Elever
      - Personer utanför ditt arbete (familj, vänner)
   b. Vilka av dessa personer skulle du säga är viktiga för dig och har en viktig inverkan på din roll som lärare?
   c. Vad är dessa personers ståndpunkt om teknik i undervisningen? Vad anser de, generellt sätt?

11. Har du observerat personer i din omgivning som använder tekniken och som påverkar dig och din inställning gentemot teknikanvändning i din undervisning?

12. Finns det andra sociala influenser som påverkar teknikanvändningen i din undervisning?

13. Anser du att användning av teknik i undervisningen är nära kopplat/relaterat till din identitet som lärare?
   a. Varför? // Varför inte?

**Facilitating Conditions**

14. I vilken utsträckning bestämmer/påverkar tekniken hur du ska göra ditt arbete?

15. På vilket sätt har tekniken påverkat ditt arbete och hur du utför ditt arbete?

16. Har du den tiden som krävs för att använda tekniken?
   a. Tar det mer eller mindre tid med detta arbetssätt (teknikanvändning)?
      - Lära dig användningen
      - Uppdatera och anpassa din pedagogik och didaktik
         - Planera
         - Utvärdera
      - Hålla dig kontinuerligt uppdaterad med det ’senaste’

17. Anser du att det finns nödvändiga resurser tillgängliga för att du ska kunna använda dig av den tekniken ni har idag?
   - Fungerande teknik
   - På plats support – som går att få tag på mer eller mindre direkt
      - Specifik individ
Appendix E

- Manualer, policies, riktlinjer
- Kompetensutveckling

   a. vilka arbetsuppgifter är det?
   b. andra arbetsuppgifter som inte kräver teknik (teknik inte kan användas)

19. Hur kompatibel är de olika teknikerna och systemen ni använder gentemot varandra?
   - T.ex. undervisningsplattform – betygsrapporteringssystem

Experience (vana/erfarenhet)

20. Hur länge har du använt dig utav teknik i ditt arbete?
   - Undervisning
   - Administrativt arbete
   - Annat

21. Använder du teknik hemma och på din fritid?
   a. vad och på vilket sätt?
   b. påverkar det din roll som lärare?

Voluntariness (frivillighet)

22. Har ni en skyldighet att använda teknik i ert dagliga arbete?
   a. från vem?
   b. på vilket sätt?

23. Använder du teknik mer/på annat sätt än det som begärs?
   a. varför? På vilket sätt?

24. Skulle du vilja använda teknik mer/på annat sätt än det som begärs och är er skyldighet?
   a. varför?
Appendix F: School Leaders Interview Guide

The interview guides used for interviewing the school leaders were modified slightly and questions were added to the original guides since new issues were identified though previous interviews. However, the core questions were unchanged and are presented below.

1. Vad har du som bakgrund?
   a. Hur många år har du arbetat som rektor? Lärare?
   b. Varför valde du att bli rektor?

2. Vad ingår i din roll som rektor? (Generellt)
   a. I relation till integration och användning av digital teknik?

3. Hur arbetar rektorer?
   a. Hur skulle du beskriva en ’vanlig’ dag på jobbet?

4. Varför kan hur ni arbetar bli olika? (olika skolor fungerar på olika sätt, har kommit olika långt i integration och användning av tekniken)
   a. Ledarskap
   b. Införande
   c. Användning
   d. Resultat

5. Hur insatt och på vilket sätt är du som rektor insatt i lärarnas dagliga undervisning och elevernas dagliga lärande?

6. Var förväntar du dig att slutresultatet av er undervisning ska vara?

7. Vilka värderingar vill du förmedla till era elever?

8. Var ni någon specifik pedagogisk ansats eller filosofi som ni följer generellt på skolan?
   a. Varför just denna filosofi?

9. På vilket sätt och hur ofta använder du digital teknik i ditt arbete?
   a. Vad för verktyg/stöd?

10. Hur användbar anser du att digital teknik är när du utför ditt arbete?
    a. När lärarna utför sitt arbete?

11. Vad är din allmänna/generella inställning till digital teknik i skolan och även integrering och användning av digital teknik för undervisning och lärande?

12. Belönas användning av teknik på något sätt på er skola?
13. Anser du att användning av teknik i undervisningen är nära kopplat/relaterat till lärarens identitet?
   a. Varför?
   b. Varför inte?

14. Hur ser beslutsprocessen ut inom skolvärlden och vilka förutsättningar ges för ert (rektorers) arbete och ledarskap?

15. Skolan, ni som rektorer och lärare får direktiv från regering och sedan kommun i form av IT-strategier, handlingsplaner och sedan har ni skollag och läroplaner som kommer från skolverk etc.
   a. Vad är det egentliga för direktiv som ni får uppförän?
      i. Generellt vs. specifikt gällande digital teknik
   b. Vad har ni för verktyg/förutsättningar/resurser att hantera detta?

16. Anser du att det finns nödvändiga resurser tillgängliga för att ni ska kunna använda er av den tekniken ni har i skolan idag? (fungerande, support, policy, riktlinjer, kompetens etc.)

17. Vilka är dina favorit uttalanden angående undervisning?
Appendix G: The Municipality Interview Guide

The interview guides used for interviewing the representatives from the municipality were modified slightly and questions were added to the original guides since new issues were identified though previous interviews. However, the core questions were unchanged and are presented below.

1. Vad har du som bakgrund?
   a. Hur många år har du arbetat som ...? ...
   b. Varför valde du att bli arbeta inom utbildningsförvaltningen/IT-enheten på kommunen?

2. Vad ingår i din roll som förvaltning-/verksamhet-/områdeschef / chef för IT-enheten?
   a. I relation till integration och användning av digital teknik på skolor?

3. Hur arbetar du som förvaltning-/verksamhet-/områdeschef / chef för IT-enheten?
   a. Hur skulle du beskriva en ‘vanlig’ dag på jobbet?

4. Varför kan skolor (rektorer, lärare) arbeta olika? (olika skolor fungerar på olika sätt, har kommit olika långt i integration och användning av tekniken, använder olika typer av enheter etc.)
   a. Ledarskap
   b. Införande
   c. Användning
   d. Resultat

5. Hur insatt och på vilket sätt är du som förvaltning-/verksamhet-/områdeschef/chef för IT-enheten insatt i lärarnas dagliga undervisning och elevernas dagliga lärande?
   a. Vad innebär det för skolornas arbete och vidare utveckling (i samhället)?

6. Var förväntar du dig att slutresultatet av skolornas undervisning ska vara?
7. Vilka värderingar vill ni förmedla till eleverna på skolorna?
8. Har ni någon specifik pedagogisk ansats eller filosofi som ni följer och generellt vill att skolorna ska följa?
   a. Varför just denna filosofi?

9. På vilket sätt och hur ofta använder du digital teknik i ditt arbete?
   a. Vad för verktyg/stöd?

11. Vad är din allmänna/generella inställning till digital teknik i skolan och även integrering och användning av digital teknik för undervisning och lärande?
   a. Hur användbart anser du att digitala tekniken är för lärarna för att utföra sitt arbete?

12. Vilka krav och önskemål har ni gällande integration och användning av digital teknik i skolan?
   a. Hur pass väl uppnås dessa?

13. Belönas användning av teknik på skolorna på något sätt?

14. Anser du att användning av teknik i undervisningen är nära kopplat/relaterat till lärares identitet?
   a. Varför?
   b. Varför inte?

15. Hur ser beslutsprocessen ut inom skolvärlden och vilka förutsättningar ges för ert arbete och ledarskap?

16. Skolan, dvs. rektorer och lärare får direktiv från regering och sedan kommun i form av IT-strategier, handlingsplaner etc. och sedan har finns en skollag och läroplaner som kommer från skolverk etc.
   a. Vad är det för direktiv som ni får uppförifrån?
      i. Generellt vs. specifikt gällande digital teknik
   b. Vilka direktiv ger ni neråt i hierarkin?
   c. Vad har ni för verktyg/förutsättningar/resurser att hantera dess direktiv uppåt och neråt?
      i. Generellt vs. specifikt gällande digital teknik

17. Anser du att det finns nödvändiga resurser tillgängliga för att skolorna och framförallt lärarna ska kunna använda sig av den tekniken skolan har idag? (fungerande, support, policy, riktlinjer, kompetens etc.)

18. Har du någon favorit uttalande angående undervisning?

Appendix H: Empirical Findings: School Leaders

This appendix represents the school leaders’ perspective regarding use of digital technologies in everyday education. The data was collected through interviews with two school leaders. In order to ensure the confidentiality of the informants, the school leaders will be referred to as her, since the material has been conducted in Swedish, quotes have been translated into English. In order to ensure reading ease, quotes with minor edits have been presented by rephrasing phrases from the spoken language into written language, adding punctuation, removing duplication, etc.

In this research, two school leaders have been interviewed. Both school leaders were teachers before becoming school leaders; however, they have different backgrounds in terms of subjects and experiences. One of the school leaders, School Leader 1 (SL1), has been a school leader at various schools for six years. Prior to that, she taught language and social sciences in compulsory school. In addition to her teacher education, she has also earned a degree in leadership and management prior becoming a school leader and completed a school leader-training program at the university since becoming a school leader. The second school leader, School Leader 2 (SL2), has a background as a natural science and mathematics teacher. School Leader 2 has been working as a school leader for six years and prior to that worked as a part time teacher and part time vice-school leader.

The daily work of the school leader involves responsibilities that entail all aspects of the school. The school leader, have according to SL1 people who help and support in terms of carry out work as well as providing the school leader with material for taking decisions, although the school leader says that s/he still needs to have knowledge about everything in order to take the right decisions. SL2, mainly referring to the two vice-school leaders, also mentions having people helping and supporting in the daily work and decisions. The work of the school leader is by both school leaders described to include a range from goal achievements, development of teaching and the pedagogical practice to having right to achieve special/individual support and aid, safeness, well-being to further errands concerning parking places, work environment, allergy rounds, windows of the building and so forth. A regular day includes several meetings, administrative work, and numerous emails. Frequently, there are impromptu visits from students with questions or issues. Parents also present questions or demands, with the expectation of immediate attention. A variety of other people also knock on the office door. As a consequence, SL2 states that her day never turns out the way she planned it. SL1 confirms there
are enormous demands placed on school leaders; however, there are also tremendous rewards. School Leader 1 offers these insights into the school leader position:

[...] the school is sometimes a bit crazy, but within this a bit crazy world with demands from all directions, there is perhaps a need of someone who knows the school and understands the school, and has education in leadership, and that actually cares and protects the children and the school’s future, and reputation, and status, and so on. (School Leader 1)

To SL1, the administrative mandate given to school leaders and the students’ rights are what she protects and care about the most. School Leader 1 believes a leader should be 80 percent in the future and 20 percent in the present but that is not possible in the schools since it is limited time and much that has to be done. This means some things are left undone if school leaders do not do them. As SL1 states:

[...] the teachers need to teach. I have to give them the possibility to do that. I can not have teachers breaking down. (School Leader 1)

With a positive tone, SL1 adds: “[...] sometimes there are complaints that school leaders don’t have time to visit the classrooms”.

School leaders’ work life is also influenced by complex decision making processes, which, as SL1 explains is due to extended information and communication exchanges between the organizational hierarchies. The difficulties of decision processes are also mentioned by SL2. However, she states that they at the school have the possibility to be heard and influence how the future should be, as in the case of learning platform selection where they are able to give their viewpoints to an appointed working group. SL1 is very firm and aware about a school leader’s rights and decision taking authority within her own organization. SL1 says that a school leader can override the local political decisions since a school leader has the authority over her own internal organization according to the School Act. This is something the local political decision makers not always consider.

SL1 is also a bit skeptical on how the board is gathering information and data from the schools, mainly quantitative numbers. The data collected on the number of students thriving in school can vary from the one situation to the other. SL1 gives an example of students in the first round of data collection were happy, since prior to filling out the form they have been outdoors playing in the snow. Prior to the second round of data collection, however, the students were upset since the teacher told them not to throw rubbers in class. According to SL1, there is a need for qualitative conversations to enrich decision making and action taking. However, the school leader emphasizes that she delivers what is requested by the department since she understands that they need to collect these type of measurable information.
In relation to digital technologies, SL1 says she has the ultimate responsibility for providing for digital technology. She further mentions that two people at the school are responsible for the local IT and they have knowledge about what is needed to support the teaching practices of the school. In terms of decision making in relation to digital technologies at the school, SL2 states:

*I have a number of skillful and well informed teachers at the school as well as one of my vice-school leaders and by discussion with them, we reach a decision.*

*(School Leader 2)*

SL2 further explains the internal budget provided by the municipality clearly states that the schools should have “good access to IT”. This is pointed firmly by the local authorities, however, SL2 argues the devices are expensive and the school voucher is insufficient. She further states that within the economical boundaries given by the Department of Education, the school leader is free to choose what computers or tablet devices the school has. SL2 explains that the decision on what to invest in is taken on a yearly basis, and hence some grades have laptops, other have iPads and the upcoming classes might perhaps be given Chromebooks, since it is more economically beneficial, according to SL2.

SL1 says that digital technologies are used as a natural part of the everyday day life since it is part of the pedagogical work and part of the education goals. She explains that she give teachers the proper conditions in order for them to be able to use the digital technologies. SL1 says, for instance, that she can dedicate certain time or the whole collective weekly conference time for special wishes addressing usage of a new application, or training in something specific. SL1 says: “they are experts on what they need so…so we try to provide for it in that way.” When performing classroom visits SL1 says that the teacher’s computer is usually connected to the projector when she enters the classroom. In describing teachers use of the use digital technologies SL1 says “So it is used all the time, it is their tool.”

In SL1’s school, “Google” is used for sharing documents among colleagues and also between students and teachers. They do not use Google Apps for Education but they do use Google, even though this is not allowed by the IT-unit of the municipality, which is aware that they are using Google. SL1 also mentions that they are expecting to be given a learning platform soon, although it seems to take quite a long time to provide a proper system. In terms of learning platforms, SL2 also mentions that there are significant frustrations. She explains ongoing procurements have been contested, leading to long delays. SL2 explains that the municipality has appointed a working

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98 A yearly strategic plan document developed and provided by the Department of Education locally based on the governmental demands and requirements as well as the decisions taken by the Board of Education. The document includes visions, strategies, achievements of learning objectives, priorities, evaluations, etc.
group that is supposed to investigate and suggest a learning platform in the beginning of the year 2016. Who the appointed people in this group are SL2 is not aware of, although SL2 mentions that they can provide them their viewpoints and wishes. SL2 argues that since they have not had a learning platform they have in the school use other solutions, and for most of the teachers at her school “Google” has been the application they have used.

In addition to learning platforms, interactive teaching material was also mentioned as an issue and was approached differently by the two school leaders. One school leader decided not to replace their traditional learning material with digital. However, the school leader states digital literature as well as traditional books is bought based on the needs and demands of the teachers. The teachers have an approach where together with the students, based on the context and situation, they decided what is needed for specific topics and subjects. Based on need and context, either digital or traditional material is purchased, or material from libraries or in collaboration with the university will be used. The other school leader, however, explains that they during autumn 2015 introduced interactive teaching material at the school. Literature for 11 subjects was bought from a known teaching material publishing company that provides both printed and digital course literature. The school leader has decided to replace their traditional print teaching material with digital due to financial limitations. Besides the interactivity of the material, the school leader states, updating the material on a yearly basis has become more convenient, and she does not need to buy new books every year because the digital books are easily updated. The school leader elaborates further in saying that the result of introducing and adopting the digital material has been positive despite the high tradition bound environment of the school and the common belief that the traditional book is the best. Despite the integration being successful, the school leader mentions that it has been difficult for some teachers to get used to the new material. Some teachers have complained about the low knowledge level available for some subjects, and reading on the iPad or computer monitor is one of the major difficulties for some of the teachers. However, the school leader provides a solution to the reading problem and says that it is possible to print out if one rather prefers.

In terms of promoting use of digital technologies among the teachers, the school leaders have slightly different viewpoints. SL1 mentions the school does not additionally promote use of digital technologies, and that no distinction is made between digital and traditional formats. To illustrate, she says of digital technology: “it is a tool just as paper and pencil”. SL1 also mentions research stating that digital technologies do not increase goal achievements in schools, and recalls budget arguments given by other school leaders in order to not invest in digital technologies. SL1 says:

[…] it is a tool just as any learning material. It is the teachers’ competencies that increase the goal achievements and therefore it can not be used as an
argument. Some school leaders say that, ‘We won’t invest in it since it is too expensive and it doesn’t increase the goal achievements anyhow’. (School Leader 1)

SL2 states that use of digital technology will be promoted in the salary review for those who are very driven since it concerns developing the school practice. SL2 tells that of course efforts and interest in developing the school practice will be acknowledged; just as anything else that favors the students. Both school leaders state having positive attitude towards digital technology, though both admit to being unskilled users. In relation to their own work, both school leaders argue that digital technologies are very important and they would not be able to conduct their work without the technology. They say:

[…] I would not be able to conduct my work without it (School Leader 1)

[…] without digital technology, I would not get much done […] No, it is impossible. (School Leader 2)

SL1 says the laptop and the phone are the main devices she uses. She further uses PowerPoint and the projector for conferencing. SL1 says she was not hired at this position because of her digital competences but she is pretentious and learns along the way and can laugh together with the teachers when she is not able to turn off the projector or cannot show the PowerPoints. She states that the digital technology system consists of two distinctive parts: (1) the administrative part, which has limitations and obstacles that do not support her work, and (2) the pedagogical tool part, from which the students are supposed to benefit. SL1 says she gets annoyed and angry since there are clear requirements in the national steering documents addressing the digital technology; however, the conditions for enabling these requirements varies very much. SL1 also stresses the importance of offering children what exists in terms of digital tools.

As for financing, SL1 and SL2 state that it is the school leader’s budgets that determine the working conditions and it is very challenging to maintain and stay within the budget. SL1 explain that the local authorities decide the amount of money given for every student, and school leaders have to relate to that amount; most often of there is a collision between the limited budget and the demands the school leader has to provide for and assure. Additionally, SL2 mention the schools’ competitive situation in terms of attracting students to the school. SL2 states digital technology is prioritized in her school because if they did not offer 1:1 they would have fewer students attending the school, and hence receive less money.

SL1 says they have the pedagogical conditions and capabilities to use digital technologies, however, the technical conditions are quite bad many times due to the reason that the central municipal IT-unit. In the current situation, the schools have to struggle to adapt the system provided to them to support their pedagogical work. The technological part does not support the
pedagogical development. SL1 state that when the schools contact the IT-unit reply they cannot help them or deliver what is asked for. SL1 says that significant amount of money is given to IT; however, leaders and teachers have stopped contacting the IT-unit since they do not perceive that IT employees are giving them the help they need, especially those who have Mac computers. The competencies of the IT-unit is also questioned by leaders and teachers, while at the same time SL1 believes the support the IT-unit is giving to the administrative employees at the Department of Education is by the municipal employees considered great. Additionally, SL1 mentions that all the computers that the municipality lent students are not included in support provided by the central IT-unit, reportedly due to high expenses. SL2 recognizes this as well and mentions that they have employed additional part time personnel at the school to help students and teachers with their computers, which is an additional cost for the school. SL1 says that she exceeds her budget in order to ensure there are tools and opportunities at the school. She praises the early adopters and digital knowledgeable teachers at the school that know how to work with computers and other digital devices. These exceptionally skilled and knowledgeable teachers at the school support and advance students’ and colleagues’ digital technology capabilities. She further wonders how other – perhaps smaller – schools, without these internal competencies, solve such technological concerns. SL1 then refers to research indicating that IT-support should be local within each school, noting that is not how support is delivered in this municipality.

SL1 mentions that although there an agency provides in-service training in use of digital technology, the teachers at the school consider the training to be too basic and, except for that agency, there are no other alternatives. The agency is also mentioned by SL2, who adds that employees at the school provide training to their colleagues, ranging from basic knowledge to advanced levels. The school leader further continues that in-service training is continuously provided, however she mentions that teachers own will; if there is no will it is difficult to get through to the teachers, and they feel that they do not have sufficient time to get engaged.

As an ideal scenario, SL2 expresses a wish to have clear guidelines and policies provided by the Department of Education stating what IT strategies to apply. She also mentions the always reoccurring matter of time: it is difficult to find time. However, once again SL2 mentions the teachers’ own will, when she states:

[...] for many of them who have not reached there yet, they don’t have...they don’t dare even when...so I don’t think...it won’t help really that one allocates much time and...if you don’t want to...if you don’t dare. (School Leader 2)

SL2 additionally talks about the freedom teachers have had and that they have had the possibility to do what they wanted. In contrast, now they are being
told: “No, you are supposed to work with this now and you are supposed to use this system”. This makes it even harder to “get everyone onboard”.

When asked about the reasons why school leaders perform their work differently, SL2 mentions the lack of directives, policies and guidelines, while SL1 mentions the challenges created by the large size of the school leader mandate, and the uncertainties about what local schools are actually supposed to accomplish. SL1 tells about information she received from one of the District Managers99 that not all school leaders are aware of the details of the internal budget, while SL1 follows it thoroughly since she argues it is her guidance and direction reaching the stated objectives. SL1 further mention the lack of leadership skills many school leaders deal with when taking on the role of becoming a school leader after being a teacher. She explains one aspect of the challenge, from her perspective, to be:

[…] you don’t really know what it is about and then I think you get caught in the trap of solving all the problems. (School Leader 1)

Making clear what is included in her role and what is included in the teacher’s role is something SL1 also believes to be very important. The number of employees as well as the quality of the teachers, in addition to the student-teacher ratio, also influences how school leaders do their work. SL1 explains that she currently has less employees and higher quality teachers. SL1 also says that she has experience of having 50 colleagues when working as a school leader at a different school, which she state was impossible to lead. At this school SL1 states the teachers are a very strong stable teaching staff who are innovative and development-keen. SL1 describes various projects in which the teachers and the school are involved. Sometimes these projects involve researchers from different universities and sometimes they include application development. SL1 also mentions having teachers wining prizes for their various efforts.

Despite their diverse and numerous work tasks, both school leaders say that they try to visit teaching classes as often as they can. SL1 says she tries to conduct classroom visits once every other week. SL2 expresses a wish to complete more classroom visits than she currently does, but her time unfortunately is not sufficient to achieve this aspiration. S L1 confirms that she is very curious to hear what teachers tell her, but - of even greater interest – she is eager to know what teachers are not telling her – i.e., what the teachers say in the coffee room or what they decide not to share with their school leader. These unofficial data would give SL1 a better indication of how well her teachers do their work. SL1 also mentions participating in the weekly conferences and asking the teachers in charge of the conferences to forward the minutes via email, which she later reads and approves. SL1 says:

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99 See detailed description of the hierarchy in Chapter 3.3 and in upcoming Appendix.
So I try to be pretty much involved in what they do. Then, what each single student does in class, I don’t know… (School Leader 1)

SL2 and SL1 believe that they are being well informed in how digital technology is used in their schools. Both school leaders have a dialog with the teachers and also with their vice-school leaders. SL2 argues having teachers adopting digital technologies in varying ways. very driven and early adopters using digital technologies while she also has teachers that are far behind. These varieties the school leader state sometimes is connected to willingness as well as age.

The leadership ambitions of both school leaders focus on the students. As SL2 states:

[…] in this organization one have to care for and like youngsters, one has to like that it is a bit troublesome sometimes, one has to like that it doesn’t work out, that it isn’t always pin straight and one has to take detours and anticipate that there will be clashes […] one has to genuinely love it, otherwise it won’t turn out good. (School Leader 2)

SL2 further says that she aspires to ensure the final outcome for students attending her school is that each student should achieve their full potential based on the specific capabilities of the student, and also to maintain the students’ motivation for the future. Her ambition as a school leader is for her students and teachers – and also herself - to feel pride and accomplishment because the students recognize that they have the whole world in front of them, well prepared by their time in school. She says: “It is our children who makes the future”.
Appendix I: Empirical Findings: the Department of Education

This appendix represents the perspective of the Director of Education, the Head of the Department and one of the District Managers at the Department of Education. The data is collected by interviews with these representatives. In order to enhance the confidentiality of the informants, the representatives will be referred to as her. Further, since the data has been collected in Swedish, quotes have been translated into English. In order to ensure reading ease, quotes with minor edits have been presented by rephrasing phrases from the spoken language into written language, adding punctuation, removing duplication, etc.

Within this municipality, located in the south of Sweden, the Department of Education is in charge of approximately 100 schools. The smallest school is a compulsory 1-3 grade school consisting of approximately 30 students and 3 teachers while the largest school is a high-school with approximately 1300 students and 110 teachers. In total there are approximately 2600 employees at the Department of Education and approximately 18000 children and youngsters from pre-school up to the age of 19.

The reason for the current organization of the Department of Education is, according to one of the District Managers, to make the organization more rational. Having one department for compulsory schools and another for high schools led to major differences between school levels, however much was carried out in similar ways. The Director of Education argues that having separate departments for education resulted that a lack of equity could be identified among the schools. According to one of the District Managers and also the Head of Department, having all students from age 1 to 19 above together gives a better whole/holistic understanding. The organization, as illustrated in Figure 3.1 and initially presented in Chapter 3.3, consists of a Board of Education, which is a political level, a Director of Education, a Head of Department and several District Managers. For this study, the Director of Education, the Head of Department, and one of the District Managers have been interviewed.

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100 Children are the smaller kids at preschool while youngster are teenagers in higher grades.
The reasons behind, and what is included in the work of the representatives of the Department of Education, varies. Having a background as a teacher and school leader, the Director of Education is the most high level municipal officer at the Department of Education and has prior to this position also worked as District Manager and Head of Department. Her motivation for working as the director of the Department of Education includes interest in the improvement and development of schools as well as general interest in organizational development, leadership and management.

The Head of Department also has a background as a teacher and school leader prior to her current position as head of a number of District Managers as well as organization developers. She deals with leadership, economic, organizational and special issues such as IT. The Head of Department states that she choose this line of work as it allows for a helicopter perspective where the focus is on the whole rather than the parts. The challenges as well as the conditions for education, and the discussions on what to do and its outcomes, are of great interest to her. In terms of digital technology, the Head of Department states that her role is to ensure equity and to ensure that the right resources are being provided, and question the working conditions of the schools in order to increase the students’ achievements of learning objectives.

The District Manager was employed as a school leader when this opportunity to work at the Department of Education as one of the district managers was offered to her. Among her duties as District Manager are overarching responsibility for a number of schools in a specific district in the municipality. She says that she allocates the budget between school leaders,
she is ultimate responsible administrator to secure students’ health, and acts as a general support to the school leaders. In terms of digital technologies, the District Manager says her responsibility is mainly economical, making sure the school leaders stay within their budgets which she further states the school leaders are not able to with the budget they are provided and with the costs the digital technology has.

The Board of Education takes the final decisions within the department. On a yearly basis, a document referred to as the internal budget is produced. It includes objectives and strategies to focus on and work towards during the upcoming year. The internal budget together with the operational plan, besides the School Act and national curriculum, provide the strictest guidelines for the Department of Education. Based on the objectives mentioned in the internal budget, a number of efforts are discussed in the management groups on how to achieve and reach the objectives. The Head of Department and the District Managers, thereafter, take decisions on how to finance and allocate budget for achieving the objectives. In the internal budget for 2016, the Director of Education states there is a clear objective addressing digital-competencies that includes access to digital technology and also digital-competence in order to be able to develop the students’ knowledge. From initially being focused on providing digital devices and hardware, the Director of Education states that technology alone is no longer sufficient, but “everything around it”, such as competencies, must be considered and provided. The District Manager says the efforts concerning digital technology has been kept on hold for a while and they will have to see if the they will do something more onwards.

The internal budget is based on the systematic quality work and the material and reports provided by the schools to the District Managers and then reported up the hierarchy. The reports are provided to the Department of Education three times per year, and include information and material from students, various personnel as well as the school leaders. The systematic quality reports are also used as foundation for decision-making. These reports are mentioned as how the representatives from the Department of Education keep informed of the everyday practice of the teachers and the learning of the students. The Director of Education says that she is informed in a more general level. Her information comes from documents and reports from other administrative authorities such as school inspectorate reports. She is aware that the schools are very different from each other.

In terms of differences between the schools, the Head of Department argues that the Department of Education is well aware of the deficiencies as well as the assets. She observes that they are “a pretty flat organization” and they have a good steering and leadership system, something the Director of Education states needs to stronger. The Head of Department further argues that there is a high communication with one another on the different levels of the organization. However, the Head of Department states that, naturally,
some of the information is twisted along the way and some of the information might not even reach them. The Head of the Department also mention doing direct follow-ups at each internal organization, which is also mentioned by the District Manager. The District Manager explains that most of her contact with the school leaders concerns essential daily basis. Additionally, field visits are done together with the organization developers where they talk to students and school leaders. They also have talks with representatives from the labor unions. The District Manager mentions that since she recently came from a school leader position and has, as well, acted as a substitute school leader and teacher at the schools, she is especially well informed about daily practice.

The Head of Department estimates that about 30 percent of the schools have a functioning pedagogical IT-solution, while 70 percent do not. She further tells that most internal organization have islands of solutions, i.e., they find and create their own good and smart solutions: someone has a blog, someone else uses Facebook, one uses Google but in a customized way, and yet another builds their own solution. The Head of Department states there is wide variation in digital technology solutions. In addition, she mentions that some employees have chosen not to have any digital solution, perhaps due to the lack of availability and access to devices. She describes the educational authorities and organization as being quite conservative, and she states that the culture of deciding the “how” has existed for a long time. In the traditional decision-making embedded in the organizational culture, the decisive conclusion has been on teacher level; for instance, the choice of a specific mathematics book to use in teaching. The Head of Department states that a similar situation is now occurring with digital technology systems. She says that if she indicates one specific direction to move towards, there will be hundreds of other directions in the internal organizations. In order to reach equity, two pilots have been conducted with two different schools, trying out a specific learning platform, in order to find a standard fulfilling the digital needs of the schools. Accordingly, there are ongoing discussions on either allowing individual solution or finding a common one, and according to the Head of Department, the discussions are leaning towards a common choice for all the school in the whole department.

In terms of digital technologies in education, all three informants have a positive attitude. The Head of Department states:

*It is evident. We educate children and young adults for a future working life.*

*(Head of Department)*

The Head of Department also agrees in the necessity of digital technologies in schools since it is “such a strong current in everything else we do […] we can not stand without it”. She believes that the reason why digital technology is not perceived positively in schools is because the essential usefulness is still not understood, so people do not know where to use it and why to use it. She further observes that teachers and students do not know how to work with
each other using digital technologies, which makes digital technology a problem rather than an asset. The Head of Department acknowledges it is a journey to reach a state where “everyone will be so-so positive”. The District Manager discusses digital technology from a different point. The District Manager states that the possibilities provided by the digital technologies cannot be denied, however, it is important to find the right ways for using it. She says:

*It gives unthought-of possibilities compared to how we have had it previously.*

*(District Manager)*

The digital technology is considered as a part of the teacher role and the teacher profession. The Head of Department and the Director of Education mention the use and the identification of teachers in their roles with digital technology to be widely different. The Head of Department argues that it is not possible to not have digital technology as part of how teachers identify themselves today. Professional identification with use of digital technologies, she continues, is a precondition in order to serve as a teacher. However, the level of integration and use of digital technologies varies greatly between teachers. For some, using digital technology is a replacement for paper and pencil while for some others, it is fully integrated into the learning process. The Director of Education mentions the SAMR\textsuperscript{101} model and tells that currently the teachers on all four levels. According to the Director of Education, the model makes very clear what digital competencies actually are and how the digital technologies can be understood. The Director of Education says the aim is to create equity so that everyone gets the conditions to reach the top level of the model. She further continues that the department is aware of the difficulties, such as lack of resources and conditions for the schools to fully integrate and use digital technologies. The District Manager also mentions differences in teachers’ identity in relation to digital technologies, and says for the “spearheads” the digital technology is part of their identity as teachers, while there is a majority of teachers that are not frequent users of the digital technologies. She argues there is a wide range of competencies among the teachers and many times teachers do not know much about the digital technologies and therefore use it as a typing machine. However, the District Manager explains, digital technologies are sometimes a bit overvalued as the means to ensure what the students are expected to learn and achieve during their school education. Capable good teachers will manage regardless of technology. However, she states that digital technologies of course can in a simple way attract students that have difficulties learning. She further state:

\textsuperscript{101} Short for Substitution, Augmentation, Modification and Redefinition. See detailed description in Chapter 4.6.3.
It is about finding a simplicity in the use so it has a large impact. (District Manager)

She also mentions the high level of administrative work that comes with the digital technologies as well as the importance of the IT-support. The District Manager states that the municipal IT unit only works with the schools up to a certain level, and much can be said about how it rather should be, but she not mentioning anything explicitly.

As for the question of demands, requirements or directives from the municipality for schools and teachers to use digital technology, responses from informants vary slightly. The Head of Department states that the use of digital technologies for the administrative side of the school’s mission is inevitable, and beyond that digital technologies are supposed to be:

[… used as a pedagogical functional tool for planning, performing and assessing teaching. (Head of Department)

When the issue of resources is mentioned again, the Head of Department says that given the current conditions in the schools, municipal level representatives cannot push the schools much more. The Director of Education also mentions not being able to put demands and requirements on the schools. The Director of Education says that they have not provided good enough conditions and resources and therefore it is difficult to put demands since they are connected to one another. In contrast to the statements of the Director of Education and the Head of Department, the District Manager states there are no directive or requirements from the department on how to use the digital technology. The District Manager states that the use of digital technologies is a pedagogical question/issue and should be solved within the internal organization. However, she continues, when the Department of Education purchases systems, the freedom of the schools will be limited, and that is something she argues can be beneficial for some teachers while it decreases the possibility to step outside the system and find own ways of thinking or own visions for others. She further states a wish for having a minimum level on what is expected in terms of using digital technologies and based on that the schools should give needed resources in order to achieve that level.

The requirements and directives the Department of Education has on them for digital technologies in education the District Manager states the general ones, while the Head of Department believes that digital technology is to be used as a “pedagogical functional tool”. She states:

It should be easily used, and it should be built in a way that it is equable for the whole organization and it is build on having good competencies among the personnel but also the students. (Head of Department)

The Director of Education states the directives they are given to follow, and they convey further is their internal budget, with the aim to increase the
students’ achievement of learning objectives. She also mentions the economy, noting that it is essential that schools use the money they receive in the most effective and efficient way, which requires prioritization. According to her, digital technologies have been one of the higher priorities in recent years. The District Manager mentions the economical several times. In terms of whether the department has sufficient resources to convey and implement the decisions and the directives, she says at one point that they “sort of” have resources and at the same time she says that they do not have sufficient economical resources. With this in mind, the District Manager refers to whether they are willing to put that much money on the digital technology in the schools, especially since the student voucher is as low as it is. Aside from the central and local costs, the infrastructure cost needs to be considered, and according to the District Manager, it is the surrounding costs that are the heavier costs and not the devices as such. As one point, she says:

[economically] we are quite hard-pressed […] I can feel it myself. I am almost willing to tell my school leaders ‘No, if we can’t afford it, we shouldn’t buy it’.

(District Manager)

The District Manager continues with an example, stating that for a school with about 500 students, the hardware costs can be about 1-1.5 million\textsuperscript{102} per year, which the school leader has to weigh against the cost benefit of having three more teacher positions and salaries.

The Head of Department states that their economic conditions are limited and there is limited competencies within the Department of Education. The Head of Department says the resources needed to enable digital technology use are missing. She state in terms the administrative authority part the resources for the digital technology is sufficient, however not in terms of a learning environment and nor in terms of hardware and pedagogical use in general. Additionally there is also lack in resources in terms of competencies as well as personnel resources, which the Head of Department describe as certified teachers\textsuperscript{103}. According to the Head of Department there is a need for new types of competencies, both on municipal level but also on school level.

The Director of Education responds to the availability of resources differently. According to her, the educational practice is currently in transformation and a change of culture. She states:

The school today is organized in the same way as it was 50 years ago, an infrastructure that builds upon an old way of teaching students and improving

\textsuperscript{102} 1-1.5 million Swedish crowns (SEK) is at date (summer 2016) approximately €100 000-15000 and $110 000-165 000.

\textsuperscript{103} Effective 2011 as part of the latest school act, all Swedish teachers must be certified in order to receive a tender position and to assign student grades. The certification is given by the Swedish National Agency for Education to those who have a degree in education, with the aim to improve the quality of education and to increase the status of the profession.
learning processes. We need to start with changing these structures. (Director of Education)

The Director of Education continues by saying that she is not sure that the resources are not sufficient, but rather thinks that the resources are not used in the right way. She adds:

It is not possible to squeeze in two systems in the same...for the same money, cause that is what we are currently doing. We are lining up with a new society with digital technology while we are working in with everything else we have been doing before. That is not possible. (Director of Education)

The Director of Education and the Head of Department state that the pedagogical approach they follow in the municipality is entrepreneurial learning. The Head of Department mentions the Department of Education’s Creative, Entrepreneurs, Curious, and Safe (CECS) focus. She describes a very good learning environment as when engagement, curiosity and creativity are awakened within students, while when creativity, curiosity and engagement are killed within students in school, the results of education will be negative. She continues that digital technologies can hinder such negativity and make it possible to gain much of the engagement, curiosity and creativity. The District Manager mentions that the entrepreneurial abilities are part national the curriculum and is a political decision, which the municipality have chosen to make explicit part of the local goal objectives. The District Manager also mentions development of creative, secure and independent students as important to achieve.

In terms of digital technologies, the Director of Education states that the Department of Education is directed and controlled by the IT-architecture of the municipality, and that restricts digital technology uptake and development. However, the Director of Education states that they should provide their needs, from a learning perspective, and the IT-unit then should to reply with what possibilities exists and what could be provided.

All three informants agree that the practices of the schools vary considerably. The reason why schools and schools leaders are leading and directing their schools differently and why schools have varied approaches for conducting education is, according to the Head of Department and District Manager, the freedom the school leaders and the teachers have according to the school act. In addition to the school act, an old tradition of freedom exists in how to lead your own school and how to plan and execute your teaching. They also both acknowledge that allowing school leaders to have the freedom to lead their own internal organization is important. However, in terms of digital technology, they both, in different ways, mention the need for a common understanding and frame of use for all school leaders and teachers.

104 The actual abbreviation used by the municipality is different and in Swedish. This is a paraphrased translation of the concepts.
The District Manager says there is a long tradition of having things in certain ways. In relation to the school leaders’ freedom, she says:

 [...]a freedom, accordingly to the school act [...] not so many ‘how’-questions are decided, neither from the state/government or from the municipality. And it is fairly clear in the school act that it, in other words, are the school leaders as school leaders that lead and run their school. [...] They need resources and conditions to build the organization accordingly as well. (District Manager)

Teachers as owners of the “how” is also mentioned by the Head of Department. She further explains that teachers have considerable freedom in how they conduct educational activities, which must be allowed to be different based on varying local conditions and capabilities. According to her, teachers own much of the how together with the students that the teachers are teaching. To have these local varieties is a must since educational practices are working with “living material and we need to catch and engaged the students here and now”.

The Head of Department further says that the municipality should provide the conditions for the schools to be able to achieve the governmental mission they are given. However, she tells that the pressure and demand on stronger leadership is increased and major changes in the schools have occurred practices over the past five years; it is now possible to see that even the how is being more controlled and govern from higher levels. She also stresses the importance of the “freedom of how” that is stated in the school act in order to benefit and adapt to internal organizations’ circumstances and conditions. Although, the Director of Education also mentions the importance of equity which is mentioned in the school act, but has not been achieved. The Director of Education it is due to much variations in the different internal organizations and the authorities have not done proper follow-ups on what the different approaches have led to in, and there has been a lack of clarity in the steering and leadership.

In regard to the varying adoption and use of digital technologies, the Department of Education does not have any direct incentive or reward for those school leaders or teachers that use digital technologies. The Director of Education and the District Manager state that from the municipality, they do not reward any one in any specific way and the school leaders can chose if they want to reward their teachers. The Director of Education states that at the Department of Education are quite good in displaying and showing innovating users as good examples. She further mentions student and parent appreciation, being considered a cutting edge and modern pedagogue, as well as the reputation of the school as indirect rewards.

When asked about what the informants expect the final results of the schools education to be, the answers of all informants focuses on the students and their future. Advancing entrepreneurial learning and having a democratic approach and an understanding of solidarity is mentioned by the District
Manager, in reference to the national curriculum. The Head of the Department mentions students feeling safe, as well as for them to thrive in the school in combination with being challenged, and further learn how to take advantage of the learning and knowledge they gain during their education. She states that their aim is to prepare the students for the future, she states:

So the final goal is somewhere for us to provide competent young adults that can move on either into further studies or further jobs. (Head of Department)

Also the Director of Education states that they are educating for the future, and digital technologies should be a completely natural way of performing and taking part in education. She adds that the digitalized society is not a vision of the future any longer, but it is what we are currently living in. She underscores the need to ensure the possibility for schools to access the tools and also to solve the question of competencies.

In terms of the Department of Education’s own use of digital technologies in their everyday practice, the representatives state that they use digital technologies as part of their daily jobs and consider this to be highly important. The technologies used are mainly the computer, presentation technologies and technology as means of communication. The Head of Department argues there is a high maturity in IT-use among the employees at the department, however she also argues their usage is different and a more office based IT-use compared to how teachers use the digital technologies in the schools. She mentions using the computer as a necessity, which is also mentioned by the District Manager. The Director of Education states that she would not be able to conduct her work without the digital technology, adding that her use of the digital technology could be improved. The District Manager explains using the technology as described by the Director of Education. She tells that they in the municipality building do not have interactive boards or similar technologies; they only have more common basic devices. The District Manager says when she was a school leader, not too long ago, she aimed to set an example in using the technology more interactively and innovatively, and to take advantage of the opportunities enabled by the technology as much as she could. However, she further continues that she, like the majority of teachers, would become disinterested when the technologies would not function properly. She continues that they at the municipal level do not suffer much from problems with the digital technology as they mainly use projectors, computers and iPads.
Appendix J: Empirical Findings: the IT-unit

This appendix represents the perspective of the Chief Information Officer (CIO) of the municipal IT-unit regarding use of digital technologies in everyday education. The data were collected in one interview. In order to ensure the confidentiality of the informant, the CIO will be referred to as her. Further, since the data has been conducted in Swedish, quotes have been translated into English. In order to ensure reading ease, quotes with minor edits have been presented by rephrasing phrases from the spoken language into written language, adding punctuation, removing duplication, etc.

The IT-unit is considered to be a central supportive unit to several departments at the municipality in south of Sweden. Within the municipality there are approximately 200 different working systems, and according to the Chief Information Officer of the IT-unit, 16 000 devices have to function properly on a daily basis within the municipality. Of these 16 000 devices, approximately 10 000 belong to the schools. Currently there are 45 employees at the IT-unit who, within a year, address approximately 30 000 cases. According to the CIO’s statistics, approximately 33 percent of the yearly cases are related to the Department of Education and the schools. However, a clearer distinction between these has not been provided. These numbers do not include issues with student-devices since each school is responsible for providing this support for students. The IT-unit supports only teachers and employees at the Department of Education, despite the fact that the devices loaned to students are owned by the municipality.

The strategy of the IT-unit can be summarized in four areas which assume that digital technology should be: (1) transformable, (2) economical beneficial, (3) safe, and (4) accessible. The CIO of the IT-unit says that they can provide for any needs there are, however, the challenge it that it should be cost efficient. The responsibility of the IT-unit according to the CIO is the underlying infrastructure where they are supposed to answer, meet and satisfy the needs of the organizations. The IT-unit does not have specific, detailed directives to follow or to conduct their work upon but rather has based its strategies and priorities on various directives and regulations from the different departments of the municipality developed a collective IT-strategy for the whole concern. All aspects involving digital technologies or digitalization are summarized in one strategy document. Along side these strategies there are demands on the municipality from The Swedish Civil Contingencies Agency and for the IT-unit there are demands from The Swedish Data Myndigheten för samhällsskydd och beredskap.

105 Myndigheten för samhällsskydd och beredskap.
Protection Authority\textsuperscript{106} stating, for instance, “This type of information about a student needs to exist and in this specific secure way”.

The scope of IT-unit services to the schools includes three specific areas: printing and printer issues; network and server connections; and personal account issues. The CIO of the IT-unit stated that previously there had been a lack of communication and dialog between the IT-unit and the Department of Education, but this has recently changed and a dialog have been initiated. For the CIO of the IT-unit it is important to have this dialog with central authority representatives in order to identify the needs in the next 3-5 years. The CIO says:

\textit{We can really solve all your needs, but tell us how it looks in four years and we will help you with the solution that will last the longest.}

Based on whether the need is to increase the teaching time available for the teachers or to decrease costs for the schools, the IT-unit can deliver different solutions. The CIO since she argues they do not need to know how the teachers exactly work, in the same way that they do not know how those who drive the garbage trucks work, or those who work as nurses with ill people at their home environments work. So direct communication with school leaders and teachers or visits to the schools is not of interest to her. The CIO rather believes there should be a division of responsibility where the schools are responsible for clarifying their needs and then municipal IT provides the solution. She says:

\textit{[...] they have to collect the needs, and they can not be unique for different schools. If we have 100 schools, the goal achievements are the same.}

The information from the schools, therefore, should be based on what leaders and teachers need to do rather than the specific tools or applications that they want to use. According to the CIO, there are many opinions and diverse ideas among teachers about various IT-solutions. The CIO argues that we live in a consumption society, very much influenced by what we consume as private persons. Therefore, teachers are likely to use arguments such as “it is just to go to MediaMarkt”, or “it is just to do like this”. However, the CIO argues, work and home environments are different. Whereas individuals in a home environment can always ask someone for help when things do not work properly; while at a school everything should work without needs of any questions, it needs to be cost efficient and it needs to be transformable. The CIO argues that teachers should not have to devote their time to help students; the IT solutions in the schools need to be available every day and work properly every day. She mentioned another difference as well: that in a home environment there are no specific laws or regulations like the municipality is obliged to follow. Use of Google is an example given which

\textsuperscript{106} Datainspektionen.
several teachers according to the CIO choses to use due to various reasons. However, the CIO says using Google Apps is not legal, it is not safe and it is not possible to share information with the rest of the organization. When the needs are turned into technology solution too prematurely it will run counter to the whole. In the school, the CIO argues there is a culture of self-determination that does not exist in other organizations. There is decision making at a classroom-teacher level, a teacher-group level and a school leader level. At each level, there is a very strong feeling of “I decide what concerns me because ‘I have the responsibility to educate my students’”. She continues:

*It is a good thought, but when this becomes a hundred islands where we have thousand classrooms, two thousand classrooms, it becomes a whole that is not coherent.*

In considering the reasons why schools work differently than other municipal units, the CIO attributes blame to the school leaders who do not govern in ways that enable adaption amidst rapid changes. The CIO lamented that schools have not approached change from big picture strategic perspectives, including teachers as one part, parents, administration and students each as own parts. The CIO states the focus has been on the students while the rest have been left out. Four years ago when one-to-one computing (1:1) was initiated, no one saw the need to have the same structure for the whole educational system, and now it is no longer possible to have own initiatives and various tools and solution as it was previously. This is something that at least centrally, according to CIO of the IT-unit, there now is an understanding of. Further, the CIO argues that the teachers have been forgotten. The teachers are those who have the worst IT-support in their work compared to all other employers within the municipality, and if they were given the same tools as the others, the CIO states she can promise that the teachers’ time for teaching would increase. One of the reasons behind this current situation is due to the cultural differences and the history of self-determination in the schools. Within a huge organization the CIO argues there is need of specialists who have an understanding of how everything should be connected; for example, the enormous flow of teachers and students moving across classes and schools, and at the same time the need to follow through within all systems. As she said:

*Here there are 10 000 students that move between classes, that move between districts and so forth. There is a huge user-management problem that needs to be done per automation.*

The automation which currently is provided to others within the municipality is not given to the teachers; they do not have a support to contact unlike all. The CIO says IT has the tools and the people needed to support the teachers. However, the schools have decided that they do not have sufficient funds to enable the same level of support for the teachers as there is for other municipal
employees. Currently teachers have to put their time to do what others could do. Many schools have additional people or even teachers who handles the IT-related issues within their school and that lead to teachers wasting time rather than using that time for their actual profession. The CIO promises that the IT-unit could do the IT-related jobs much more efficient since it is the only thing they work with compared to a “poor teacher” who is extremely busy with other tasks and, in addition, has to help students with their iPads or colleagues with their computers. The CIO further promises it would be much more cost efficient if the IT-unit assumed responsibility for IT-related issues in the schools. The costs of providing for the 1:1 within a year, not including the teachers, is 27 million Swedish Krones, and this include a cost of 10-12 full time employments at schools taking care of local technology support, a task that according to the CIO can be done by the IT-unit more cost efficient and more effective.

The CIO argues there is a need for a change whereby the Department of Education needs to point the direction to move towards. The head of the IT-unit continues:

And we need to get there with all schools, with all teachers, and with all students. Away from all the islands…cause it creates differences, and one of the schools most important goals are equab…equity.

The head of the IT-unit argues that today teachers have become as much IT-technicians as they are teachers. The technology use is of course considered a part in teachers’ job to raise and educate tomorrow’s workforce. The head of the IT-unit states she, the next coming day can provide a solution if she is given the needs. However, establishment of the collective needs of thousands of classrooms and hundreds of school leaders should be negotiated in dialog with one management at the Department of Education.
Appendix K: Logo Copyrights in the Rich Picture

- Doctopus
- Dropbox
- Facebook
- Goobrick
- Google Classroom
- Google Drive
- Google Sites
- Google Maps
- iBooks
- Instagram
- Kahoot!
- Padlet
- Pinterest
- The Swedish Data protection Authorities
- Twitter
- Snapchat
Appendix L: SSM Content Analysis

This appendix includes the outcome of the SSM\textsubscript{C} analysis conducted for this research. The analysis includes the conceptual models of SSM and is based on the empirical material including four teachers, two school leaders, representatives from the board of education and the CIO of the municipal IT-unit. The empirical data the analysis and models are built upon can be found in Chapter 7.

The Purposeful Activity Modeling the SSM Content Analysis (SSM\textsubscript{C}) draws upon are the outcome of the SSM\textsubscript{P} analysis presented in Chapter 8.1. In order to find the appropriate and purposeful level of modeling, Cognitive Maps\textsuperscript{107} were drawn for each actor and thereafter the most relevant models were modelled using the SSM techniques.

The SSM Content (SSM\textsubscript{C}) Analysis is presented based on each actor, starting with the teachers, the school leaders and thereafter the District Manager of the Department of Education, the CIO of the municipal IT-unit and finishing with the Head of Department and Director of Education of the municipal Department of Education.

Teacher DK

\begin{itemize}
  \item \textbf{P} allow for it to be okay to use the technology differently
  \item \textbf{Q} by acknowledging teachers have varying conditions and capabilities
  \item \textbf{R} in order to use digital technologies
  \item \textbf{P} accept and make possible that the technology does no control and direct the learning development
  \item \textbf{Q} by combining use of technologies (digital and traditional)
  \item \textbf{R} in order to encourage and promote learning/achieve effective/efficient education and teaching
\end{itemize}

\textsuperscript{107} See Chapter 8.2 for each informants' Cognitive Map.
### Appendix L

#### Teacher LA

| P | take advantage of experience/knowledge that exists among teachers and ask them what they need when purchasing digital technology |
| Q | by gathering and collecting experience from those who work with this and are interested and successful |
| R | in order to use the digital technologies |

#### Teacher LA

| P | counteract fear and ignorance to use digital technology |
| Q | by fulfilling the need of education and training |
| R | in order to be able to use the digital technologies naturally in the education |

| P | be able to adapt the teaching |
| Q | by having awareness that students group are different and vary |
| R | in order to achieve a functioning/working education |

| P | be able to use the digital technology naturally in education |
| Q | by using solutions that are flexible |
| R | in order to achieve obligations and directives from higher levels |

| C | teachers |
| A | school leaders, teachers |
| T | need to use digital technologies naturally ➔ need met |
| W | duties and directives from above can be achieved using digital technologies naturally in education |
| O | school leaders |
| E | resources, capabilities, attitude, inflexible digital solutions |

| P | have collaborative-/dialog pedagogic |
| Q | by adopting and using digital technologies |
| R | in order to put the students in focus (student centered learning) |
teachers  

A  

need to have collaborative and dialoging pedagogy need met  

W  

collaborative and dialog pedagogics enables focusing on the students and achieve student centered learning  

O  

teachers, school leaders  

E  

availability, attitude, ‘time’

### Teacher LF

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<tr>
<td>A</td>
<td>school leaders</td>
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</tr>
<tr>
<td>T</td>
<td>need to have and use good and functioning digital technologies need met</td>
<td></td>
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<tr>
<td>W</td>
<td>in order to use digital technologies, the technologies needs to be good, function properly</td>
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</tr>
<tr>
<td>O</td>
<td>school leaders</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>resources, attitude and capabilities, clumsiness and inflexibility of digital technologies</td>
<td></td>
</tr>
</tbody>
</table>

P  

ensure the technology to be good and functioning properly  

Q  

by purchasing right, flexible systems avoiding making it more difficult for those already believe it being difficult  

R  

in order to be given the possibility to use digital technology

P  

find something to relate to the students’ life situation making them see the advantage and benefits of the knowledge  

Q  

by applying flexible learning adopted to the students allowing for considering their background, interests etc.  

R  

in order to manage to make and motivate the students to want to learn
Teacher MK

\[ P \] gain trust in digital technologies
\[ Q \] by ensuring it won’t take time from the classes
\[ R \] in order to use digital technologies

**C**
- teachers

**A**
- teachers

**T**
- need to trust the digital technologies ➔ need met

**W**
- achieving trust in digital technologies enable to use the digital technologies

**O**
- school leaders

**E**
- inflexibility of digital technologies, limited local IT-support

\[ P \] adopt the teaching and accommodate for all the students’ differences
\[ Q \] by acknowledging that there is not only one solution
\[ R \] in order to reach functioning and successful individuals

School Leader 1

\[ P \] use what we need to use
\[ Q \] by assuring adequate conditions exists for use of the technology
\[ R \] in order to enable teachers to teach (avoid overstressed teachers)

**C**
- teachers

**A**
- school leader

**T**
- need to use what we need to use ➔ need met

**W**
- Using what is needed enable teachers to teach

**O**
- decision makers at the department of education

**E**
- resources, capabilities

\[ P \] enable and maintain an environment allowing for growth and development
\[ Q \] by assuring needed possibilities and opportunities
\[ R \] in order to focus on the students and their achievements
Appendix L

P fulfill/achieve mandate from the government
Q by assuring students’ achievement of learning objectives, right to certain support, development of the teaching, etc.
R in order to give the children their rights

C students
A school leaders, teachers
T need to achieve governmental commission ➔ need met
W achieving the governmental commission enable to give/provide students what they are entitled
O school leaders
E resources, capabilities, attitude

P have the outmost responsibility and have knowledge about ‘everything’
Q by making use of support functions and have an insight in what is going on (take part in education and listen what is said and not said)
R in order to be a good leader and be able to take decisions

School Leader 2

P have good access to digital technologies
Q by getting the budget to be sufficient to accomplish what we are endowed
R in order to get to a point where digital technologies become a natural part of everyday education

C teachers, students
A decision makers at the department of education, school leader
T need to have good access to digital technologies ➔ need met
W for digital technologies to become a natural good access to digital technologies is important
O decision makers at the department of education
E resources, attitude, lack of insight in day to day practice
312

District Manager

not be satisfied by only having digital technologies
by clarifying what digital technologies is to be used for and in what way
in order to reach where digital technologies become a natural part of everyday education

conceptualize a minimal level of in-service training and education
by providing conditions
in order to increase the knowledge level of using digital technology of some teachers

teachers
decision makers at the department of education, school leaders,
need of a minimal level of in-service training ➔ need met
conceptualizing a minimal level of in-service training and education increases some teachers’ knowledge level in terms of using digital technologies
decision makers at the department of education
resources, attitude, available training and courses

ensure people not getting tired of using the digital technology
by finding a simplicity in the use
in order to make use of the possibilities brought by digital technology

acknowledge the need of local IT-people at schools
by acknowledging/creating insight in central IT only support to a certain level
in order for each school not having to solve this (use of digital technology) on their own

make use of the possibilities brought by digital technologies
by finding the right forms for use of the digital technology
in order to achieve the values according to the national curriculum and the objectives of the municipality
CIO UT-Unit

| P | achieve and fulfill FEST |
| Q | by ensuring central IT is involved in the decision making |
| R | in order to satisfy the needs of the organization |

| P | delimitate 1000 islands (all individual solutions) |
| Q | by acknowledging and change the culture of the schools/teachers ‘own decision making’ culture |
| R | in order to reach equity |

CIO of the IT-unit

- school leaders, teachers
- decision makers at the department of education
- need to delimit all individual solutions ➔ need met
- equity can be reached when individual solutions have been delimitated
- department of education
- freedom of ‘how’, lack of insight in day to day practice, lack of insight in varying capabilities (school leaders, teachers, students)

Head of Department

| P | create a thriving and safe environment that enables challenging students and their learning and knowledge gaining |
| Q | by using digital technologies as a functional tool |
| R | in order to deliver curious, competent you adults ready to take on the future work and studies |

| P | find a common digital standard/picture on how digital technologies can support (have a minimum level) |
| Q | by catching the essence on where and why to use digital technology |
| R | in order to use digital technologies as a functional tool |
### Appendices

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<tr>
<th><strong>C</strong></th>
<th><strong>teachers</strong></th>
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<tbody>
<tr>
<td><strong>A</strong></td>
<td>decision makers at the department of education</td>
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<tr>
<td><strong>T</strong></td>
<td>need to have a common picture ➔ need met</td>
</tr>
<tr>
<td><strong>W</strong></td>
<td>finding a common digital standard on how to IT enables to use IT as a functional tool</td>
</tr>
<tr>
<td><strong>O</strong></td>
<td>decision makers at the department of education</td>
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<tr>
<td><strong>E</strong></td>
<td>freedom of how, varying mindsets, attitude and perceptions</td>
</tr>
</tbody>
</table>

**P**

*enable ‘shall’ directives to everyone*

**Q**

*by having a clear and strong leadership (on municipality level)*

**R**

*in order to decrease the possibility of the ‘how’ to become 1000 flowers (everyone have their own solutions)*

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<tr>
<th><strong>C</strong></th>
<th>teachers, school leaders</th>
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<tr>
<td><strong>A</strong></td>
<td>decision makers at the department of education</td>
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<td><strong>T</strong></td>
<td>need to enable ‘shall’ directive to everyone ➔ need met</td>
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<tr>
<td><strong>W</strong></td>
<td>giving ‘shall’ directives to everyone rather than should directives leads to decreasing everyone have their own solution</td>
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<td><strong>O</strong></td>
<td>decision makers at the department of education</td>
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<td><strong>E</strong></td>
<td>freedom of ‘how’ according to school act, lack of insight in day to day practice, lack of understanding of varying capabilities and mindsets</td>
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### Director of Education

**P**

*all teachers should reach the highest level of SAMR*

**Q**

*by providing good conditions and resources*

**R**

*in order to reach equity for all*
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<tr>
<td>A</td>
<td>school leaders, teachers</td>
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<tr>
<td>T</td>
<td>need to reach the highest level of SAMR → need met</td>
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<tr>
<td>W</td>
<td>reaching the highest level of SAMR enables to reach equity for all</td>
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<tr>
<td>O</td>
<td>decision makers at the department of education, school</td>
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<tr>
<td>E</td>
<td>resources, capabilities and attitudes</td>
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### P

- meet and fulfill the objectives and strategies of the board
- by enabling the school leaders to take responsibility (freedom) they are given by the school act in order to adapt according to the conditions of their organization
- in order to increase the students’ achievement of learning objectives

### Q

- decrease the frustration in the organization
- by clarifying authorities and responsibilities on each level concretizing and creating new ways of working in the department
- in order to use digital technology as a natural way of education

### R

- reaching equity in terms of digital technology
- by accommodating all needs
- in order to educate for the future (we don’t know anything about)

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<td>T</td>
<td>need to reach equity in terms of digital technologies → need met</td>
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<tr>
<td>W</td>
<td>equity is important in terms educating for a future we know nothing about</td>
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<td>O</td>
<td>decision makers at the department of education</td>
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<td>resources, attitude and capabilities, freedom of ‘how’</td>
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Appendix M: Summarizing Issue Based Model
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