

# Designs for Learning in an Extended Digital Environment

Case Studies of Social Interaction in the Social Science Classroom

Susanne Kjällander



Doctoral Thesis in Didactic Science at Stockholm University, Sweden 2011

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# Abstract

This thesis studies designs for learning in the extended digital interface in the Social Science classroom. The aim is to describe and analyse how pupils interact, make meaning and learn while deploying digital learning resources. Together with the thesis a multimodal design theoretical perspective on learning has developed: *Designs for Learning*. Here learning is understood as multimodal transformative processes of sign-making activities where teachers and pupils are viewed as didactic designers. A model called *Learning Design Sequence* has been developed and serves as a tool for data collection and analysis. Video observation material from five ICT-advanced schools with pupils aged 6-17 was multimodally transcribed and analysed.

In conclusion the thesis, among other things, indicates that:

- Social Science acquires informal features and pupils are independently designing their own digital Social Science material.
- Pupils' interactions are significantly multimodal and the digital learning resource becomes a third element in interaction. Pupils are constantly active and very responsive to each others' representations. They cooperate as if learning in the extended interface is a collective responsibility.
- Pupils' learning is also significantly multimodal. Being digital natives, they engage in colours, sounds and images to represent some of their learning.
- Learning represented in modes other than text and speech becomes invisible and disappears in the digital divide.
- Pupils are simultaneously designing parallel paths of learning. One path represents the formalised education which is the path initiated, promoted and assessed by the teacher. The other path is guided by pupils' interests and by affordances in the digital interface. This represents the extended learning that goes on below the surface.

The thesis ends with a discussion about didactic complexities in *The Online Learning Paradigm*.



## List of included articles

- I. Engström, S. (2006). The digital learning resource – a tool, content or a peer? Digital media in Learning Design Sequences. *Stockholm Library of Curriculum Studies*. Vol 16, p 2-21. Stockholm: HLS Förlag.
- II. Engström, S. (2008). Eh, they even have a special tool, did you see that? Affordances in digital learning resource mediated interaction. *Digital Kompetanse, Nordic Journal of Digital Literacy*, Vol. 3, 1-2008, p. 5-20. Oslo: Universitetsforlaget.
- III. Kjällander, S. (2009). Vad blir SO i en digital lärmiljö? In: Selander, S & Svärde-Åberg, E (Eds.) *Didaktisk design i digital miljö – nya möjligheter för lärande*, p. 127-143. Stockholm: Liber.
- IV. Kjällander, S. & Selander, S. (2009). Design för lärande i en digital, multimodal lärmiljö. In: Jonas Linderöth (Ed.) *Individ, teknik och lärande*, p. 239-262. Stockholm: Carlssons.
- V. Kjällander, S. (submitted). Assessment in the digital divide: Teachers' and pupils' multimodal interaction.

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# 1. Introduction



*The classroom is loud. Pupils are running to and fro, getting their laptops from next door. Some pupils already have their computers out, have put them on a table, logged in and opened the document they had been working on during the last lesson. One pupil has opened an online educational computer game and begun to play. Others are trying to find their headphones and some are helping each other to log in. Three pupils in a corner are laughing and pointing at something on one of the computer screens. One pupil has forgotten his user name and is trying to find a note where it is written. One pupil's R-key on the keyboard is loose and he is asking for help to fasten it again. The projector is on as usual and the teacher is preparing her introduction that she will begin in a few minutes.*

At a first glance this Social Science classroom situation can be seen as chaotic – but it can also be seen as a creative and exciting environment with immense possibilities for pupils’ interaction, meaning-making and learning. This is what this thesis is about: pupil interactions, learning and meaning-making in Social Science in an extended digital learning environment where mouse clicks and screen activity is viewed as equally important as teachers’ interventions and laughter.

## Background

### School of today - changes and paradoxes

This compilation thesis, which encompasses five articles, has been written in a time of changes, where learning environments can be seen as fragmented and filled with paradoxes, but are also distinguished by globalization where different areas converge and become more and more similar (Selander & Kress, 2010). One of these changes is related to the digital technology that is being introduced and used in schools today. Until recently digital technology has been defined as tools developed for certain activities. Today digital technology is characterised by an overall condition in the form of social infrastructures (Holm Sørensen et. al, 2010) and the Internet is the “fabric of our lives” as expressed by Castells (2000:1). In this thesis the digital interface is described as *extended*, as it is not restricted to the physical interface where the pupils interact with the computer’s keyboard, mouse or touch screen. It is not just about program design. Instead it is about being able to understand *the extended digital interface*. Social interaction within an institutional framing has to be considered, which means that the interface is extended to include everything of importance for pupil interactions and learning, such as for example peers’ comments, classroom furniture, class rules and school norms. The interface has also been extended by technical developments over the last few years. Today there are lots of 1:1-schools, where all teachers and pupils have one laptop each. This means that the digital interface can be extended by means of time and space to include leisure as well as excursions. To mention some other examples, people are using smart phones with touch screens and constant internet access; there are computer games times where the gamers interact via dance-mats and special cordless controllers; and there are *pervasive games* where the physical environment and uninitiated people around the ones playing the game are included in the digital interface (Montola et al., 2009). According to Shaffer (2008), schools face new challenges in an extended digital learning environment since pupils

need to practice to solve problems that do not have easy answers. He means that in the digital age of global competition, schools have to educate their pupils in creative thinking, collaboration and complex problem solving. He argues that digital technology that makes innovative and creative thinking critical skills for the future also makes it possible for pupils to prepare for that future by means of using digital learning resources. On the one hand a global OECD project called “New Millennium Learners” deals with learning in a digital learning environment. In a review of this project, Pedró (2007) suggests that education is challenged because of pupils’ massive use of digital resources at home. This is thought to change their lifestyles and make the contrast between practices, within and outside school even larger. On the other hand, a lot of research indicates that the Internet eliminates the boundaries between the private and the official sphere and between school-life and home-life. According to Alexandersson (2002), pupils’ learning faces new conditions and new challenges with the introduction of digital learning resources into schools. Digital technology and mobile media change the possibilities pupils have to acquire updated information and to spend time with each other in virtual space – these resources, as expressed by Holm Sørensen et al. (2010), radically change pupils’ patterns of communication. In the recent Swedish Media Council’s annual report (Medierådet, 2010) about children’s media habits children (aged 9-16) for the first time ever answered that they use the internet more than they spend time with their friends. Learning environments in schools have clearly become more multimodal and extremely information-rich, and at the same time have become more flexible. Pupils’ learning is closely linked to what resources they use in the learning process, as the resources do not just mediate information neutrally. Instead the computer, for example, is linked to a culturally charged information and interaction environment (Säljö, 2005).

Digital learning resources are sometimes described as having lots of positive effects on pupils’ learning (Zucker, 2005, for example) or as the key to the future, but seldom are these statements based on qualitative research. *The Swedish National Agency for School Improvement* (Myndigheten för skolutveckling, 2007), states that digital learning resources have positive effects on pupils’ learning. The statement is based on research reports from Europe that show that pupils’ independence, skills and motivation increase along with their attention and engagement, as well as their skills in group work. Taking an opposite stance, the media at times presents the Internet as dangerous and complicated to use in a school context. For instance, it is claimed that pupils’ learning in a digital learning environment is degraded to an activity of “copy&paste” of the information found on the Internet (Perkel, 2008). Regardless of whether you interpret *ICT* (Information and Communication Technology) as a promise or as a threat, almost all scholars, according to Hylén (2010), agree that information technologies are a strong revolutioniz-

ing force in society that will have a direct influence on the school's activities.

All of the articles in this compilation thesis are based on an assumption that learning in the digital environment is something new, or at least different. One of these differences is the relationship between pupils and learning that digital learning resources render possible. Pupils acquire an active role. In order to participate in the digitalized society a competence to express oneself visually and verbally with technological resources is required (Carlsson & von Feilitzen, 2006). This is not a problem for the pupils in this study. Instead, they are what Prensky (2001) would call *digital natives*, since digital media has been present throughout their entire lives. They are used to surfing the web, sometimes more so than their parents and teachers (who can be referred to as *digital immigrants*). There is a digital knowledge gap between the generations (Lister et al., 2003; Papert, 1996; Prensky, 2001; Tapscott, 1998; Underwood, 2007) and pupils' learning is supposed to take place in this *digital divide*, in the digital interface between what goes on in the classroom and at the computer screen.

A pupil is not just a receiver of information in the digital learning environment, instead she or he is an active individual designing her or his own learning and knowledge (Selander & Kress, 2010) – the pupil is a “didactic designer”. This study, unlike many educational studies, therefore focuses on the *representation* of information instead of the *reception* of information. This is the starting point from which I study pupils' interactions in order to understand how they make meaning and learn when they use digital learning resources in Social Science.

## Implementation of ICT in school

Even if digital learning resources are referred to as new tools in school contexts, the implementation has been going on for about 40 years. Koschmann (1996:6-15) identifies four different international paradigms in the development of, and research about ICT for learning in schools. In Sweden, four different arguments, or aspects, for implementation of national investments in ICT in schools are usually highlighted (Hylén, 2010) in the literature about ICT-development in education. They are presented in the paradigm where I consider them to belong.

### Four paradigms

The first paradigm was developed during the 1960s and was about efficient learning. It is called the *Computer Assisted Instruction Paradigm*, developed by behaviouristic thoughts (cf. Skinner, 1968). As the name suggests, learning was seen as a passive acquisition or absorption of established informa-



tion. Teaching and learning activities became a process of transmission or delivery and reception, where the teacher's role was to gather formal knowledge, find efficient ways of sharing it with their pupils and test if the pupils had learned it or not. It was during the era of this paradigm that the first parliamentary bill considering ICT in schools was presented in Sweden. That was at the end of the 1960s, but it was not until the very beginning of the 1970s that the first experimental work was set in motion in the Swedish school system – although this was only in upper secondary school education as ICT was considered to be too expensive to be introduced into preschools, primary and secondary schools (Riis, 2000).

The second paradigm was based on cognitive beliefs. It took off at the beginning of the 1970s and can be called the *Intelligent Transportation Systems Paradigm*, influenced by Artificial Intelligence. This means that cognition is seen as a computational process that can be studied by constructions of intelligent systems as models of processes of the human mind. Systems were thought to be able to be designed to assume the role of a skilled teacher, which means that the teacher as a person was suddenly viewed as rather unimportant. The aim was to provide each pupil with an individual digital tutor (Lepper et al., 1993). Learning was thought of as the process where the pupil acquires the representation of a problem and teaching was for that reason thought of as the activities made to facilitate the pupils' acquisition. In Sweden an ICT-project called DIS (Datorn I Skolan<sup>1</sup>) dominated ICT-development during the era of this paradigm in schools, by studying the effects of computers on content, methodology, organization, teaching aids and in-service training. The main focus of DIS in schools was teaching about computers and their use in society, subject related use of computers to modernize teaching and the use of computers to aid learning (Skolöverstyrelsen, 1980).

The third paradigm is called the *Logo-as-latin Paradigm* and is based in Piaget's (1985) constructivist theories about learning. The paradigm emerged in the 1980s, with learning regarded as a process of subjective construction and experience (von Glasersfeld, 1979) dependent on personal inquiry and discovery. Pupils learned by programming, designing, building and debugging computer programs in the programming language Logo. At the beginning of the 1980s digital learning resources were introduced into Swedish schools because of democracy aspects. Computer science was taught in order to provide pupils with skills that would make them want to, dare to, and be able to, influence the use of digital learning resources in society (Pedersen, 1998). In the National Curriculum accepted in 1980<sup>2</sup>, computer knowledge was included in the curriculum for Mathematics. A few years later "Computer Science" was introduced and schools began to invest

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<sup>1</sup> In English: Computers in schools.

<sup>2</sup> Lgr-80

in hardware such as computers, screens, keyboards and mouse units. Nothing in the National Curriculum of 1980 said that Computer Science should be taught with computers; it was instead about computers, and about how they worked (Skolverket, 2000). Later on in the 1980s two campaigns were launched, the first of which requested that schools buy hardware and the other one championed the development of educational software (Riis, 2000). ICT was judged not to be a teaching subject, but was incorporated in several subjects. ICT was supposed to be linked to reality and pupils should develop control of their own learning and computer work. Computer software should be designed in order for the user to be able to pose questions in a dialogue format and to be in control of the computer work, not the opposite. A special user-friendly computer – Compis – was designed to be used in the educational setting, but when this finally launched the ICT development had moved ahead in the development of operative systems (Lindh, 1993). In the middle of the 1980s the state ran a campaign to get municipalities to develop local curriculum in Computer Science (Riis, 2000). The strongest reason for introducing digital learning resources into schools in the middle of the 1980s was that education needed to adapt to the future labour market (Edström & Riis, 1997); the discourse referred to as the aspect of working life. In the middle of the 1980s tutorial programs, tools programs and training programs were used in schools. Practice programs were only intended to be used in specific situations, since they were thought to have a controlling influence on the pupil's work. By the end of the 1980s digital learning resources had been brought up as a possible support for pupils with handicaps and special needs (Dataprogramgruppen, 1988). At the end of the 1980s the needs for better pedagogic software had been identified and within a Nordic cooperative project 30 pedagogic programs were developed (Riis, 1991).

In the 1990s, a fourth paradigm emerged, called the *Computer Supported Collaborative Learning Paradigm* (CSCL). It built on perspectives such as anthropology, sociology, linguistics, communication science and socio-cultural theories and aimed at understanding language, culture and social settings. The supply of, for example, computers and CD-ROM players in Swedish schools increased (Skolverket, 1996a) due to this paradigm. Applications were open and interactions, communication and assessment by means of digital portfolios were the main topic of educational thinking (Dysthe, 2003; Selander & Åkerfeldt, 2008). Situated learning became a key concept, with the focus on the learning process, rather than the outcome and the motive for using digital learning resources in Swedish schools was the aspect of learning that concerned the thought that ICT would facilitate learning and make education more efficient (Pedersen, 1998). At this time the new curriculum (Skolverket, 2006a) was launched, which highlighted one of school's assignments to be to make sure that pupils had the ability orientate in a complex reality, with a large flow of information and a rapid pace of change. Pupils were supposed to be able to use ICT as tools for learning and

it was the head teacher's responsibility to provide the school with computers, as well as to provide teachers with ICT skills (Skolverket, 2006a). A Swedish school computer network was also developed by The National Agency for Education. The aspect of change summarizes the debate at the end of the 1990s; digital learning resources were regarded as the engine in a general school development process (Pedersen, 1998). A large international study (SITES) shows that pedagogical innovations are very common with ICT-investments (Kozma, 2003). The IT commission of 1994 reinforced that digital learning resources in education were the primary mission in the common drive to make Sweden a prominent ICT-using country (Nissen et al., 2000). In the middle of the 1990s The Knowledge Foundation was founded and a lot of money was invested in different school projects (Riis, 2000). By the end of the 90s their ICT-project (ITiS<sup>3</sup>) provided teachers with both in-service training and computers (Riis et al., 2000). Spelling and syntax programs were used in schools at the end of the 90s (Skolverket, 1996b) and pupils with dyslexia used different software to compensate for their limited skills (Svårdemo-Åberg, 1999). Distance tuition developed and CD-ROM products were used along with the Internet. Digital learning resources were thought to be interactive by providing questions for the pupil to respond to, but the answers were predetermined and interactivity levels were still low.

### The emergence of a new paradigm

At the turn of the millennium *digital competence* was referred to as the fourth basic skill in school discourse, after reading, writing and arithmetic (Riis et al.2000). The focus was on the communicative aspect of digital learning resources, which were often used for collaborative learning. The digital learning resources have not changed schooling as was predicted, partly because they are not pedagogically supported and also because some digital learning resources are not designed for the educational setting (Riis, 2000). The implementation of ICT in schools at this time was seen as part of a general development process in schools and there was still the motivation of working life preparation for using digital learning resources in schools (Riis, 2000). The democracy aspect also became valid once again (Jedeskog, 2000). Digital learning resources are used more or less in all schools and the various reasons for using them are highlighted by the media; they are considered to increase opportunities for individualization; they are relatively easy and cheap to update; they stimulate different learning styles, and they give greater opportunities for interactivity and direct feedback. Furthermore their multimodal character is thought to increase the possibilities of explaining and displaying complicated relations (Myndigheten för skolutveckling,

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<sup>3</sup> IT i skolan, in English: IT in school.

2007). Online learning resources are used a lot by teachers and pupils. The Swedish National Agency for School Improvement offers digital tools with Practical IT and Media competence – PIM – which is used in many schools. In 2007 The European Parliament (2006) issued a recommendation about eight key competences of special importance for lifelong learning; one of these is *digital competence*. This competence is described as the use of digital learning resources to retrieve, assess, store, produce, present and exchange information. This recommendation is in itself a reason for using digital learning resources in the educational setting, but it becomes clear when engaging in literature and research in the subject that all four aspects of the reasons for using digital learning resources in education (the aspects of democracy, working life, learning and change) are still valid reasons for using ICT in the classroom (Hylén, 2010; Schierbeck, 2007).

At the turn of the millennium the countries of Europe formulated the goal that by 2010 Europe should be the most competitive and knowledge-based economy in the entire world. This goal was to be met through the development of online learning systems as well as the inclusion of digital learning resources in education and the production of newer and better digital teaching aids and services. Digital learning resources were not to be regarded to be tools but instead to be means to mediate cultural heritage and to link schools in different countries (Cavanagh, 2004). Today yet another paradigm is emerging, indicating that interest is shifting from hardware to software and from technological to pedagogic possibilities (Selander & Åkerfeldt, 2008). As most resources used for education are to be found online, I call this paradigm *The Online Learning Paradigm*. This paradigm has been noticed at different levels by different researchers. For example, Kroksmark (2011) writes about a transition from an analogue to a globalized and digital learning, where the Internet is the identity of what is referred to as new media. Hylén (2010:81-90) explains the phenomenon by highlighting four different trends of the paradigm. The first one is called *unpacking of items*, and is expressed by how different modes, such as text, sounds and images that used to be jointly integrated are now accessible individually. To give an example, songs can be accessed one by one instead of buying a whole album and the same goes for articles in journals or clips from a TV-programme. The second trend is called *users are producers* and means that the users of digital media are now also considered the producers of the digital media. Teachers and pupils do not only consume digital learning resources, they are also making their own digital products. They go from reproducing knowledge to being producers of knowledge (Jewitt, 2003a). They are what is sometimes referred to as *prosumers* (Hylén, 2010:84), but as this does not have anything to do with learning or schools I use the term *didactic designers* (Selander, 2009), which is a central term in this compilation thesis, and which will be developed further. A third trend in the paradigm is that *informal learning increases in importance* by the use of the Internet, as many

children are using communities for their learning. Formal learning in this paradigm aims at capturing elements of spontaneous informal learning to incorporate into formal learning. This leads us into the fourth trend that *learning is independent of time and space*, since digital developments efficiently support, for example, the distribution of video-filmed lectures and video-conferences.

## Initial attraction to the research field

The specific phenomenon that caught my interest for digital learning resources in Social Science initially was that I repeatedly experienced that pupils were thrilled to use the computer, but that they did not seem to take digital assignments very seriously. They listened to music, visited different websites that seemed to have nothing to do with the subject, chatted online and talked about other issues while working with the digital presentation. The web pages where they surfed did not have children as a target group and the pupils did not spend much time on one page before clicking onto the next. The digital interface interaction was fast, or even uncontrolled, and difficult to follow and understand by just watching. Despite this seemingly chaotic situation, the pupils somehow in the end managed to make sense and engage in the digital interface and they always presented digitally designed products with a content of higher quality than I had expected. The pupils proved to have gained impressively much knowledge about the specific subject, but also about various peripheral areas. All of this occurred in front of me, but was invisible to me as a spectator. How was this possible?

By studying the pupils' interface interactions in detail the question can be answered. Hence, this thesis studies pupils' interaction when they are working with digital learning resources. I chose the subject of Social Science since digital learning resources are prominent in the curriculum of Social Science in Sweden and because I (being a Social Science teacher) have experienced it as a very exciting subject, mainly due to two factors. Firstly, the subject is significantly influenced by the pupils and their worlds. Their interest in, and interpretations of, the subject often lead the way in the design of the subject and, especially in years 1-6, only a small part of the subject is steered by textbooks. Secondly, I have experienced how pupils develop their identities framed by Social Science, by means of, for example, serious ethical, religious and political discussions. In order to study my research interest in pupils' learning in Social Science in digital learning environments, I have documented pupils' interactions in learning environments where digital learning resources such as computers, digital cameras and scanners are used.

The research interest was gradually developed during my own teacher training and while writing my Masters degree project dissertation about pupils' learning in Social Science and Science using the Internet, as well as

while working during my first years as a teacher. The more precise research questions that will be introduced in the next paragraph were developed while collecting and becoming engrossed in the empirical material from the project *Digital learning resources and Learning Design Sequences in Swedish school – a users' perspective*.

## Aims and research questions

This compilation thesis aims to, using a multimodal design theoretical perspective, describe and analyse how pupils interact, make meaning and learn while deploying digital learning resources in the Social Science classroom. A multimodal design theoretical perspective on learning, or designs for learning, is a theoretical perspective that gives me the opportunity to approach these issues. *Designs for Learning* is the perspective used in this thesis to understand learning as interaction and sign making activities (Selander & Kress, 2010). I study and analyze interaction in order to understand meaning-making and learning between individuals. Their activities with digital learning resources are documented and analysed using multimodal design theoretical research methods.

The following sets of general research questions have been established to be able to meet the aims of the thesis:

- How do teachers didactically design for pupils' learning with digital learning resources in Social Science, and how do digital learning resources influence the subject design?
- How do pupils interact with the digital interface and with what affordances do they engage in the digital learning environment?
- How do pupils design their own paths of learning in Social Science in the digital learning environment and with what modes do they represent their learning?
- What is recognised as learning in a digital learning environment, how is this learning assessed and how do pupils make meaning in assessment actions?

These research questions will be elaborated on and discussed in each article and in the discussion chapter of this thesis. The concept of *identity* has developed and grown in importance during my work with this thesis. It has been under investigation all through the thesis, although there is no outspoken research question referring to identity in any of the articles. Therefore identity is not represented in the general research questions above, but is still

present in the different chapters and has an important position in the discussion. Specific aims and research questions will be further developed and presented in detail in each article.

## Scientific framework of this compilation thesis

This study does not stand on its own but is instead part of a larger context. The thesis has been constructed in a theoretical context and the empirical material derives from the research project presented below.

### Project description

All empirical material collected and analysed in this thesis was collected within the framework of a larger research project at the Stockholm Institute of Education, later Stockholm University. In the first years of my doctoral studies I participated in this project. The project was called Digital Learning Resources and Learning Design Sequence in Swedish Schools – Users' Perspective<sup>4</sup> and was financed by the research program LearnIT<sup>5</sup> which was part of the Knowledge Foundation<sup>6</sup> organization in Sweden. The project's purpose was to deepen our understanding of how digital media is used as a resource for learning in education. The project ran for three years, from 2004 to 2007. In 2004, at the beginning of the project, 19 schools – describing themselves as being ahead in their ICT-development – were contacted via interviews with head teachers and teacher questionnaires. Ten schools were selected because they used ICT in advanced ways. Pupils of ages between 6 to 19 years old were observed in different subjects such as Maths, Science, Languages and Social Science. The main part of the material consists of around one hundred hours of recorded video from classroom interactions, with field notes accompanying each film. The material also includes soundtracks gathered with an Mp3 player. The audio tracks consist of interviews with pupils and teachers, as well as speech and sound from classroom interaction. The project collected all of the pupils' products, such as written material, PowerPoint-presentations and digital films made within the framework of the subject area or the Learning Design Sequence. In a few cases pupils have written log books, which were gathered and copied.

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<sup>4</sup> More information is available at <http://www.didaktikdesign.nu/learnit/>

<sup>5</sup> More information is available at <http://www.learnit.org.gu.se/>

<sup>6</sup> More information is available at <http://www.kks.se/>

Each research project member<sup>7</sup> transcribed and analysed sequences from the research material according to her or his individual research questions. The whole research material was analysed in relation to four aspects;

- Design – how the digital learning resource is built and how different modes are interacting
- Usage – how pupils interact and use the digital learning resources, what actions occur and with what objectives
- Understanding representations – how pupils represent their learning
- Meta-narratives and reflections – how the users understand the usage of the digital artefact in comparison to their own learning

My part in the project was to study aspects two and three. As I participated in this project from start to finish, and since I have gathered the material selected and used in this thesis, the text will from now on be written in first person singular even though we have often been two or more researchers collaborating, especially in the data collection phase.

## Designs for learning

This compilation thesis explores a design theoretical perspective to collect and understand pupils' meaning-making and learning. This perspective began to develop within the framework of the research project presented above. The perspective, which is also called Designs for Learning, was developed within the research group DidaktikDesign<sup>8</sup>, in discussions and collaboration between several different research groups and universities internationally, such as the Danmarks Pædagogiske Universitet in Copenhagen, the Learning Lab and the Institution of Education in London and the University of Technology in Sydney. The perspective embraces and focuses children's learning in formal learning setting as studied in this thesis, but also learning in semi-formal and informal settings, as well as adult learning. Therefore the perspective can be used in many different research areas.

There are many design theories that present different approaches to how people design their environment. *Designs for Learning* is a perspective that focuses on the production of knowledge rather than the reception or the understanding of knowledge. The transformation process is focal, with concepts that can facilitate analysis of learning in different degrees of formal contexts, such as education. Didactic design offers tools for studying pupils

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<sup>7</sup> Research project members were: Staffan Selander (project leader), Agneta Bronäs, Eva Svärde-Åberg, Anna Åkerfeldt, Susanne Engström/Kjällander, Eva Edman-Stålbrandt, Annika Hössjer, Fredrik Lindstrand and Susanna Malm.

<sup>8</sup> [www.didaktikdesign.nu](http://www.didaktikdesign.nu)



in the Social Science classroom and it is used in this thesis to understand and try to explain, for example, how pupils learn and how they negotiate their identities in the digital interface. The theoretical chapter in the thesis will go further into the development and utilization of this perspective.

## Structure of the text

This is a compilation thesis, divided into two separate parts; I) the comprehensive thesis dissertation and; II) the articles. I have intended to design a compilation thesis with monographic features as I want the thesis dissertation as well as the articles to be able to stand on their own. Therefore the dissertation is not only designed to summarize the theories, methods and discussions presented in the articles– it is instead designed to serve as a contribution to the field where the conclusions of the articles are analysed and discussed further.

Part I begins with this introductory chapter where a background as well as the aims and research questions are outlined. Thereafter previous, related research is presented as this is relevant to how the thesis is positioned in the research field. A multimodal design theoretical perspective on learning is introduced and discussed in chapter three and the following chapter describes how this perspective can be used to collect, analyse and present empirical material. A summary of the different articles in chapter five links to chapter six: the discussion of the results and findings of the thesis. The last chapter of part I, is a comprehensive summary of the thesis in Swedish, written for those who are not so acquainted with research about learning in digital environments.

Part II is composed of articles written between 2006 and 2010. Most of these are written in English, but two are written in Swedish because of the official language of the anthology where they were published. The articles published prior to 2009 were published in my maiden name (Engström) and the rest are published in my married name (Kjällander). Part II consists of the following five articles:

1. The digital learning resource – a tool, content or a peer? Digital media in Learning Design Sequences. (2006) Accepted for: *Stockholm Library of Curriculum Studies 16*. Stockholm: HLS Förlag.
2. Eh, they even have a special tool, did you see that? Affordances in digital learning resource mediated interaction. (2008) *Digital kompetanse, Nordic journal of digital literacy*, vol. 3, 1-2008. Oslo: Universitetsforlaget.

3. What does Social Science become in a digital learning environment? (2009) In: Selander, S & Svärde-Åberg, E (Eds.) *Didaktisk design i digital miljö – nya möjligheter för lärande*. Stockholm: Liber.
4. Designs for learning in a digital multimodal environment. (2009) In: Jonas Linderöth (Ed.) *Individ, teknik och lärande*. LearnIT. Stockholm: Carlssons.
5. Assessment in the digital divide: Teachers' and pupils' multimodal interaction. Submitted 2010-12-26.

The articles will be thoroughly summarized at the end of part I of the thesis.

## Research contributions

As will be illustrated in the next chapter, research about pupils' interaction and learning in a digital learning environment is a huge research field in Sweden, as well as internationally. Still, this thesis brings something interesting to the table:

A first unique contribution to this field is the understanding of learning with digital learning resources in the specific subject of Social Science. Since research is dependent on economic funding, a lot of research has been conducted about digital learning resources in Mathematics and Languages, for example, which are core subjects (at least in the Swedish school system). Social Science is traditionally supported with less research funding. As a consequence there has not been a lot of research about digital learning resources in the Social Science classroom, although digital learning resources have a prominent position in the Social Science curriculum.

A second contribution to the research field is that the empirical material this thesis is based on includes video observations made in Social Science in preschool classes, primary schools, secondary schools, as well as upper secondary schools, which means that pupils in this study are between 6 and 17 years of age. This is a rather unique age range in a qualitative thesis of this kind and offers the possibility of an overall picture of pupils' learning in Social Science with digital learning resources.

A third contribution to the field is that the thesis presents a perspective on pupils' learning, essentially developed to conduct and to understand research concerning pupils' different degrees of formal learning in a digital learning environment. The design theoretical perspective has developed side by side with this thesis, and is described thoroughly, illustrated and exemplified in this thesis, both as a tool to conduct multimodal design theoretical research by means of collecting and analysing empirical data, and as a way to explain

learning. To my knowledge five doctoral theses with a (fully or partly) design theoretical perspective on learning have been published. These are the Öhman-Gullberg (2008) thesis about representation and meaning in young girls film-making, the Sandberg Jurström thesis (2009) about choir conductors' multimodal communication, the Insulander (2010) thesis about meaning-making in museums, the Boistrup-Björklund (2010) thesis about assessment in Mathematics and the Leijon thesis (2010) about meaning-making in teacher's education. The present thesis is thus the first one to study pupils' learning in a digital learning environment.

Furthermore, this thesis contributes knowledge about pupils' meaning making and learning within the school setting, while working with digital learning resources. The thesis also contributes by presenting what occurs in the digital interface interaction, how the pupils interact and learn by means of what modes they are confronted with in the digital interface, such as images, symbols, sounds, animations, colours and text. The thesis contributes knowledge about what is recognized as learning and with what modes this learning is assessed. The thesis provides knowledge about how a school subject and course criteria are changed in a digitalized environment. Finally, the thesis illustrates how pupil and teacher roles are changed in the digital learning environment and how pupils, as well as teachers, become didactic designers in the digital learning environment. The thesis concludes with a discussion about the challenges schools will face in the near future.



## 2. ICT in Swedish education – a brief overview

The purpose of this chapter is to explain Sweden and Swedish education from a general ICT perspective, mainly for readers unfamiliar with ICT in Sweden. The text is retrieved from an article called *E-learning in Sweden* by myself and Eva Edman-Stålbrandt (2009), published in *E-learning practice. Cases on challenges facing e-learning and national development: Institutional Studies and Practice. Volume II*, which is an international publication representing 39 countries worldwide<sup>9</sup>. Since the book was also published online some references in this chapter are web addresses.

### ICT in Sweden

Sweden has for a considerable time been known as world leading in ICT in education, with all Swedish schools having had computers and Internet access for many years now (Myndigheten för skolutveckling, 2007a). Although the financial crisis struck Sweden's economy hard, digital development in Sweden marches on (EIU, 2009). On the Economist Intelligence Unit's list<sup>10</sup> 2009, Sweden was ranked second. The Swedish social and cultural ICT environment is the most supportive for innovations in Europe and performs strongly in fostering new businesses. Swedish government ICT policies and visions are very well developed (EIU, 2009).

Sweden as a country has a high tech profile and slightly more than 80% of its population of about 9 million people uses the Internet, with about 40% being broadband subscribers (Internet World Stats, 2009). According to Statistics Sweden (2009), Swedes often use mobile Internet connections and

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<sup>9</sup> The intentions with the book were to identify clusters of common trends and challenges in e-learning, analyse them and present sought-after and useful information for different funding agencies and global organizations such as, for example, UNESCO and the World Bank. Another intention was to present strategies and experiences of ICT strategies and implementation for countries about to implement ICT in education.

<sup>10</sup> The Economist Intelligence Unit's list is the world's leading resource for economic and business research, forecasting and analysis. It is independent and provides governments, multilateral organizations and companies with insights about industry, countries and markets.

generally they use the Internet as follows: The average Internet user in Sweden is a man of 15-24 years of age. However, about 70% of all Swedes use the Internet daily or almost daily (Nordicom, 2009) and spend 9.7 h/week online. 50% of all 5 year olds have used the Internet (Skolverket, 2008). The purpose for individuals using the Internet in 2007 was sending/receiving e-mails: 69%, playing/downloading games and music: 35%, reading/downloading online newspapers/news magazines: 43%, listening to web radio/watching web television: 33% and other communication uses: 28% (Nordicom, 2009).

As we have seen, Sweden is a country where most people are digitally competent, still the government puts effort into bridging the digital divide. The Swedish government participates in the *i2010 Strategy for an innovative and inclusive European Information Society*. i2010 connects EC ICT-policies, initiatives and actions so that ICT can make a positive contribution to economic growth. i2010 is part of the Lisbon strategy to make Europe a more competitive economy (i2010, 2008).

- The Swedish government presented three ICT objectives in 2008:
- ICT shall give life quality and ease every day lives for people and companies.
- ICT shall enhance sustainable development.
- ICT shall be effective and safe in all parts of the country for everyone to be able to access interactive public e-services (Regeringskansliet, 2007).

The Swedish government has financed about 40 popular adult education projects within the project *Digital divides – efforts to overcome these*. These projects were designed, for example, for physically handicapped, senior citizens, immigrant females with rudimentary education and owners of small companies (SIKA, 2007).

## ICT in Swedish education

Sweden is the OECD country that in the years between 1995 and 2002 had the largest contribution of ICT investment to GDP growth (OECD, 2005). However, given that Sweden is in the forefront of ICT development, the number of computers in schools is not so impressive. The PISA survey of 2003 found that only 0.2 computers per student were available, which was average among OECD countries. However, almost 100% of the computers in schools were connected to the Internet (OECD, 2005). Educational ICT has not developed at the same pace as the market. Researchers in Sweden often highlight *digital competence* as the fourth basic skill along with reading, writing and arithmetic and Sweden has made massive investments in ICT in

education, especially when it comes to the interface between ICT and learning. Despite this, a reluctance towards ICT is often found within the school system. Sweden was quick to see the use of ICT as a question of democracy and equality and is ahead internationally when it comes to ICT skills and competence (KK-stiftelsen, 2008). Teachers – most preschool teachers use a shared computer, with 10% of preschool teachers using this in class every day, 25% every week and only 5% of them think that they are very good ICT users. The average compulsory school teacher uses a computer in class every week, wants to learn more about how to use ICT as a pedagogic tool and how to use graphics, audio and video in class. The average teacher has the best access to pedagogic software in Maths and Languages and does not very often teach source criticism. In Upper Secondary education 80% of the teachers have their own computer and almost 30% use this in class every day. Language and vocational software is especially accessed. More than 15% think they have very good ICT competence and almost all teach source criticism. About 70% of teachers in higher education have their own computer and 40% of them use this in class every day. Students – about 50% of students frequently use the computer in school and about 95% use it frequently at home (OECD, 2005). Swedish students are among the most confident ICT users when it comes to routine tasks such as opening a file or playing a computer game (especially boys). When talking about high-level tasks the gender differences are very large, according to PISA. Swedish students are also among the most confident when it comes to using the Internet (OECD, 2005). In Sweden ICT is especially integrated in special education and special teachers think that students with concentration difficulties or other functional disabilities, such as speech, language and communication problems, visual handicaps, multiple handicaps and physical difficulties, benefit from ICT (Myndigheten för skolutveckling, 2007a).

### Government policies for ICT in education

At the end of 2008 the Swedish government gave the National Agency for Education the following commission to promote the development and use of ICT in preschools and schools: Communication between pupils, parents and students is to be promoted by ICT. The agency shall work for a safe use of ICT where integrity is secured and where critical viewpoints are encouraged. Needs for development at schools and preschools shall be assessed and especially teacher's use of ICT as pedagogic learning resources aimed to develop their education shall be promoted. The agency is responsible for the development of different projects within the frames of the European Schoolnet (Utbildningsdepartementet, 2008).

The Swedish National Agency for Education also develops “hands-on projects” and resources to increase ICT competence. To mention a few ex-

amples there is a special website for teachers, *IT for pedagogues*<sup>11</sup>, with facts, research, activities, blogs and interactive example of how to use ICT for learning. Another website called *PIM*<sup>12</sup> provides ten directions for use of different online resources in the classroom. There is a resource called *Multi-media bureau*<sup>13</sup> that offers free inspirational and supporting material such as images, sound effects and graphs. Another web resource, *Check the source*<sup>14</sup>, is designed to increase teachers' and librarians' knowledge in information searching. The agency is also responsible for a search engine, *Link pantry*<sup>15</sup> specially designed for the needs of younger school children. They also have a special website called *Lead with IT*<sup>16</sup> for principals and school leaders about how to use ICT to run a school. *The Swedish Schoolnet*<sup>17</sup> is operated on behalf of the Government. Its purpose is to serve as a guide in the process of integrating ICT in teaching in Swedish schools. It was also the initiator of the European School net with the aim to bring about innovation in teaching and learning for its key stakeholders: Ministries of Education, schools, teachers and researchers. A unique governmental initiative in Sweden is *The Swedish Media Council*<sup>18</sup>, a government office committee of inquiry in working with young people's media situation. The aim of the council is to reduce the risks of harmful effects of media, such as the Internet, film, TV, computer and video games. The Council raises awareness about the risks and benefits of media use, offering advice to parents and teachers.

One of the objectives to achieve in compulsory schooling is the use of information technology as a tool for awareness and learning. Otherwise there are no guidelines for how IT should be used in Swedish schools. Sweden has no national e-strategy for schools; this is an issue that is the responsibility of the municipalities and the schools. Many municipalities have e-strategies on a general level, some municipalities have a common e-strategy and some schools have their own e-strategy. In a report about a new teacher education (SOU, 2008:109), ICT is described as an educational resource which will characterize and permeate all teacher education. The report further suggests that Sweden should establish a national action plan for ICT and digital literacy.

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<sup>11</sup> <http://itforpedagoger.skolverket.se>

<sup>12</sup> <http://www.pim.skolverket.se>

<sup>13</sup> <http://www.multimedia.skolverket.se>

<sup>14</sup> <http://kollakallan.skolverket.se>

<sup>15</sup> <http://lankskafferiet.skolverket.se>

<sup>16</sup> <http://ledamedit.skolverket.se>

<sup>17</sup> <http://www.europeanschoolnet.org/ww/en/pub/eun/about/euninfo.htm>

<sup>18</sup> <http://www.statensmedierad.se>



## Sweden's educational ICT profile

E-learning Nordic 2006 studied the effects of ICT in learning in the Nordic countries. The results from questionnaires of Swedish school leaders, teachers, parents and students show that ICT has a positive impact on overall objectives and student performance, such as reading and writing (Skolverket, 2006b). Taking into account all statistics a complex ICT profile emerges. If you combine the assets of ICT in schools with the knowledge about ICT and motivation to use ICT in the classroom, Sweden is ranked almost last in the EC commissioned study *ICT in schools* (Myndigheten för skolutveckling, 2007a). This is very interesting since Sweden has a top rank in e-readiness and since ICT is a focal point in the Swedish educational discourse. The next chapter presents related Swedish research about learning in a digital environment, as well as gives a view on international research.



### 3. Interaction and learning in the digital learning environment – earlier research

Research on school and digital learning resources has been conducted in many disciplines and from different perspectives. ICT been subject to discussions at different levels of society and many claims have been made during the years (Papert, 1993). As described earlier, this thesis has a multimodal design theoretical perspective on ICT and learning. There is a large research field of multimodality in HCI (Human Computer Interaction). This field is referred to as Multimodal Human Computer Interaction – MMHCI – and it borders on my research field with lots of similarities, such as the interest for the users' gestures, speech and actions in the digital interface. A difference is the technical interest; MMHCI focuses on the design of the tool, i.e. how computer technology can be made more usable, investigating how the user interacts with the system by input and output in the digital interface<sup>19</sup> (Jaimes & Sebe, 2007). In this thesis, the view on the digital interface is extended to include everything around the pupils in the classroom as well. The focus is on analysing learning processes in detail, rather than on the tool itself, with a main focus on pupils' multimodal interaction, meaning making and designs for learning in the digital learning environment. This framework has guided the design of this chapter as well as the selection of earlier research.

#### Selection of earlier research

Research on children using digital learning resources has during the last 30 years moved from behaviouristic and cognitive theories on interaction and learning, where the individual is a focus, to theoretical perspectives where the social situations and environment – *the setting* – is allotted a higher and higher importance. Research based on social circumstances is often influenced by socio-cultural theories and theories about situated learning (Koschmann, 1996). The latter served as a frame for my search for earlier research, which means that the earlier research presented in this chapter is made within a school context. Further, the selection is based on three vari-

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<sup>19</sup> Within HCI a growing interest in design and learning is currently emerging.

ables; initially research about pupils' interaction and learning where digital learning resources were used was selected. Secondly, earlier research with a multimodal and/or a design theoretical approach was selected, since the view on interaction and learning is similar to the perspectives this thesis builds upon. The third variable was that research about pupils using digital learning resources in Social Science was selected. None of the selected research below fulfils all three criteria, as such research, as far as I am aware, has not been performed until now.

## Organization of earlier research

This chapter is organized according to 1) themes that have been recognized as recurring tendencies in the research results, and 2) themes that are of interest as a foundation for my own study. This chapter presents earlier research according to some recurring, relevant characteristics, rather than listing different research projects and their findings. Some research projects can therefore be discussed twice, but under different headlines. I want earlier research to serve as a foundation for the discussion and conclusions at the end of this thesis, thus this chapter has a descriptive rather than an analytical character. The chapter is also divided into two parts with relevance for my research questions; 1) *interaction* and 2) *learning*, although these two notions are not always possible to separate. Each paragraph will be introduced by a comment on the relevance to my own study.

## A selection of research focused on pupils' interaction

A lot of research about children and digital learning resources is made in informal settings, such as at home or during after school activities. Their focus is primarily on how children interact with the digital interface, rather than on what they learn. In this chapter, primary research conducted within a school setting is of interest. A lot of such research shows that interaction differs between children when they are using digital tools, compared to when they are not – this part of the chapter will provide a picture of how.

## Multimodal interaction

As mentioned earlier, this thesis has a multimodal approach to interaction and other research about the multimodality of interaction in a digital environment is therefore specifically interesting.

A lot of recent research emphasizes how modes other than speech and text are important in digital interface interactions (for example Jewitt, 2003a; 2009; Kress, 2010; Kress & van Leeuwen, 2001; Kress et al., 2001; van Leeuwen, 2011; Selander, 2009; Selander & Kress, 2010). Birmingham et

al. (2002) shows how pupils interact by pointing at the screen to move from one activity to another, instead of speaking about the activity change. Klerfelt's (2007b) research demonstrates similar results. She shows how pre-school children interact in front of the computer. Verbal turns do not arise, instead children answer by acting with the mouse. The importance of physical interaction in the digital interface is suggested by the research of Price & Rogers (2004) to have educational benefits, since physical action with digital learning resources can add a new dimension to the learning environment. This dimension can make abstract concepts concrete. Research by Fernaeus & Thorlander (2006) illustrates how physical performance can be important in children's programming activities. The research shows how pupils use gestures to negotiate ideas around the dynamic properties of a game they are programming and how bodily action with physical resources can add a social dimension to a computer game. Their research shows how a significant part of the interaction between pupils in the digital learning environment is about physically displaying and acting out ideas and suggestions for one another. The research also shows how children are creatively inventing and appropriating alternative uses of the resources that they have at hand. This creativity is equivalent in how pupils use modes presented by the digital learning resource. Compared to texts and images in a book, a computer screen can provide information in many more modes, such as animations and sound effects (Kress, 2003). According to research by Underwood (2007) children prefer to present their work by graphical or audio modes, rather than by texts and speech. Pupils who are using digital learning resources to interact with each other use available modes within the resources in new and creative ways. Sofkova Hashemi & Hård af Segerstad (2004) show how children make up new words, abbreviations and new spellings of words with letters and numbers, and that they use symbols such as dots, brackets and exclamation signs to express attitudes and moods, i.e. smileys. The research of Alexandersson (2002) also shows how pupils' communication in front of the computer is developed, probably by the new technology's organization of information in images, metaphors and virtual worlds. Digital learning resources can gestalt information in ways that are more varied than other teaching aids and the inherent visual affordances make it possible to give meaning to what the pupils are supposed to work with and develop an understanding of. Simulation programs and other digital learning resources can support pupils in handling their everyday lives in different ways than other resources can. Multi-modal interaction is one interaction pattern in the extended digital interface, but there are a lot more. Some of them will be discussed below.

## Interaction patterns

One of the research questions of this thesis specifically concerns patterns of interaction when pupils are using digital learning resources in Social Science. This is a common research interest, perhaps due to the fact that pupils, as mentioned earlier, often work in pairs or groups in the digital interface. Earlier research has pointed out some different patterns of interactions that will be introduced here. Some research claims to have found specific patterns that are valid for digital interface interaction.

Swedish research by Svärden-Åberg (2008:14) shows how different interaction patterns develop between primary school pupils in a digital learning setting. She calls one of the patterns *pupils as inspirers*, where pupils interact by exchanging ideas and experiences and showing peers what they have learned. The interaction is symmetric, and similar results have been found in Danish research where ICT has proved to stimulate pupils to inspire each other with, for example, presentations on the web (Holm Sørensen et al., 2006). Another pattern is called *pupils as instructor and amateur* where the instructor takes on the role of a leader, managing the hands-on activities with the digital learning resource and guiding the amateur peer by giving facts and explanations with different modes. The interaction is not as asymmetric as the title indicates and the roles can be switched. Similar results are found in research where beginners learn from those with experience in learning hierarchies that develops in the classroom (Holm Sørensen et al., 2006). Ljung-Djårf's (2004) research results in similar patterns of interaction among preschool children using computers. She argues that the computers allowed one pupil to be active interacting with the digital interface; this pupil is called the *owner*. Pupils around the digital learning resource are called *participants* if they are actively engaging in the interaction between the digital learning resource and the owner, and *observers* if they are observing the interaction without actively engaging in it. The *owner* in Ljung-Djårf's research is in charge as much as the *instructor* in Svärden-Åberg's, with the difference that the owner was in control of the situation and all changes of positions between the pupils were negotiated in relation to the owner. The observer's role in the digital interface interaction has been investigated, for example, by Vered (1998) who argues that the observing pupils are not only watching, but instead both acting as an active audience and collecting experiences from watching the interface interaction. These experiences are used in interacting with, for example, peers in other situations.

Other patterns of interaction in the digital learning environment show for example how pupils are acting as if they are in a rush. Research indicates that pupils are interacting in a fast pace with the digital interface, aiming at completing the given task (Wheeler et al., 2002) and doing all the exercises on time (Holm Sørensen et al., 2006). Lantz-Andersson's (2009) research of mathematics software shows how students struggle hard to maintain the ac-

tivity they are doing and that reaching a common definition is viewed as important. The results show that students are concentrated, as if they are driven by the well-known phrase “the show must go on”. On the other hand, there is research that indicates that pupils are not afraid of asking for guidance or make mistakes. A large study of American primary school classrooms concludes that pupils ask for help more when they are using a computer and that pupils develop new strategies for problem solving in a digital environment, since they learn that making mistakes is not a problem (Schofield, 1995).

Research about ICT and education often asserts that leisure and school work merge in a digital learning environment. Swedish research by Hernwall (2001) indicates that a digital learning resource, such as the Internet, provides a natural arena for pupils’ own interests that they share with peers. They use digital communication, such as e-mail and chat sites, to keep in touch with people geographically distant or nearby, as well as to meet new friends. Interaction in the digital environment was understood in the study as being about exchanging experiences, but also about seeing each other in the physical room. Pupils create different identities in this digital interaction, and the results show how the possibility of anonymity influences the topics of communication. Another pattern in pupils’ interactions has to do with how they cooperate. Since this is a large research field in education and ICT, it will be discussed in the next paragraph.

## Cooperative interaction

In the empirical material in this thesis pupils are cooperating most of the time, often because their teachers didactically design for cooperation, but also because they seem to prefer to work in groups or pairs. A difference is present here in 1:1-schools, where pupils often work alone on their own laptop (Kroksmark, 2011). As stated in the introduction to this thesis there is a paradigm called CSCL<sup>20</sup>. The large research area with the same name focuses on two different aspects of educational technology research: 1) effects *with* technology describing what the student plus the computer could achieve in synergy and 2) effects *of* the technology, describing how the student is changed (how she/he learns) by the technology (Kolodner & Guzdial, 1996) – both of which have a more technical focus on collaborative learning with ICT than this thesis does. Cooperation is a common research focus in a lot of earlier, related research about pupils using digital learning resources in the classroom (for example Birmingham et al., 2002; Farkell-Bååthe, 2000; Karlström et al., 2005; Kroksmark, 2011; Loveless, 2003; Svärden-Åberg, 2008; Säljö, 2000; 2005). Loveless (2003) states that pupils’ capabilities in developing ideas, as well as exchanging and sharing information with each

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<sup>20</sup> Computer Supported Collaborative Learning

other in interaction, is developed when they are using digital learning resources. According to Alexandersson (2002) they prefer to write texts on the computer cooperatively. Pupils' cooperation and helpfulness increases in the digital interface – overall the classroom's social climate was appraised as improved while the pupils used digital learning resources (Farkell-Bååthe, 2000). Recent research in five Swedish 1:1-schools highlights a new form of collaboration between the pupils that is characterised by spontaneous curiosity. The pupils ask each other questions and give each other hints and tips – they perceive themselves to be a team and schoolwork becomes a collective project where the pupils help each other rather than cheat (Kroksmark, 2011). American research in 1:1-schools also indicates that pupils interact more with the digital interface and that they participate and cooperate more actively in classroom discussion (Russel et al., 2002). This is confirmed by a Swedish research project that studied pupils' programming in a Lego-program. The results show that the digital environment supported interesting forms of social interaction where problem solving became a collective responsibility. In the cooperative interaction, pupils changed their perspectives and engaged in new ways of thinking collaboratively (Lilja & Lindström, 2002). The same phenomenon is discussed in English research where Birmingham et al. (2002) state that pupils interweave their actions and are *super-responsive* to each other's actions in a digital learning environment where they are designing story board frames in a computer program. They co-produce the story boards in every detail. Birmingham et al.'s research suggests that authentic cooperation is thought to occur when pupils are faced with authentic problems. Authenticity is also something that, in research about computer programs and games, is highlighted as a positive feature. This will be discussed, among other things, in the following paragraph.

### Interaction in computer programs/games

A large part of research about children's interactions in digital environments concerns computer games and play-and-learn-programs. Although neither computer games nor play-and-learn-programs are visible in the empirical material analysed in this thesis, interaction within these resources can still be useful in the analysis of the material, primarily because computer game-like educational activities are visible in my empirical material.

To begin with, play-and-learn products are designed for education, but generally not for use within the school setting. These are commercial DVD and CD-rom programs in which young children can learn the basics in, for example, writing, reading and calculation in a fun and imaginative setting. Play-and-learn programs for older pupils are often web-based games, where pupils can develop their relations or languages or where they may, for example, plan and build a community (Myndigheten för skolutveckling, 2007b). Alexandersson's research draws conclusions on interaction characteristics



between pupils when working with play-and-learn-programs. The pupils in the study constructed virtual worlds with maps and models using different strategies. One strategy was to create a holistic structure and another was to create a link structure with different places, linked together linearly. Pupils who were used to playing computer games tended to find it easier to conceptualize structural overviews, but generally the pupils hovered between the two strategies in order to understand the virtual worlds (Alexandersson et al., 2000). This research was undertaken a decade ago, when the digital environment was different, but some results are still interesting today. For example the study emphasizes the risk that pupils' interactions with the digital interface in such games can be reduced to instrumental actions where the focus is on finding the "right" answers to score points rather than to support learning (Alexandersson, et al., 2000). Linderöth's (2004) research shows similar results; pupils' interaction alters between different focuses, for example between the rules and what is possible to do in the game. He has studied pupils' interactions while playing computer games in school and the results show that the pupils are hovering between different frameworks in the digital interface in order to meet the action in the game. In a computer game the digital learning resource can be designed to act, for example, as an opponent, a partner or a teacher. When the digital learning resource is used to search for information in the classroom, its role is not as clear. Research about the role of the digital learning resource in interaction will for that reason be discussed.

### The digital learning resource as a third element in interaction

One of the research questions of this thesis concerns how pupils interact with the digital interface. The question of *if*, and if so is the case, *what* role the digital learning resource plays in interaction is emphasized in my thesis as well as in a lot of earlier research.

Birmingham et al. (2002), claim that the digital learning resource can become a third element in the interaction between pupils. The computer helps to make visible, and to throw into sharp relief, actions and activities that teachers and pupils engage in. The research shows how the digital learning resource facilitates pupils to go through the lesson feeling that interaction was smooth and rather successful. American research by Schofield (1995) indicates that the interactive aspect is a natural part of the digital interface interaction and that the computer invites problem solving and interaction between pupils when trying to navigate between the affordances offered by the technology. Research by Duranti & Goodwin (2000) shows how pupils interact by deictic expressions with each other and with the digital interface, which means that they take for granted that their peers are viewing the same information as they are on the screen. Hanks (1992) studies how the ones interacting share (or sometimes fail to share) a common framework, or a

*common ground* (1992:67ff) in the interface interaction where they share spatial, perceptual and cognitive frameworks with each other. Recent Swedish research shows how preschool children and preschool teachers never face each other in digital interface interactions, but instead are focused on the screen, which works as a visual basis in their interaction (Klerfelt, 2007a). Lantz-Andersson's (2009) research about students' interaction with a mathematics software program indicates that the software serves as a neutral partner – or a patient *response giver* (2009:100), as it does not, unlike a teacher, react no matter how many times the students write incorrect answers. This leads on to research about the interaction between pupils and teachers in the digital learning environment.

### Pupil/teacher interaction

In my thesis pupils' interaction is the central focus, but since they interact a lot with the teacher in the digital learning environment, the interaction between the two, performed in interventions or assessment actions, are also highly relevant. There is a lot of research about this.

Some investigations show that pedagogues' attitudes to digital interface interaction are that an adult supervisor is not so required at the computer. Observations in the learning environment show the contrary: adult interaction is needed at the computer (Klerfelt, 2007b; Lantz-Andersson, 2009). Some research actually suggests that support from the teachers is needed even more (Edman-Stålbrandt, 2009; Enochsson, 2001). Research reveals that adults take the initiative to interact with children in front of the computer as soon as there are technical problems with the computer, but not as long as the pupils are getting on with their work. Teachers do not initiate interactions about what the child is doing in the digital interface (Klerfelt, 2007b). Other research actually shows that the teacher's confirmation of what the pupils are doing in programming software is a very important element for the pupils to feel that the activities are personally meaningful. Pupils can lack motivation and become insecure when they are encouraged to work independently (Lilja & Lindström, 2002). The Internet use of primary school pupils has been studied in a research project and the results show, among other things, that pupils engage with hypertext independently but that they are in need of teacher interventions in information searching. They need to develop practical search skills, and they need help to set goals for their searches. Furthermore, they need help to practice to critically review the information found on the Internet (Enochsson, 2001). This is confirmed by Klerfelt's (2007a) study too.

The relationship between pupils and teachers is defined as more equal in a digital learning environment (Holm Sørensen et al., 2006; Schofield, 1995). Research by McGuire et al. (2004) shows how pupils and teachers interact when they are using mobile phones in school. The results show how teachers

and pupils began to interact more with each other, and that the interaction was more evenly balanced. A lot of research concludes that interaction between teachers and pupils in a digital learning environment takes place in a *digital divide* (Prensky, 2001) since pupils, unlike most teachers, are digital natives. How digital natives interact in the digital interface in a school setting will be discussed below.

### Digital natives' online interactions

In this thesis the notion of the *digital natives* (Prensky, 2001) is central. A lot of recent research worldwide assumes that pupils today interact and learn differently than earlier generations due to the digital technology they are brought up with. Research scrutinises how digital natives interact in the digital interface and some of this research is valuable for the analysis of how pupils in my empirical material interact.

Research by Underwood (2007) shows how digital natives parallel process and multi-task with digital resources that permit a range of sources and a range of modes to be used at the same time. One aspect of pupils' multi-tasking represents how they chat online, while working at their school assignments. Aarsand's thesis (2006) shows how pupils in the seventh grade chat online in MSN<sup>21</sup> in the Social Science classroom, although this is forbidden by the school. The study shows how pupils switched between different activities on the Internet and in the classroom. When the teacher was out of sight for a longer time than usual, the pupils that normally chatted in brief exchanges or by posting questions to pupils at home, suddenly engaged in advanced chatting with each other in the classroom, while working on a paper on travelling in the US. Digital natives also multitask by simultaneously using different languages. Sofkova Hashemi's (2003) research visualises how pupils interact via two different written languages; the formal written language and the digital written language. She means that it can be stimulating for children to master two parallel languages (cf. bilingualism), and that children do not mix the two different linguistic usages. Her results also show how using the two languages is creative.

A lot of what has been presented in this section about digital interface interaction touches upon learning. In the next section the research results that deal primary with pupils' learning will be presented.

### A selection of research focused on pupils' learning

The educational technological field is based on the belief that ICT ultimately will lead to improved learning (Schrum et al., 2005). Educational software is

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<sup>21</sup> MSN stands for Microsoft Net.

often described as having benefits such as flexibility, facilitation, motivation, involvement and increased learning (Lantz-Andersson, 2009), as well as being effective (for example Bebell & O'Dwyer, 2010; Skolverket, 2006b; Jewitt, 2003a; Kozma, 2003). For example, the largest 1:1-project ever<sup>22</sup> reports that student learning has increased *and* improved (Silvernail & Lane, 2004) and lots of research and projects in schools indicate that digital learning resources improve learning. As learning, from my perspective, is a complex matter to study, measure and discuss, I have avoided using publications illustrating the work of more commercial projects that implement a new digital learning resource in a school setting, where after its efficiency is tested and evaluated.

## Learning by different modes

This thesis is based on the idea that pupils learn using other modes than just speech and text hence research that draws similar conclusions is relevant and useful for the analysis of my empirical material. A great quantity of earlier and recent research indicates that new ways of learning emerge when pupils are working with digital learning resources. A major part of the research selected in this thesis highlights a multimodal aspect of learning in the digital learning environment (for example Fast, 2007; Jewitt, 2003a; Lindstrand, 2006). Kroksmark (2011) has interviewed teachers in five Swedish 1:1-schools and the teachers bear witness that knowledge in a digital environment stands out as physical, when pupils for example touch the touch screen, write on the keyboard or take digital photos, as well as in how they are always positioned towards the laptop.

Jewitt (2003a) has studied the work of 7-year-olds in designing computer games and her results show how the multimodal design of the system shaped potentials for construction and required the pupils to engage with specific kinds of imaginative work. The multimodal resources pupils used to design the game helped them to understand mathematical terms such as movement, direction and space, and the characteristics of their learning moved from a matter of interpretation to a matter of design. Comparable results are found in a Swedish research project (Wyndhamn, 2002:112). Material in the form of metaphoric models in computer programs are found here to assist in mediating pupils' mathematical knowledge in the process of transformation of information.

The multimodal possibilities for on -screen display are identified by many researchers as holding potentials for learning. American research about digital resources in History shows how pupils engage in, and learn by means of, interactive multimodal maps in online environments. The research of Vess (2004) suggests that work with interactive maps can enhance levels of par-

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<sup>22</sup> Maine's Middle School Laptop Program.

ticipation and that students demonstrate high analytical skills. But the research also shows that students did not engage in digital self-tests or mini-quizzes after exploring the maps and that they relied significantly more on the texts provided next to the maps than on the maps themselves. Mavers' (2003) research on English primary school pupils' mind maps about computers demonstrates how communication possibilities are expanding in digital technologies as they extend the communicative potential and the spectrum of semiotic resources that is made available in the digital learning environment. Pupils' learning and performance was analysed in relation to an online library of Social Science and Science video clips in a research project in the USA (Boster & Meyer, 2002). The results show that young pupils who were working with the video clip library learned by means of its multimodal displays.

Children's language learning is a core issue in research about learning in a digital learning environment, as the multimodal possibilities are highlighted as holding potentials for learning. Pupils learn to write and read more easily when using digital learning resources (Mathiassen, 2003) and the possibilities of engagement with different modes are by Mathiassen understood to make learning more fun. Tønnessen (2009), who has studied children's use of language programs on the computer (Tønnessen, 2002), found two factors in digital learning environments that support pupils' learning. First of all, a video recorded narrative where pupils could experience what was supposed to be learnt in a meaningful and engaging context. Secondly the instant feedback provided by the digital learning resource supported learning. The multimodal character of the film clips supported pupils' learning by displaying modes in dialogue interplay, such as body language, authentic pronunciation and natural intonation. Fast's (2007) thesis about preschool pupils' practice of literacy illustrates, among other things, how the pupils use computers and computer games at home and that they learn the alphabet and how to read and write by means of their multimodal interaction with the computer. A Dutch research project has studied preschool and primary school pupils' first attempts at reading in Dutch and English. The work with digital learning resources includes different modes such as images and sounds, and was shown to alleviate difficulties in reading, especially in English, since English vocabulary is often spelled differently from the pronunciation (Blok et al., 2002). Computers are often highlighted as affording individualisation, something that will be discussed in the next paragraph.

### Learning adapted to individualistic needs

Since some of the empirical material that is analysed in this thesis is gathered in a class for pupils with special needs, a few words about research on digital learning resources and individualisation needs to be introduced here.

There is a lot of research in this area, and most of it is applicable to all pupils. Papert's (1999) research calls attention to the findings that digital learning resources offer flexibility in education, which allows each pupil to find her or his best strategies to learn. This is one of the reasons for computers being widely used in special education, and why a lot of research in this field concerns pupils with special learning needs in a digital learning environment. On the other hand Lantz-Andersson (2009) shows how digital educational mathematics software totally lacks the ability to adjust feedback to the specific needs of a pupil. Dils (1999) has studied pupils' work with, among other things, politics, and his research suggest that using computers in middle school History or Social Studies classrooms can help diversify teaching and the curriculum, as this is able to address the needs of learners with different learning styles, as they can engage in different activities dependent on how they prefer to learn. The study also suggests that teachers' use of multimodal media, such as PowerPoint presentations, reaches verbal, kinaesthetic and visual learners. Two Danish research projects have studied the role of language games in children's digitally based practices. Holm Sørensen & Meyer (2007) mean that interactivity, cooperation and exploration simulations allow children to perform at their own pace and stage of achievement. Research on assessment in the digital learning environment shows that individual feedback to pupils can be facilitated by the use of mobile phones. The research by McGuire et al. (2004) indicates that formative assessment was facilitated as teachers could, for example, send an individual SMS to a pupil informing her or him about what to develop or to do next to keep on learning.

Yet, other research suggests that it is more complex and difficult to adjust teaching to individual needs in the digital learning environment. According to Jewitt (2003b) pupils do not get enough, nor the best organized, feedback or formative assessment in the digital learning environment. The flow of information is rapidly increased by the combinations of all different modes that are displayed by the digital learning resources pupils engage in. Information is constantly configured by modes and their arrangement on the computer screen and Jewitt's research discusses how teachers struggle to meet pupils' different needs accordingly in the digital learning environment. Pupils, or digital natives, are frequently using their digital skills and sometimes the digital skills are appreciated as learning to the disadvantage of the subject content, something that will be reviewed in the next paragraph.

## Learning as digital skills

The relationship between form and content is an issue in many aspects in this thesis. Form and content is from my perspective understood to be two sides of the same phenomenon, and in this thesis, where Social Science is described as Geography, Religion, Social Studies, History *and* ICT, form and

content are even more strongly linked together. But in the thesis, as well as in earlier research, a division between Social Science knowledge and digital skills emerges; therefore research about this is introduced here.

Earlier research indicates that digital learning resources, such as play-and-learn programs, are mainly used as a bonus for pupils that have finished their ordinary school tasks. The knowledge area the program is designed to train is thus not focused (Roach, 2003). This is confirmed by Swedish research as well. Play-and-learn programs tend to be used with younger pupils and a common resemblance between computer games and play-and-learn programs are that they have narratives built-in in modes, such as animations, images, colours and texts. The programs are often constituted in two aspects: 1) rules; and 2) narrative content. It is seldom obvious to the pupils what knowledge the program is supposed to bring about. According to Alexandersson et al. (2000) pupils may instead engage with the content by just considering the rules, without being able to understand the knowledge that the game is designed to communicate. Research in English classrooms shows how pupils' interaction risks concerning the digital learning resources rather than subject ideas and knowledge, if the teachers didactic design leads pupils' attentions to the consumption of ready-made information rather than active construction of knowledge (Jewitt, 2008a). Swedish research also shows that a consequence of using the computer for writing texts is that the automatic spelling control can draw attention from learning, meaning-making and the creative process, to the formal aspects of text writing (Alexandersson, 2002). A similar aspect is one of the conclusions in Norwegian research (Ludvigsen et al., 2002) about pupils searching for information on the Internet during project work. The research brings out the importance of using digital learning resources to support pedagogic goals in order to make ICT a tool for learning the subject. Otherwise there is a risk that they just practise their digital skills, rather than learning the Social Science content. A similar tendency in earlier research is how pupils focus on finishing the task rather than learning. This will be discussed below.

### Learning as completing the assignment

One of the research questions of this thesis concerns how pupils design their own paths of learning. Significant in earlier research are examples illustrating how pupils focus on the assignment (Holm Sørensen et al., 2006; Wheeler et al., 2002). This is not unique for the digital learning environment, but since learning with digital learning resources is less often assessed by a traditional written test, the assignment might be given a higher importance. This focus has consequences for how pupils design their learning. According to Birmingham et al.'s (2002) research in English schools pupils are focused on completing the digital assignment by being very concerned about when the different constituent activities of tasks should be completed. With such a

focus they are maintaining the business of the lesson by minimising the risk of disruption that a criticism or correction by, for example, the teacher may cause. A lot of research details similar results (for example Lindwall, 2009; Wheeler et al., 2002). When pupils are using digital learning resources in Physics labs, they often chose to go on to the next task instead of going to the discussion about discrepancies in their work displayed on the screen (Lindwall, 2009). Pupils do not get to the bottom of their misunderstandings in the digital learning environment. Lantz-Andersson's (2009) research concerns mistakes in the digital learning environment too. She video-documented and analysed secondary students engaged in solving conceptual problems in Mathematics with computers in classrooms. The results indicate that digital technology does not improve learning linearly, but that the software implies different learning with new possibilities and new problems. The results show how students blame the software instead of realising that they may have made a mistake on their own. They miss opportunities to learn mathematics. In research by Lantz-Andersson et al. (2009) the same research material is studied and the results illustrate how pupils, when they realise that they have given an incorrect mathematical answer, risk working within a framing that has to do with the design of the digital learning resource, instead of the subject area. In such a situation their work does not relate to any form of subject-related discussion. On the other hand, the digital learning resource can facilitate learning by pupils' meta-reflection on inadequacies in their representations and results. This will be further developed below.

### Meta-reflective learning

Meta-reflection is, from my theoretical perspective, an important activity by which pupils' learning can be tracked and understood, especially at the end of a subject area. Much research in digital learning environments exemplifies how the digital learning resource offers possibilities for visualisation of pupils' thoughts in representations via the screen or display. Research by Mills Kelly (2000) showed how students using web-resources for information searching in History, were more likely to meta-reflect on their learning and go back to original sources than when searching for information in books. The results suggest that exploring on the web encourages students' original thinking about historical events. They are more guided to make sophisticated connections between different information sources, events and people than they are by using texts in books. An English research project studied pupils' interactions when mobile phones were used in the classroom. The result shows how pupils reflect on their school work by sharing thoughts and sketches and exchanging feedback with each other and teachers with voice messages, SMS and MMS (McGuire et al., 2004).



Digital films can be a successful medium for meta-reflection. The impact of digital video cameras on preschool pupils' learning has been studied in a research project in the USA. The method of Instant Video Revisiting was used for documentation of pupils' actions. Immediately after the recorded incident the filmed sequences were viewed by pupils and teachers, and discussed in order to develop the pupils' learning. The results show that digital learning resources can help pupils to reflect and solve problems. The filmed sequences supported pupils' meta-reflective thinking, and the method also resulted in teachers reflecting on the pupils' behaviour and for that reason the teachers could better assist pupils in their learning (Hong & Broderick, 2003). Lindstrand's (2006) thesis about aesthetic learning processes demonstrates how teenagers work and communicate by means of making films. The result shows how the teenagers use various modes to contribute with meaning, and that they reflect and make choices along the way, using film-making as way of dealing with their own experiences in their cultural and social contexts. Their films tell something about the social worlds the teenagers work in. Lindstrand's results indicate that there are many potentials for meta-cognitive learning with digital filmmaking in school; 1) teachers can learn more about their pupils and their thoughts; 2) the democratic processes can be strengthened in the classroom; 3) the awareness of the constructed nature of filmed representations can be conducted and 4) pupils can learn in ways other than the traditional ways. The results indicate that schools, by using pupils' own expressions, can design contexts that a majority of pupils can appreciate as meaningful. Another untraditional didactic design, which is at the moment gaining ground, is teaching by means of online games. Learning in computer games will be discussed below.

### Learning/illusions of learning in computer games

Some of the articles in this thesis discuss how a subject area can be designed with similar points of departure as those of online computer games, such as *World of Warcraft* or *The Sims*. To be able to analyse the empirical material with such a didactic approach, earlier research about learning with computer games will be presented here.

Computer games are often described as having profound effects on pupils' behaviours and attitudes; more so than the traditional educational media. This is thought to have pedagogic potentials as well as risks, depending on the game in question. A lot of research on pupils' learning with computer games has been conducted within an international program called the Fifth Dimension (Cole, 2006; Nilsson, 2002). In this program, pupils and students, teachers, researchers and others with an interest in learning play, learn and collaborate in a special digital learning resource lab. The lab is often located at the school but is organized as an after-school program. Research reveals that the Fifth Dimension acts as a powerful, enduring motivator due to the

computer programs offering a balance of intellectually enriching exercises with development enhancing games. Pupils learn by playing these computer games together with a “buddy” – a student that sits next to the child at all times, creating a kind of zone of proximal development (Vygotskij, 1978). Shaffer (2006) means that what computers do is let pupils work with simulations of the world around them. The use of computers affords models that can do some of the work that pupils otherwise would have to do on their own, and the models let them play with reality, which would otherwise be impossible. Shaffer’s research deals with *epistemic computer games* (2006:8) – games that are fundamentally about learning to think in innovative ways. Using epistemic computer games does, according to Shaffer, change education for the better as these use technology to think about learning in ways that are appropriate for the post-industrial global economy and society. Innovation is a key concept also in Serious Games, which contextualize simulations that involve fruitful thinking. Serious Games are computer games with an agenda of educational design that are beginning to attract attention in the educational discourse. Serious Games initially communicate knowledge but also invite learners to participate in creating knowledge (Holm Sørensen & Meyer, 2007). The Danish research project Serious Games in a Global Marketplace develops and studies these games and research shows that the players learn to communicate to attain common goals; an aligned curriculum. Pupils are challenged intellectually and claim to enjoy this kind of learning, but research also shows that these kinds of games must be incorporated in a school context and discussed with teachers and peers in order to be interesting (DPU, 2007). Research with preschool children in the USA shows that advanced computer games can demonstrate how to interact with each other and with the digital interface through choosing different strategies within the game. These games are used in mathematics and reading and they help pupils to focus on the given task and to develop mathematics as well as reading and writing skills (Weiss, 2005).

Linderoth (2002) has in his research studied preschool, primary and secondary school children’s patterns of interaction in front of the computer game, and his thesis shows that computer games do not lead to more realistic experiences. Instead children are focused on what they can do in the game, rather than what the game is designed to simulate. His research discusses how computer games can give an illusion of learning. Someone that is significantly more positive to learning by means of computer games is Gee (2003), who states that video and computer games, even the violent ones, hold learning potential. He highlights the social interaction and creative design processes that many computer games are based on, and points out how the identity work in these games is cognitively demanding; developing pupils’ minds and thoughts. He also brings to the fore the fact that games are very challenging and that children put a lot of time and effort into playing them, and that they do this enthusiastically. Gee has set up a lot of learning

principles<sup>23</sup> about learning in a digital learning environment, prominently with computer games. Most of the principles have been discussed earlier in this chapter.

## Summing up of earlier research and positioning of the present study

This chapter has provided an overview of research about interaction and learning in digital learning environments by going through some recurring characters about pupils' interactions and learning in the extended digital learning environment.

There is a vast quantity of research within this field; a justifiable question is then what this thesis can add that earlier research has not identified. Three concrete research contributions that cover a gap in the presented research field of pupils' learning with digital learning resources have already been discussed in the thesis introduction. These are; 1) the understanding of formal learning with digital learning resources in the specific subject of Social Science; 2) the unique age range that offers the possibility to attain an overall picture of pupils' learning in Social Science with digital learning resources, as most research focuses only on one age group, and 3) the presentation and illustration of a perspective on pupils' learning, essentially developed to conduct and to understand research concerning pupils' learning in a formal digital learning environment: *Designs for learning*. This perspective embraces a view on interaction, meaning-making and learning as multimodal, which renders description, interpretation and analysis of detailed aspects of sign-making activities possible (Kress & van Leeuwen, 2001). The perspective emphasizes communication and action in situated activities. This thesis studies interaction and activities rather than results and a focus is *the transformation process* (Selander, 2009:21) that pupils engage in within the digital environment. The *production* of information and knowledge (design in learning), rather than the *reception* of the same, is studied. This is, as presented in this chapter, a difference compared to most of the earlier research about ICT in education. These and other design-theoretical standpoints will be thoroughly presented in the following chapter.

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<sup>23</sup> In Gee's book *What Video Games Have to Teach Us about Learning and Literacy* (2003), 36 principles are presented and discussed.



## 4. Multimodal and design theoretical perspectives on pupils' interaction, meaning-making and learning

During the last 30-40 years the way to look at school objects or entities of the curriculum in school has been to look at language as speech, or language as writing (Kress et al., 2005). Learning in school is often thought to fall out in language where modes such as speech and writing are central and thought to be the fully articulate means of representation and communication (Jewitt, 2006), whereas other modes such as images and gestures are seen as illustrative supports to language (Kress et al., 2001). Two distinct, but related, changes in schools are the move from the dominance of writing to the dominance of the image; and the move from the dominance of the book to the dominance of the screen (Kress, 2003). According to Kress (2003), the screen can now be understood as the dominant site of texts where young people are communicating. Contemporary media have important effects on communication and learning as there has been a shift from print and book to digital technologies and screen. With a multimodal approach to learning it is obvious that pupils need multiple modes when forming their representations, such as, for example, a film about fears, a sketch about the solar system, or music to represent a certain country. Contemporary digital media offers a lot of modes for pupils to form their representations with. Pupils make signs based on school material using media and modes to form, for example, a slide show, a film, a booklet or a poster to represent their learning. According to Jewitt (2006) non textual modes dominate the screen space. Pupils form their representations in different modes present in the digital interface. They can point at images, record their voices, click on icons on the computer screen, press buttons on the Mp3 player, and move the digital video camera to be able to film from another angle. In this process, the pupils are forming their representations.

One purpose of this study is to, from a multimodal design theoretical perspective, describe and analyse how pupils interact, make meaning and design their learning while deploying digital learning resources in the Social Science classroom. Pupils' interaction with each other, with the teacher, and with digital learning resources is the research topic of this study. Multimodal methods are used in order to gather empirical material and to analyse pupils'

interactions. The data is interpreted from a multimodal design theoretical perspective on learning.

This chapter will present the theoretical framework. The theoretical perspective from which I look at my research topic will be introduced, and the concepts and notions that will be used for the analysis of pupils' and teachers' interactions in this thesis will be presented. The chapter opens with a presentation of underlying assumptions about interaction and learning. My intentions were to make a theoretical map to explain the theoretical framework within which I make these assumptions. The theoretical concepts that I use in this thesis are introduced and discussed here, but how they are used as tools will be further developed in the subsequent chapter.

## Underlying assumptions of interaction and learning

According to Jewitt (2008b), multimodality is to some extent an eclectic approach, something that is salient in this thesis. The theoretical field within which this thesis is written is made up of different, yet compatible or like-minded theories, which have in common that they view learning as social; as something that occurs in the interaction between people (Säljö, 2005; Vygotskij, 1978; Wertsch, 1998). Communication is thought to be dependent on the social context (Lave & Wenger, 1994; Vygotskij, 1978; Wertsch, 1998). A dialogistic perspective on communication (Bachtin, 1986) is highlighted in this thesis. This means that at least two voices, or participants, are included in each utterance, and that all utterances are always related to other, earlier utterances. Utterances are reused in interaction and meaning-making and learning occurs *between* individuals. People's actions are thought to be mediated by intellectual and physical resources that facilitate communication (Säljö 2000; Wertsch, 1998). These mediation tools change the activity in which they are being used as well as how people communicate and think (Säljö, 2000). Within this theoretical framework the social aspects of language are central<sup>24</sup> and so is Social Semiotics, where a fundamental assumption is that people communicate with each other with different signs (Halliday, 1978; Kress & van Leeuwen, 2001; van Leeuwen, 2005). Social semiotics deals with meaning-making in all its appearances, in all social occasions and in varied cultural sites (Kress, 2010). Communication is from this perspective seen as being built up of signs. The appearance and form of a single sign cannot tell the whole story (Kress et al., 2005). Instead multimodality means that communication occurs in different modes, simultaneously. Kress describes multimodality as *the normal state of human communication*. (Kress, 2010:1) and the expanded notion of text (cf. Kress, 2003) is used.

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<sup>24</sup> Also in sociolinguistics (Halliday, 2004; Bernstein, 1971) and in critical discourse analysis (Fairclough, 1999), the social aspect of language is brought to the fore.

Communication is thus viewed here as multimodal, which means that it consists of several modes to communicate different meanings in parallel. Multimodality can be described as the use of several semiotic modes in the design of a semiotic product (Kress & van Leeuwen, 2001). Oral and written language has often been viewed as being superior, more exact as neutral depictions of reality (Kempe & West, 2010). In line with “the linguistic turn” (Rorty, 1991) language is viewed here as a social construction; language is historically formed. As a result, communication is viewed here as important for forming and transforming people’s perceptions and thinking.

In this theoretical framework learning is not regarded as transmission of information between people. Learning is, as brought to the fore by for example Säljö (2005) a creative activity, rather than an abstract process inside the learner’s head. Mediation (Säljö, 2000; 2005) describes an interesting phenomenon, but since focus is laid on the creating process, the notions of transforming, forming and design are used in this thesis instead. The focus in this thesis is not on reception, but on production, with a special interest in design in learning or composition, as described by, for example, Latour (2005) and Kress (2010).

Learning is understood as dependent on meaning-making. Meaning is thought to be made by the individual, although acting in a social environment and using available resources (Kress, et al., 2005). Learning is understood as a social process whereby knowledge is constructed. Theories of importance for this thesis have in common that they regard learning as occurring in social communication. This perspective on learning is used in this study, as it focuses the relationship between the learner and the context. Learning is understood as situated (Lave & Wenger, 1994; Säljö, 2000; 2005) and occurs by means of social activities where cultural conditions are of significance – learning is understood as occurring in communication and sign-making activities (Selander & Kress, 2010) and the learner’s communication and activities are thought to be integrated in different social contexts (van Leeuwen, 2005). The institutional settings, by offering different resources, frame what is possible to recognise as learning (Selander & Kress, 2010), and the resources the teacher or the pupils choose to use, or are given to use, are significant for teaching and learning (Jewitt, 2008b). A more precise definition of learning is given under the headline “The transformation process”.

### Learning in an institutional setting

Here, the institution of school is understood as a formal learning setting. Formal in this sense does not mean a traditional way to teach; instead it is used to indicate that the setting is designed for learning. Schooling has specific organizing principles that have been developed over time. These can be pronounced norms written in for example the Education Act, curriculum

objectives or the “rules of order” of the individual class. Interpretations of the history of the school and people that constitute the school in the educational discourse, such as policy makers, politicians and head teachers, also contribute to exercise power (Foucault, 1982) by more or less unspoken norms, such as where the pupils and the teachers are supposed to sit, how to address one another, what to wear and so on. The learner is understood by considering the environment she or he encounters (Nordin-Hultman, 2004) and norms regulate pupils’ actions in telling them how it is possible to create meaning and learn in school. Of course pupils have the possibility to question the norms, break the expectations and design their own *paths of learning* (Selander & Rostvall, 2008:25; Selander, 2008a:37). Communication in a formal learning setting can be viewed as different from communication in less formal settings. To mention an example, teachers in school often ask questions they know the answer to and pupils are always aware that everything they do will be compared to school norms or course objectives. Such framing aspects influence what kinds of meanings are being offered and who gets the preferential right to interpretation priorities (Selander, 2008a).

### Learning in an extended digital environment

A medium, such as the computer is, in this thesis is understood as a means for dissemination in which different modes, such as text, images, sound and colours can be used. Digital learning resources can be described as mediating tools (Säljö, 2000) and cultural resources that follow and foster social change while being shaped by them (Kress, 2010). Digital learning resources facilitate a multiplicity of modes such as film, image and sound. They make a lot of information sources of text, sound and image accessible and they offer tools to work on existing and/or design new representations. Information in digital learning resources has a rhizomatic structure – branches that are intertwined with different possible reading paths (Selander, 2009). A *rhizome* has no beginning or end (Dahlberg & Bloch, 2006:3; Deleuze & Guattari, 1999:25), just like the Internet, and the phenomena of hypertexts contribute to the rhizomatic structure by facilitating links between texts, permitting the learner to enter into an entirely new relation with an infinite number of other information sources on the Internet (Kress, 2003), only by clicking on a small symbol.

Communication and learning with digital learning resources are here referred to as *digital interface interaction*. The interface is understood as the link between the users working by the computer and the computer’s software or hardware. In the digital interface, a person can make an *input* such as pressing keys on the keyboard or by inserting digital photos via a USB port. The computer can present information by making an *output* such as an image on the screen or a beep sound as a result of the person’s input. People do not only interact with the digital learning resource in the physical digital inter-



face, they also interact with peers, online-contacts and teachers as well. In this thesis the digital interface is for that reason extended to include everything in and around the digital interface of importance for pupils' interactions and learning.

## Background to a design theoretical perspective on learning

Social semiotic multimodal concepts are used to understand and analyse pupils' interface interactions. To be able to understand what goes on in the social interaction between the pupils on a deeper level as well, answers are searched for by exploring and testing concepts and thoughts from other theories. According to Jewitt (2008b) a variety of disciplines and approaches can be used to explore the multimodal landscape. New environments carry new problems and so new theories can be developed to solve upcoming problems (Kress, 2010). Digitalized learning cannot build on theories about learning that are founded in analogue environments (Kroksmark, 2011). Kress and other multimodal theoreticians are at the moment engaged in introducing a social semiotic theory of multimodality (Kress, 2010:5). This perspective has many features and thoughts in common with a design theoretical perspective on learning – or *Designs for Learning* – that is being developed in the research group of *DidaktikDesign* headed by Staffan Selander at Stockholm University. There are many design theories that present different approaches to how people design their environment. *Designs for Learning* is a perspective that focuses on the *transformation process* with concepts that can facilitate analysis of learning in different degrees of formal context such as education. *Designs for Learning* offers tools for studying pupils in the Social Science classroom and it is used in this thesis to understand and to try to explain, for example, how pupils learn and how they negotiate their identities in the digital interface. The design theoretical perspective on learning has developed through two significant aspects:

To begin with, the design theoretical perspective on learning has been developed to meet and embrace the changes in society as the conditions for learning change with the changes of society. In order to meet the demands of a post-modern society, it is no longer obvious how learning in the Swedish school shall be organized. Guidelines or school norms do not tell teachers about what specific teaching material to use, how a classroom shall be furnished, how computers shall be used or how large the groups or classes shall be. Head teachers, teachers and other school personnel are supposed to make these choices themselves; as a result they are active in forming the school of today (Selander, 2009).

The other aspect is that pupils are also active in forming the school. Pupils are supposed to take a larger responsibility for their own school work. According to the Swedish Education Act<sup>25</sup> the school is supposed to promote pupils development into “...*responsible human beings and members of the community*.” (Skolverket, 1985) and in the Swedish curriculum a special section deals with the: “*Responsibility and influence of pupils*.” (Skolverket, 2006a). Pupils already in preschool class, at the age of six, are made aware of their own capabilities and needs through *individual development plans*<sup>26</sup> (Myndigheten för skolutveckling, 2009) and written opinions/assessments on their knowledge and learning. These are some of the reasons for pupils acting from a different agency in the school today, where *agency* (Kress et al., 2001) here refers to the pupil’s participation and space of action (Selander & Kress, 2010:99) and their role in meaning-making (Jewitt & Kress, 2003). Pupils actively orient themselves by means of accessible resources, which influences communication as well as what parts of the subject stand out as interesting to engage in. They form their own *learning paths* (Selander, 2009:24).

The perspective Designs for Learning is built to meet these new conditions. It provides with a set of conceptions that makes it possible to describe, analyse and understand pupils’ interactions and meaning-making, as visualized in action. The perspective elaborates the understanding of learning on the basis of peoples’ meaning-making activities within different institutional framings (Selander, 2009), and it elaborates how people, on the basis of choices of modes and media, transform and form their own knowledge (Selander, 2008a). This perspective offers a possibility to understand the ongoing and multimodal interface interaction in the empirical material that is analysed in this thesis. This design theoretical perspective on learning has, in fact, developed during the same time period as this thesis. The first didactic design thoughts sprung from discussions that arose in the research project “Digital learning resources and learning design sequences – a user’s perspective”, which my research material is part of, and these concepts have since transformed along with this study.

## Design

According to Kress (2010), design is at issue in the shaping of all environments of communication and therefore also for social relations and interaction in the digital school setting. In the empirical phase of this study, I noticed that the school is constantly being interpreted and transferred to the

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<sup>25</sup> There is a new Swedish Education Act (2010:800), as from July 1, 2011.

<sup>26</sup> IUP (individuella utvecklingsplaner).

municipal/school/subject/class/pupil special prerequisites<sup>27</sup>. As a consequence the school is designed by, for example, teachers and pupils. Ideally the design is prospective (Kress, 2010), as it responds to demands in the school setting that are constantly new.

From a design theoretical perspective there are three understandings of the design concept (Selander & Rostvall, 2008:21). The first understanding embraces the learners' design of her or his learning. The second understanding focuses on the framing of the learning, including for example the producer of the digital learning resource and the teacher. The third understanding of design refers to an approach to the analysis of learning processes in certain conditions. The third understanding has relevance for methodological issues and will be discussed in the subsequent methodological part of this thesis, whereas the first two will be discussed below.

Selander & Kress (2010) discuss two aspects of design: *Design in learning* and *Design for learning*. These two will be presented here.

## Design in learning

One understanding of design is referred to as the pupils' *paths of learning* (Selander, 2008a; Selander, 2009) and answers to how pupils create their own learning in relation to the conditions of the learning situation. Selander & Kress (2010:97ff) describe this as *Design in learning* and highlight the learners' transforming and forming processes. This is viewed as the primary aspect of design in this thesis. At the beginning of the pupil's path of learning the setting has more or less articulated objectives (*such as that the pupils are asked to make a film about their day at the preschool*). Design, in this aspect, starts with the pupil's imagining of the formation (*such as that they want to show their parents the things they like to do in the preschool room*); an acknowledgement of the resources at hand that may be used to perform the formation (*a digital camera and a stationary computer for example*); an understanding of the object that is to be worked on (*such as digital photos and how they can be transferred to the computer and then manipulated*); an understanding of the school settings social conditions (*such as knowing what is acceptable to document with a digital camera and what is not*); and knowledge of the pupils own capacities (*such as knowing how to use the camera and the image program*) (cf. Kress, 2010:136).

Pupils' learning is understood as a trajectory of sign-making, designing activities within a framing. They learn multimodally, for example by saying a word at the same time as pointing with a finger to notice details in an image displayed on a computer screen, or by finishing a spoken sentence with a sound, a gesture or by clicking a button on a digital camera. Digital informa-

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<sup>27</sup> This is explained in Kjällander & Selander (2009), the 4<sup>th</sup> article in this thesis.

tion sources have brought along a power shift from the text and the producer to the reader<sup>28</sup>. A traditional text in a text book implies a fixed reading path. Web pages, on the other hand, imply an open reading path where the pupil chooses what and how to engage in, and how to navigate between the images, texts, links, icons, symbols and animations presented. Digital learning resources are hence more open to different use (Kress, 2003).

## Design for learning

The second aspect of design has to do with the conditions for learning, bringing to the fore the question about how modes and media are arranged for learning. Here design has to do with the framing of the interaction that goes on in the digital school setting and includes the producer of the digital learning resource or the web page. This kind of understanding of design is described as *Design for learning* by Selander & Kress (2010:67ff) and highlights the three concepts: *framing*, *forms for representation* and *knowledge practices*.

This study is interested in how the users (teachers and pupils) design modes and media for learning by means of digital learning resources in a situated education act. *Orchestration* is a notion that can be used in this thesis to describe the process of how the teacher – according to her or his interest – selects and assembles the material which is given a shape through the process of design (Kress, 2010:162) and which can be viewed as a matter of choices in relation to a specific setting or context (Kress & van Leeuwen, 2001). The teacher is thus a didactic designer (Holm Sørensen, et al., 2010; Selander, 2008a). The teacher's interest in, and assessment of, the pupil's learning establishes interaction in the classroom setting as the pupil interprets the teacher's interest as something to take action on, which leads her or him into a process of meaning-making. She or he begins transforming and forming information. I view design in this perspective as prospective in that the teacher does not only implement conventionally given practices, but also interprets governmental documents and creates opportunities for pupils' meaning-making and learning (Kress, 2010). Didactic design starts in the classroom with the teacher's imagining of the task; knowledge of both the resources available to perform the task and knowledge of the pupils and their capacities. This aspect of design enables me to point out and understand how teaching and learning activities are outlined and how the teacher organizes learning, by means of, for example, the resources that are being offered, how the subject matter is negotiated and how pupils' learning is embraced and assessed. As pupils' interaction, meaning-making and learning is my re-

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<sup>28</sup> This is aligned in the thesis' focus on pupils' representation instead of reception.

search topic this aspect of design is mainly analyzed in the empirical material representing teacher's interventions and assessment actions.

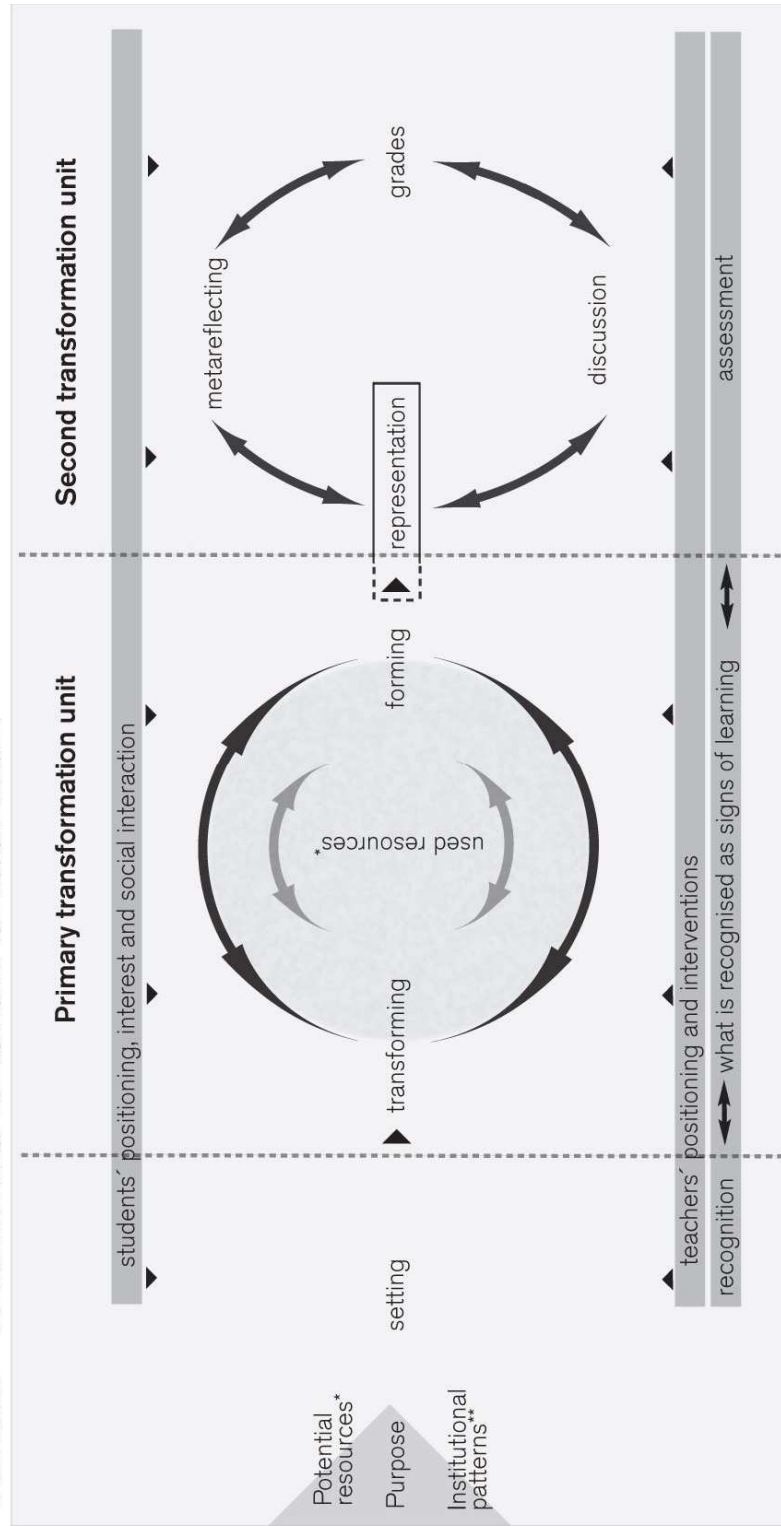
## The design process

To sum up, the concept of design is referred to as the transformation process where pupils and teachers act as didactic designers in interaction with each other and different resources. This is made during a thematic sequence where pupils and teachers choose between sets of semiotic resources when bringing modes and media together in order to represent their understanding of something, or to direct focus and attention at something. The pupils represent their understanding in physical products, such as films and texts, but also in, for example, utterances, gestures and negotiation of identities. The process involves several strategic options made by the teacher and the pupil in order to, in different modes, lead the participants' focus of attention in a specific direction that is intended to satisfy her or his interest (Kempe & West, 2010; Selander & Rostvall, 2008). From this perspective representation is highlighted instead of reception, something that has been rather uncommon in research on digital learning environments. In order to visualise this approach a model, which will be presented next, has been designed.

## Learning Design Sequence – LDS

Along with the development of the design theoretical perspective on learning, a representation to visualise it has been developed within the research group of DidaktikDesign. The representation is a model called a Learning Design Sequence – LDS.

## Formal - LEARNING DESIGN SEQUENCE



\* Modes, media, (raw-) material and tools

\*\* Norms, routines, rules and sanctions

The rest of this theoretical chapter describes and discusses concepts from the LDS model, since these are central to how the empirical material of this thesis has been gathered, analysed and understood. A few things need to be said about the Learning Design Sequence model beforehand.

The model serves as a framework for the empirical material, providing an image of how learning in school can be organized. The model suggests that there are outlines for learning in the setting but it does not say what these outlines are. A LDS represents a sequence of learning following from the teacher's introduction of the subject area all the way to the evaluation and assessment of the same area. A Learning Design Sequence in school can consist of everything from a few hours to several weeks. To name one example, one of the LDSs studied in this thesis consists of two occasions where three preschool children are designing their own digital film about their preschool day. They document their preschool's environment by means of a digital camera, they make a digital film out of the photos and they add speech to it. In another LDS, pupils in year seven use more than ten weeks to make a film about their own fears. They search for information on the Internet, write manuscripts, interview municipal staff and they act out different roles in front of the video camera. Although they are very different to each other, these two LDSs embrace the same kind of learning activities, such as transforming and forming, teacher's interventions, representations and assessment. These learning activities can, by means of the model, be studied, explained, discussed and analysed. This reveals that the LDS-model is used for analysis of empirical material. How this is possible will be discussed in the methods part of the thesis.

## Modes

Social semiotics deals with signs as means for meaning-making in communication and representation. A *sign* is when a semiotic resource is used for communicative purposes (van Leeuwen, 2005:285), such as nodding one's head to show approval or making a tick on a to-do-list to indicate that something has been done. Sign making is seen as a social activity, where people are motivated to use signs to combine content and form to carry meaning. Sign-making both expresses and sets conditions for meaning-making (Kempe & West, 2010). From this perspective, meaning-making comes about in a transformation process (Selander, 2009) when signs are brought together to form meaningful entities. This transformation is made in relation to the sign-maker's motives and interests. A sign can be seen as the conjunction between form and meaning (Kress, 2010) in a certain context or situation. Signs can be explained as follows:

”In a sign something to be meant is brought together with a form which can mean it; that is, which can carry and express that meaning.” (Kress, 2010:108).

A sign can be regarded as motivated when form and content are combined (Kress, 2003; 2010) or when it is apparent why a special sign is used to express some kind of *meaning* (van Leeuwen, 2005:281, 285). Signs can be articulated inwardly, as when a pupil is interpreting and trying to understand the meaning of a diagram found on the Internet, or outwardly, as when the pupil writes a text based on the numbers in the diagram (cf. examples in Kress, 2003:37). Sometimes this process is referred to as if the pupil creates meaning in two rounds; *inwardly* and *outwardly* (Kress, 2010:108). This thesis only concerns signs made outwardly. Signs are thought to be organized in different modes. The notion of mode can be explained as a means for making representations:

“Mode is a socially shaped and culturally given semiotic resource for making meaning.” (Kress, 2010:79).

From a social semiotic perspective, modes are described as resources that have been historically, culturally and socially formed and organized for communication (Kress, 2003). They have been developed as sets of resources for making signs (Jewitt, 2006). As represented by the LDS model, the setting is crucial for understanding pupils’ interactions and meaning-making in this study. As modes are the results of a historical and social shaping of materials chosen for representation (Kress, 2003), the mode of, for example, reaching one’s hand up in the air means something very specific in a school setting. The same mode can also mean different things depending on in what transformation unit the mode is made. Raising a hand in the primary transformation unit is most likely made to get help, whereas in the secondary transformation unit the same thing might be a call to get approval for a representation or to pass a comment on a peer’s representation. Modes that are almost always present in the interaction between pupils in the classroom setting are for example gestures, texts, facial expressions, sounds and speech.

As pupils are using digital learning resources in this study, a wide repertoire of representational and communicative modes are made available (Jewitt, 2006) such as colours, letters, images, music, notes, words, layout, music and sound effects (Kress, 2003; Lindstrand, 2006; Selander, 2008b). Different modes offer quite different potentials for meaning-making. In the mode of writing signs, bold letters, exclamation signs and coloured letters can be used to create meaning, whereas intonation, pauses and volume can be used to create meaning in the mode of speech (Kress, 2010). Modes on the computer screen can be designed to draw attention to different layers of



meaning and different modes can mean different things. To mention one example, images are often used to highlight patterns, colours to direct attention and sounds to give warnings or create a specific atmosphere (Jewitt, 2006).

Different modes hold different possibilities for communication of meaning (Kress & van Leeuwen, 2001; Selander & Rostvall, 2008). Here modes are viewed as being equally important for meaning-making and learning, but they are not equally important all the time (Kress, 2003). Instead they complete each other in situations which are for that reason considered multimodal. Modes contribute to making meaning in different ways in *multimodal ensembles* (Kress, 2010:93). Kress means that modes have different “takes” on the world and this makes ontological and epistemological issues present (Kress, 2010). I understand this to mean that a mode, such as image, has a distinctive take on the world other than, for example, the mode of writing. The mode of image presents all its elements simultaneously by the logic of space and is not organized according to the logic of time. Hence, a pupil is less likely to present an image in a chronological style than, for example, if she or he would write a narrative. I understand the relation between mode and meaning as lying in how different modes are simultaneously arranged in multimodal ensembles (Kress, 2010). Therefore I see studying modes as a key to understanding meaning-making and learning.

## Affordances

From a design theoretical perspective learning is studied as a series of sign-making activities where semiotic resources are used for representation of understanding and knowledge. These sign-making activities are present during the whole LDS. Different semiotic resources offer different possibilities for meaning-making and there are always choices to make in an activity. There is not just one meaning but many possible meanings. The analysis focus from this perspective is on the potentials and limitations each mode has for communication. A notion that embraces this reasoning is “affordance” (Kress, 2009; Kress & van Leeuwen, 1996; Selander & Kress, 2010), which Selander & Svärde-Åberg, define as;

“The semiotic potential/limitation for representation that is to be found in a mode.” (Selander & Svärde-Åberg, 2009:250, my translation.)

According to Gibson (1979), an affordance is a quality of an object, or a physical environment, that allows people to take action. Affordances are understood here as the potential uses of a resource; different modes offer different potentials and impose different limitations for meaning-making.

These can be both material and social possibilities and influence how pupils make meaning (Kress, 2010). Modes, such as speech and writing, are convenient to use to name things, whereas the mode of image is more often used to illustrate. A mode such as gesture can be used to enact things, whereas a mode such as screen layout is often used to orient pupils in the digital interface (Kress, 2010). A mode's affordances can be understood as inherent in the mode or object (c.f. the way informatics uses the term affordance where it is seen more as a technical function), but I understand affordances as being culturally and socially constructed over time, at all times dependent on the social situation and the participators.

Affordances can be described as *meaning potentials* (van Leeuwen, 2005:5) that have been designed into an object, but the term affordance can also embrace meanings that have not yet been recognized (van Leeuwen, 2005). Different pupils recognize and comprehend different affordances, which they explore and make use of. What the pupils recognise as an affordance in a specific mode depends on the pupils' needs, interests and the specific situation at hand (van Leeuwen, 2005). Here I view interest as being a question of what the pupils choose to focus on. It can be driven by pleasure, but it can just as well be that they are interested in following the teacher's instructions. Things like purpose and institutional patterns, represented in the LDS model as a framework for the transformation units, are thus carefully considered in this thesis.

## Prompts

Modes offered by the digital learning resource may involve hardware as well as software affordances (Kress, 2010). Affordances, for example, can be highlighted icons on the screen or symbols on the buttons of a digital camera. Affordances can also be red underlining in a text on the computer screen, indicating incorrectly spelled words. Images and animations in Clip Art and layout suggestions in Word Art are other designed affordances in the software's modes. This leads on to the notion of the prompt:

“At all times communication is a response to a “prompt”...”  
(Kress, 2010: 32).

A prompt can be seen as an invitation to interaction. I understand the crucial difference between an affordance and a prompt to be that people are encouraged to answer back or respond to the prompt. Communication is the issue and a prompt directs someone's attention to something. A potential prompt can be when one pupil makes a suggestion to another or the prompt could be a teacher intervention, where the teacher points at something on the screen. As perception is selective as well as being culturally and socially condi-

tioned (Selander & Kress, 2010), a prompt is not turned into a prompt until the learner interprets the gaze, the comment or the change of body position in the specific situation as a trigger to some sort of action (Kress, 2010). Power plays a decisive role when communication is framed by the setting of an institution, such as a school, and one can assume that pupils are likely to appreciate and respond to teacher's prompts. The pupil's action, in many educational situations, is to follow the teacher's request.

Digital learning resources almost demand interactivity by giving prompts. Pupils are encouraged to "write back" to the producers of the information sources used in education such as, for example, blogs, YouTube, Facebook and Wikipedia. As the criterion of a prompt is not that it is meant to be a prompt but that it becomes a prompt when the learner notices it as a prompt, I assume that a digital learning resource can offer potential prompts. These prompts can have a didactic function in the learning situation. *Salience* (van Leeuwen, 2005:284) is in this context a notion that can help to explain the phenomenon of how something in a representation is perceived as a prompt:

"It creates difference between the elements of a composition in terms of the degree to which they attract the viewer's attention."

If a pupil is viewing a website where a colourful animation suddenly pops up on the screen, this animation can be considered as salient – as important and prominent in the website composition – to the pupil. Movement, size, colour contrast or specific cultural factors, such as the appearance of a human figure can matter to how salient a sign is (van Leeuwen, 2005). The pupil can make meaning from the animation – *a second move in a unit of dialogue* (van Leeuwen, 2005:283) such as laughing at the animation or clicking at it with the mouse. Prompts and salience are decisive for a pupil's interaction, meaning-making and learning

## Transformation process

Learning is in this study understood as a social sign-making activity. Learning is the result of a person's transformative engagement with something that she or he notices that leads to a transformation of the person's semiotic or conceptual resources (Kress, 2010). Selander (2009:25) describes learning as:

"...an increased ability to engage in a social domain in a meaningful way."

More specifically, learning can be defined as an increased ability to use and elaborate an established set of signs within a certain domain in a meaningful way (Selander, 2009). In the digital school setting, learning can sometimes be confused with plucking information from the environment (Kress, 2010), but this thesis understands learning as a lot more than just being able to present some facts about something. Knowledge in this thesis can be described as the ability to engage in a subject interface interaction in the school setting in a meaningful way (Selander, 2009).

Pupils learn about the world and design their own learning paths in the *transformation process* (Selander, 2009:21). The transformation process is perhaps the most crucial concept in the design theoretical perspective on learning and it has a central position in the LDS model. As seen in the primary transformation unit of the LDS, pupils choose between different modes, media, material and tools to create a meaning-making process whereby they transform existing representations of the world and form representations on their own (Selander, 2008a). The communicational conditions for a situation where pupils transform and form, i.e. design their learning is interesting to investigate from a design theoretical perspective to be able to understand how these conditions influence meaning-making and learning.

The pupil's interest focuses her or his attention on what becomes the aim of the situation, which I, for that reason, understand as a *curricular prompt* (Kress, 2010:174) in the specific LDS. The pupil chooses, for example, if an image on the screen, a sound or a question posed by the teacher is turned into a prompt, which the pupil then chooses whether and how to engage with. The pupil transforms different semiotic resources available in the situation and gives form to her or his own understanding by means of them (Kress, 2003; Selander, 2009). From this perspective, pupils are viewed as active (even if just listening or watching); acting as producers rather than consumers. Interest becomes what the pupil chooses to engage in. Here interaction in the extended digital interface is understood as selection-driven, reminiscent of navigation (Kress, 2010) and yet again power plays a decisive role, which means that the pupil's interest in many situations is to please the teacher in order to be assessed well.

The transformation process in the primary transformation unit of the LDS involves changes. Not only is the material that is being worked on changed into something new, the resources or tools that are being used are changed as well. The pupil too is changed by her or his experiences. Each of these changes produces meaning and is described by Kress as the:

...“attention to an aspect of the social world; engagement with it in transformative action; which constantly remakes my inner resources; and in that, changes my potential for future action in and on the world.” (Kress, 2010:14).

Pupil's change is here understood by the notion of *transformation* which is explained as:

“...changing a representation by redesigning it by means of different modes.” (Selander & Svärde-Åberg, 2009:257, my translation.).

The pupil's meaning-making changes through the re-ordering of the elements in a text or an image, for example, as the pupil is engaging with it. A pupil can choose to read and take notes on some parts of a text and while doing so she or he changes the ordering in the arrangement forming the text into her or his own. *Transformation* as such is done within the same mode (Kress, 2010:129). How independently the transformation is depends, among other things, on the institutional framing and the teacher's interventions as represented in the LDS model. When pupils engage with the multimodal information they change it – sometimes more so, sometimes less so. A text copied from the Internet can be altered by pupils in Word. Pupils can redesign a digital photo in Photoshop or record a sound effect based on something in a film. Transformation can be understood from the point of view of individual interest (Kress, 2010), since the pupils choose what material to engage with. Multimodal texts, as presented on the Internet, offer different “filters” for understanding. These texts offer new potentials for engagement with the information as pupils can enter this freely, designing their own learning path while transforming the text, picture or other piece of information. Pupils use existing material to make a sign and in this process the material is transformed to fit the new context. As an example, a text from Wikipedia on the Internet can be changed while a pupil engages with it. Hypertext itself suggests that pupils reconstruct the text while reading it (Jewitt, 2006).

In different ways, pupils can design their knowledge in the same mode – this, as discussed earlier, is called transformation. But as contemporary media used by pupils in this study makes a wide repertoire of representational and communicative modes available (Jewitt, 2006), pupils can also choose to make use of another mode to make meaning – this is called *transduction* (Kress, 2010:188). Information is presented to pupils in different colours, images, movements, texts and sound effects. Different modes at the computer screen, for example, can be equivalent, complementary or even contradictory, which results in pupils transforming this information to be able to make their own meaning (Jewitt, 2006) and transducing the information into a different mode. Transduction occurs for example when a pupil draws a picture out of a story he or she has been told or makes a film based on a written conversation on Facebook. Transduction is a thorough, yet common and constant process in meaning-making, where meaning is dragged across from

one mode to another, meaning that the logic is changed (Kress, 2010). Transforming, transduction and forming are woven together in the transformation process in the primary and secondary transformation unit of the LDS.

Representation is part of communication and interaction. It is a meaning-making social activity where the pupil somehow designs her or his understanding of a subject, but it only shows a subset of how pupils understand the subject. The subset has been selected by means of the pupil's own interest in the specific situation. The meaning the pupil expresses with a representation is only a subset of the original image, event or phenomena represented (Kress & van Leeuwen, 2001). Representations show how pupils relate to the subject and what they think is worthwhile to communicate. To choose a form is also to choose content, and the pupil is showing *what* he/she understands by showing *how* he/she understands it (Selander, 2009:27). A representation occurs in the space between what the pupil already understands and the material that is being worked on. The representation tells us how this experience is interpreted, what is thought to be interesting and relevant and what aspects are considered to be focal (Selander, 2009). Learning can be visualized in pupils' representations, such as in their way of speaking, their actions and choices, images, texts, PowerPoint-presentations, films and their negotiation of identities. This kind of representation occurs throughout the whole of the LDS, although in the secondary transformation unit pupils are more focused on some kind of a physical representation or product, such as a text, a PowerPoint or a film.

## Assessment of signs of learning

Pupils' learning can be seen in representations and these representations are always somehow assessed – teaching and learning cannot be separated from assessment (Lundahl, 2009). Communication in a school setting has different inherent aspects of exercise control, as visualized in the LDS model where recognition and assessment frames the transformation process. Power is expressed in different modes in the digital interface interaction, both between pupils and between pupils and teachers in, for example, teacher interventions. The teacher can exercise power in assessment actions by modes such as being silent when looking at a representation, by frowning before answering a question or by asking a rhetorical question in class.

In the setting of the LDS the teacher sets up conditions for the pupils' learning and influences them to focus on certain things by giving them prompts that they choose, or choose not, to respond to. Such didactic processes include a framing that in this study means that pupils make (and are supposed to make) meaning in the specified knowledge domain of Social Science. Meaning-making occurs all the time, but what is recognized as learning in the setting is not independent from the processes of assessment

(Selander, 2009). This will also be revealed in this thesis. Pupils' meaning-making can, but does not have to, be in line with the curriculum or the meaning-making their teacher intends and is striving for. This is embraced by the notion of *purpose* in the LDS model.

What the pupil does in school is assessed by a teacher in the *teacher's interventions* – where the teacher for example comments on the pupil's work – or by grades. Learning is related to what the pupil presents in different semi-otic systems, such as their own photos or drawings, oral expressions, sighs and body movements. From a design theoretical perspective the assessment of learning can be described as:

“understanding signs of learning, as shown by different communicative modes” (Björklund Boistrup & Selander, 2009:2).

Assessment actions can be understood as being formative and summative – although there is no need to polarize them (Newton, 2007). Instead formative assessment can have summative aspects and vice versa. Formative assessment is here understood as frequent, interactive interventions of pupils' signs of learning while the pupils are transforming and forming their representations, primarily during the primary transformation unit of the LDS. The teacher assesses small units of representation of the not yet finished product to identify the pupils' learning needs and support their learning (Black & Wiliam, 1998; Selander & Svärde-Åberg, 2009). When pupils are forming their representations this is a matter of deliberate design (cf. Kress et al., 2001). A recent thesis (Björklund Boistrup, 2010:166-169) with in part a design theoretical perspective concludes with four discourses on classroom assessment, based on work by Foucault (2002). Some of the reasoning of these discourses can also be valid for assessment in a Social Science classroom in a digital learning environment. The first discourse is called *Do it quick and do it right*. Assessment actions here are characterized by feedback from the teacher to the pupil. Questions are closed; there are no follow-up-questions, guidance or challenging. The focus is on the task. Teachers and pupils interact by short utterances about what to *do* next, rather than what to *learn* next. The second discourse is called *Anything goes*. Assessment actions are characterised by feedback where the assessment focus is on the task, rather than on the process. Feedback is mainly from the teacher to the pupil, but the pupil is encouraged to contribute to the discussion. The teacher is active in the assessment action, but can also take on a passive role, leaving indifferences in the pupils' representations unchallenged. The third discourse is called *Anything can be up for a discussion*. Here the focus is on the process and teachers and pupils interact in both directions with the teacher's questions often being open. The last discourse is called *Reasoning takes time*. As the name suggest, pupils and teachers are active in the act of assessment for longer periods of time. Pupils are encouraged towards new

learning with an emphasis on, for example, processes of inquiring/problem-solving, reasoning/arguing and defining/describing.

As the pupils enter the secondary transformation unit of the LDS they are getting closer to the final product – i.e. the test or the presentation in class – the character of assessment gets more and more summative, focusing on the pupils' representations. Here this kind of assessment is understood as planned by the teacher. It is used in order to relate what has been presented in the setting to what has become a part of the pupil's knowledge. It embraces the whole learning process as well as the final product. Summative assessment is understood here as oral or written feedback and also as grades. Criteria corresponding to different levels are a common approach in assessment internationally. These levels tend to begin at a novice level and end at an expert level (Lindström, 2002). The novice level is about answering simple tasks, supported by the teacher, and doing what the teacher asks for. The expert level, on the other hand, is about engaging in complicated problems with self-confidence. Here pupils work independently, find new problems to solve, search for models and motivate their choices (Lindström, 2002). If curriculum objectives and grade criteria are defined and explained at the beginning of a LDS, they can be used by the teacher as a tool for a summative assessment of the pupils. Part of the assessment (which can also be referred to as valuation) is the concept of evaluation (cf. Forsberg & Lindberg, 2010), by which pupils are encouraged to meta-reflect and discuss their own experiences, engagement and learning in the subject area – before, during and after the learning process.

## Positioning

The concept of identity will be discussed here as learning, from a design theoretical perspective, involves a change or a development of identities in a social context (Kress, 2010; Selander, 2008a). Selander & Aamotsbakken refer to Fuglerud & Hylland Eriksen (2007) and Ricoeur (1994) and describe identity work as a matter of subject positioning:

“...identity is not a fixed quality but a relational concept; neither the “individual subject”, nor “identity” or “culture” are seen as given or as the point of departure for analysis, but rather the result of social interactions, negotiations and power relations.” (Selander & Aamotsbakken, 2009:13).

A crucial assumption in my study is that a child must be understood by considering the environment where she or he acts (see for example Bauman, 1991; Butler, 1999; Lyotard, 1984). Children's identities, behaviour and actions are interwoven with different educational settings and situations. The



educational setting and the pedagogic realizations are, in this thesis, viewed as decisive for pupils' identity-making (Nordin-Hultman, 2004). Identity, from my perspective, is an ongoing and formative process in which pupils constantly interpret, negotiate and try out different identities (Selander & Aamotsbakken, 2009). Society's views on what a pupil is and shall do play a decisive role as pupils constitute their identities (Nordin-Hultman, 2004). The pupil's identity is transformed and formed over and over again in her or his own actions (Butler, 1999) during the LDS. How the pupils position themselves in the classroom is of importance for their meaning-making and learning, as their identity affects how they engage in the *multimodal ensemble* (Kress, 2010:161). In this thesis, pupils' negotiation of identities is especially interesting, since pupils are given yet another arena, platform or dimension to act upon in the extended digital interface as they are using digital learning resources and the Internet (cf. Moinian, 2008; Shaffer, 2006). *Multiple identities* (Davies, 2003:17) here take on another meaning, as pupils can act from one identity offline in the classroom and simultaneously from a different one online on the Internet or playing a computer game.

## Recap of theory and link to methodology

This chapter has introduced central concepts will be used to understand pupils' interactions, meaning-making and learning in the digital interface in Social Science. Concepts from theoretical fields such as social semiotics, and multimodality have been discussed in order to establish (and elaborate on) a design theoretical perspective on learning. According to Jewitt (2008b), multimodality refers to a field of applications, rather than a theory. The next chapter will show how the theoretical approaches, mentioned in this chapter, have been applied in analysis. A representation – the Learning Design Sequence model – of the design theoretical considerations has been introduced and explained and the following chapter will further develop how the LDS model is used as a tool for collection and analysis of multimodal empirical material in a formal learning setting.

## Conceptual tools for analysis

A multimodal design theoretical perspective offers conceptual tools for studying digital interface interactions in, for example, a classroom. By means of analysing interaction an attempt is made to understand learning by placing a grid of theoretical concepts over the empirical material. The main conceptual tools for analysis that are used to describe, analyse and understand learning in this thesis are: *mode*, *affordance*, *forming/transforming*, *group climate*, *choice*, *interest*, *interpretation*, *agency*, *teacher's intervention*, *representation*, *signs of learning*, *formative* and *summative assessment*,

*identity* and *didactic design*. Most of these concepts have been thoroughly introduced above and will now be discussed in general in the following chapter, as well as more in detail in the summary of each article.

## 5. Methods of multimodal design theoretical perspectives on learning

This thesis will analyse and try to understand pupils' meaning-making and learning in a learning situation in Social Science where pupils are using digital learning resources. In order to gather empirical material and to analyse pupils' interactions a multimodal method is used and the data interpreted from a multimodal design theoretical perspective. The method has some features in common with ethnomethodology (Garfinkel, 1984) and Interaction Analysis, the latter of which is described an interdisciplinary method for the empirical investigation of interactions between individuals and between individuals and objects, such as digital learning resources, in the environment (Jordan & Henderson, 1995). Interaction Analysis investigates human activities such as verbal and nonverbal interactions as well as the use of artefacts and technology. My methodological approach also does this, with the difference being that my method is more flexible and takes more variables into account, as will be described below. This chapter will describe the whole research process as transparently as possible. The chapter begins with an introduction of what a multimodal research method means, and of the reasons for the choice of video documentation to approach pupils' interactions. The chapter will present, reflect on and discuss how the empirical data used in this thesis has been constructed and analysed. The method of video documentation is thoroughly described and portrayed with empirical examples and images to enhance transparency.

Interaction is the research topic of this study. I view interaction as being multimodal. Within the field of multimodality there are diversities in approaches regarding what method to use to collect and analyse data (Flewitt et al., 2009). One of the aspects highlighted in a design theoretical multimodal perspective is that different modes are attended simultaneously (Kress et al., 2001; van Leeuwen, 2005; Selander, 2009). Pupils' interaction is therefore documented by *audiovisual video recordings* and detailed transcriptions of the interactions are prepared (Erickson, 2006:177), providing potentials for understanding *multimodal interactions* (Norris, 2002:97). Norris exemplifies how hard – or even impossible – it is to understand interaction that involves digital resources when focusing only on the mode of speech. In *Interaction Analysis*, speech is appraised as always important in human interaction (Jor-

dan & Henderson, 1995:48), but in this thesis the multimodal video material opens up for an approach where speech is seen as one of many modes (Jewitt, 2009) as visual, action concentrated and lingual modes are documented simultaneously. Although my approach is multimodal, not all modes have been documented as there are practical difficulties in “recording” sensory modes such as taste, smell, feelings of pain or the materiality of objects (Flewitt, et al., 2009). The empirical material is gathered in a school setting. The focus of research is on interactions in the situations where these usually occur (Erickson, 2006), cf. situated learning (Lave & Wenger, 1994).

The Learning Design Sequence (LDS) model serves as a central representation of the research topic and is used to organize this chapter. The chapter will describe how the model works as a guide for data collection and for data analysis.

## The LDS model as a guide for data collection.

The Learning Design Sequence model can be used as a guide for data collection. See the model on page 62. The model (Selander, 2008a) is designed to illustrate how learning can be studied in schools. I want to understand pupils’ learning and meaning-making when using digital learning resources in Social Science and the LDS guides me in collecting data to be able to examine this.

First of all, the LDS model illustrates the importance of the learning context. As seen in the model the purposes and institutional norms that surround learning are important not only to consider but also to document. Pupils’ learning is central in the model, as illustrated by the central position of the primary and secondary transformation units, in which pupils form their learning. A lot of phenomena frame what is possible for pupils to learn in school, such as the educational setting (i.e. how the teacher designs and organizes the learning) and the teacher’s intervention in the learning process. These framing phenomena are represented at specific locations and with specific notions in the model and attention must be paid to these when documenting pupils’ interactions and learning in school. Briefly, the LDS guides me to follow and document the learning process and the interaction involved, from the teacher’s introduction of a new task or teaching unit, through forming and transforming in the primary and secondary transformation units, to the pupils presentation of the final products and the summative assessment of their work. An LDS can be two lessons in a row, all lessons during a week or all lessons in a special subject during a whole semester. The LDS guides me to produce empirical material that can illustrate how interaction occurs simultaneously in different modes. Kress et al. (2001) describes how a multimodal approach on interaction demands methods for

data collection that can facilitate focussing on different modes and that can capture the fast and complex interactions involved.

### Selection and delimitations of observation milieu

If you want to use television to teach somebody, you must first teach them how to use television, writes Eco (1979). This can be applied to digital media and digital learning resources as well (Buckingham, 2010), and this relates to this study's first delimitation. The more accustomed the pupil is to the digital learning resource, the better this mediates information to the pupil (Säljö, 2005). This was an underlying reason for choosing to study interaction in schools defining themselves as being ahead in ICT development. Teachers and pupils in this study are comparatively well experienced in using digital media in education and the pedagogic methods are more or less adapted to this kind of media. The schools have expressed their leading positions themselves, in interviews, on the school website or elsewhere. Some of the schools participate in the European Network of Innovative Schools – ENIS –and have been selected as front runners and among the most innovative schools in Europe when it comes to using information and communication technologies (ICT) for teaching and learning. The following are a few of the activities the ENIS schools are engaged in:

- exchanging ICT experiences, problems and solutions with other schools in the network
- setting up new ICT-collaborative projects with similar European schools
- participating in important educational and technological seminars, conferences and workshops
- testing and validating new educational ICT materials
- supporting other schools and offering study visits
- preparing digital school presentations for seminars and exhibitions
- improving internal quality as suggested in the e-Learning policies
- taking part in the knowledge society (<http://enis.eun.org>).

Another selection criterion was that the schools should be in the same area to make it possible for the researcher to establish close relations with the schools. Altogether 19 schools were selected and contacted. When contacting the head teacher of each school an agreement was made about how many teachers' questionnaires to send to the respective school. The questionnaires<sup>29</sup> involved a set of questions about teaching with digital learning re-

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<sup>29</sup> See teachers' questionnaire in attachment 1.

sources. Attached to this questionnaire was a letter of information<sup>30</sup> describing data collection methods and ethical issues. Also more directed and personally designed information letters to pupils and parents were sent out<sup>31</sup>. Altogether about 100 questionnaires were completed and 12 of the schools turned out to be interested in participating in the project. 10 schools were selected; six primary/secondary schools and four upper secondary schools. One or two classes from most schools are included in the material and in some cases four different classes are included. Material from eight classes in five different schools has been analysed in this thesis. The selected material encompasses ten teachers and hundreds of pupils and students. 28 pupils are included in the transcribed material in the articles. Further delimitations have been that I elected to analyse Learning Designs Sequences in Social Science. The material includes pupils at preschool (age 6), pupils in the compulsory school system (age 7-15) and first year pupils at upper secondary school (age 16). One remedial class at a lower secondary school (age 7-10) was also selected. In each class a Learning Design Sequence has been followed, from the teacher's introduction to the final evaluation.

## Empirical data collection phase

An attempt to present the empirical data collection phase chronologically is in this section made, but due to that the empirical period lasted for several years it is rather difficult. Another attempt is to present the process transparently.

### Pre-conceptions and the researcher's role in the data collection phase

I have a thorough understanding of the observation milieu, as the setting I have gathered my material in is the one I have spent most of my life within – the school. My pre-conceptions might have an effect on the empirical setting and the constitution of the material. To begin with I have pre-conceptions at different levels. I have been a pupil. I have trained to become a teacher and I have worked as a primary school teacher for several years. I educate teacher students and current teachers, and I have spent many years in school research. I also need to consider my role as a researcher in the educational setting, choosing to participate actively or being satisfied with the role of a spectator (cf. Widerberg, 2002). Although observation generates few observation effects (Denzin & Lincoln, 1994) my presence in the educational set-

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<sup>30</sup> See standard information letter in attachment 2a.

<sup>31</sup> See directed information letter in attachment 2b.

<sup>33</sup> See authorization form in appendix 3.

ting probably affects the informants in some way. I have chosen a level of participation where I am a non-participating researcher who avoids interacting and intervening in the interplay between pupils, digital learning resources and teachers. Compared to Gold's classic topology of natural observers, which includes the complete participator, the participator observer, the observer participator and the complete observer, I tried to have a complete observer's role but pupils sometimes interacted with me, which forced me to step into the role of the observer participator (Denzin & Lincoln, 1994). These sequences have not been analysed. In some schools, information meetings were held with head teachers, teachers, other educational staff and with pupils. The informants were informed about my research, thus my role was most likely clear to them. The time spent in the setting before the actual data collection has varied due to agreements with the teachers. Some of them have considered it important for their pupils to get used to me, while others have thought it would be out of the ordinary for the pupils if I spent time in class without an expressly obvious task. In some schools I have participated in the educational setting for as long as I considered necessary to gain as little observation effects as possible (especially in the special school class), in others I have arrived at the beginning of an LDS and begun to gather material immediately.

### Approach of the observation milieu

In the very beginning of this study, I began the search for schools that could take part in the study. I documented information about the schools in files on my computer and on sheets in a folder. The information sheets formed an important basis for the initial contact with head teachers. When the schools were selected, initial contact was taken with the respective head teachers via telephone and e-mail. In a few cases the head teachers referred me to the ICT-pedagogues at the school and contact was established with them in such cases. The head teachers and ICT-pedagogues were asked if they were interested in participating in the project. Notes were taken from these conversations and attached to the information sheets at each school. The information has been used as basis for presentations of the empirical settings in, for example, articles and presentations at seminars and conferences.

### Before the video documentation

In short, the following different empirical documents were designed, collected and analysed before the phase of video documentation began:

- School information sheets
- Notes from head teacher information talks/meetings
- Teacher questionnaires

- Compilation of questionnaires
- Notes from teacher information meetings
- Information letters to pupils and parents
- Notes from pupil information meetings
- Authorizations to teachers, pupils and parents<sup>33</sup>
- Notes from school/class visits
- Notes from telephone planning conversations/meetings with teachers

I have only used a selection of the wealth of research material gathered; therefore presentation of this in detail here is redundant. These documents have not been transcribed or analysed for other uses than to prepare the video observations.

### Approaches in different Learning Design Sequences

Approaches to the observation milieu have differed depending on, for example, the age of pupils and these different approaches will be described below. The LDSs are numbered according to the age of the pupils and are not chronologically ordered. The table illustrates what year and school respectively the LDS empirical material has been gathered and in which articles the material has been used.

LDS	Year	School	LDS name	Class	Article
1	2006	A	My preschool day	Preschool class	1
2	2005	I	The history about me	Year two	1
3	2006	A	Myths about Sweden	Year four	1
4	2007	A	A year	Year five	3
5	2006	D	The dolphins travel to other countries	Remedial class, year one to four	1
6	2006	A	Fears and handicaps	Year seven	2
7	2005	C	Europe – the escape to Poland	Year eight	2 + 5
8	2006	H	Authors in the Middle Ages	Year one, Upper Secondary	4



### **1. My preschool day**

This LDS was observed in a school where I had been filming for about a year. I had been there about once each week and spent lots of time with teachers in the staff room and with pupils in the canteen and at breaks. In this LDS I followed the media teacher when she met six preschool children at once in their preschool room. I had not met the pupils before, but it is likely that they had seen me around the school. I documented four sessions and afterwards I interviewed the observed the pupils and the teacher.

### **2. The history about me**

I was not in charge of this LDS, but I participated in the video documentation at the school. This was the only LDS documented at this school and therefore necessitated some planning work before the video documenting process. The teacher was asked in advance about when they were going to work in the computer room for a whole subject area and two of the project members visited the school and met head teacher, teacher and pupils before the documented subject area begun.

### **3. Myths about Sweden**

This LDS was observed in a school where I had been filming for almost two years. I had been there about once each week and spent lots of time with teachers in the staff room and with pupils in the canteen and at breaks. The pupils had been informed about my participation and research in the LDS, and they had filled in the authorizations and met me once before I began the video documentation.

### **4. A year**

This LDS was observed in a school where I had been filming for almost two years. I had been there about once each week and spent lots of time with teachers in the staff room and with pupils in the canteen and at breaks. The pupils had been informed about my participation and research in the LDS but I had met them just once before the day I began filming. This was the last LDS at the school and I had not met the pupils prior to this, although they had all received an information letter and an authorization that they had filled in.

### **5. The dolphins travel to other countries**

An initial meeting with head teacher, teachers, assistants and recreational pedagogue was held at the school and a rough schedule was made. Since this

LDS was filmed in a remedial class there were just eight pupils, spanning the ages of 7 to 10. Due to the pupils' special needs a lot of the time was spent in getting to know the children to get an idea of who would like to take part in the study and so as not to intrude too much when the actual video documentation began. I followed the pupils in different subjects and rooms at the school. I spent some time talking to the teacher on each occasion I was there filming and had e-mail correspondence in between.

## **6. Fears – handicaps**

This LDS was the first of many in the same school. As I was not familiar with the school, nor with the teachers or the pupils, I spent a lot of time at the school before actually starting to document. I met the head teacher, media teacher, ICT entrepreneur, Social Science teacher and pupils. I visited many different classes and got a thorough presentation and understanding of the school's profile and aims. I also had some contact with parents. Before the LDS began, I held information meetings with the class and I followed the introduction of the subject area before I began to video document.

## **7. Europe – the escape to Poland**

I was not in charge of this LDS but I took part in the video documentation on some occasions. An initial meeting was held with the two Social Science teachers and they were asked to suggest a suitable subject area during the next term. Since this school is a 1:1-school with an ICT-profile the next subject area was chosen and since the teachers cooperated in this LDS, the class was followed rather than the teacher.

## **8. Authors in the Middle Ages**

The initial contact was taken with this school before it was actually inaugurated and the whole research group was invited for a study visit at the school. I also met the teacher a couple of times at The Stockholm Institute of Education. We had a few meetings at the school where we were introduced to their pedagogic visions as well as their virtual platforms. An information meeting with the pupils were held before the video documentation process. A couple of meetings were held with the teachers before the LDS and the whole research group was invited for a study visit at the school, and an information meeting was held with the pupils before I began to video document.

## Video observations

The video camera has allowed me to document pupil and teacher gestures, facial expressions, positions and movements – thus the video material is extremely rich. The educational setting, with school furniture, learning resources and pupils is possible to video document. Furthermore this approach renders it possible to document pictures and images, whether they are presented on the computer or projector screen or elsewhere in the educational setting. In addition the video camera captures the audio aspect of the interaction such as pupils' discussions, oral presentations, sighs and laughter, as well as the teacher's instructions and explanations. While I was video documenting I filled in an empirical data collection form<sup>34</sup> to attach to each video tape.

The initial plan was to document the educational setting from different perspectives with three video cameras in order to be able to thoroughly document the visual, action concentrated and lingual modes as these different modes express different kinds of information that can be interpreted in many different ways (Kress & van Leeuwen, 1996; Selander, 2009). The first camera was to capture aspects concerning the digital learning resource, such as screen activity, mouse clicks and buttons on a digital camera, for example. The second video camera was to document pupils' facial expressions, their speech, gestures and their focus of attention. The third video camera was supposed to provide an over-all structure of the comprehensive educational setting, documenting the classroom and the activities that take place there. Another option was to use a mirror in front of the pupils to be able to see their faces despite filming them from behind (cf. Linderoth, 2004), but due to belief that this would disturb the informants I decided not to use a mirror. A problem that occurred almost instantly in the research process was that all pupils in a class did not hand in the authorization<sup>35</sup> about agreement in participating in the project, therefore only one or sometimes two video cameras could be used. The result of this was that only a selection of the educational setting could be documented and this part was also subjectively selected; what the camera registers is what the researcher has chosen to see (Wartofsky, 1993).

The teachers sometimes asked me if I wanted them, for example, to set together a group of pupils for whom filming authorization had been obtained in order to provide the possibility of filming them from different angles, or if I wanted to take the selected group of pupils to a special room with better acoustics. In line with guidelines in, for example, discourse psychology, an attempt has been made to base this study on naturally occurring data (Potter, 1996) and therefore these kinds of scenarios have been avoided, so as not to construct educational situations that would not have arisen otherwise. The

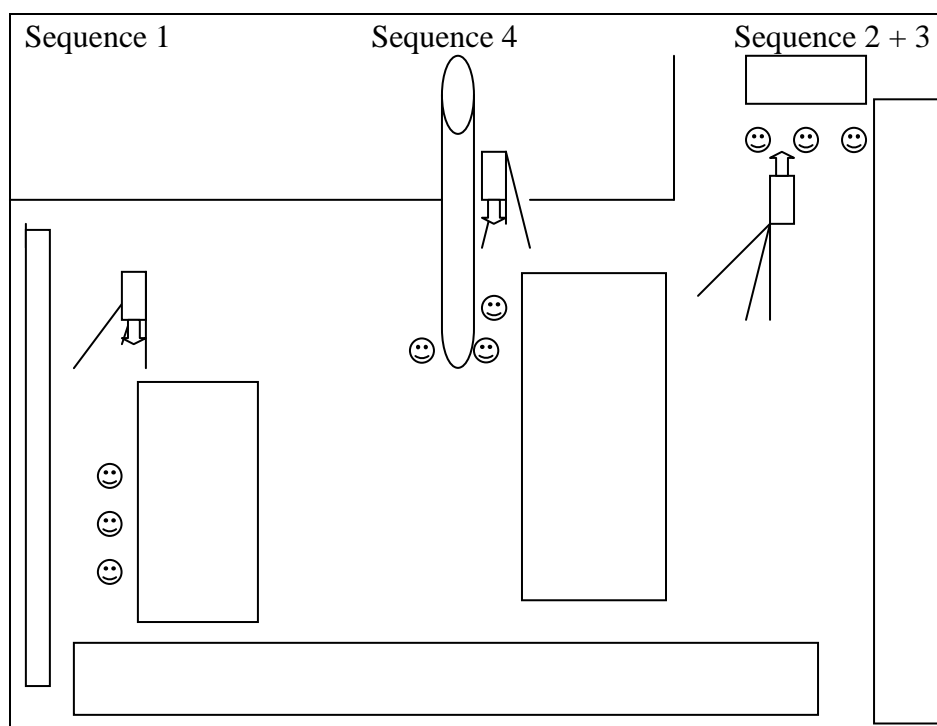
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<sup>34</sup> See empirical data collection form in appendix 4.

<sup>35</sup> See authorization form in appendix 3.

empirical design has resulted in rather complex research material. As a school is a dynamic social scene, group constellations have been flexible. If a group of four pupils were selected and I had begun to document their activities at the beginning of the LDS, a pupil could become ill or suddenly want to change groups. A pupil who I was not authorized to film could sometimes join a group, which meant that I then had to switch groups to be able to film the ongoing group interaction. The same empirical design meant that I was keen on following the class schedule exactly as it was. I had the intention of documenting all of the activities in the LDS but, for example, a field trip or the absence of a teacher could change the schedule at the last minute and the re-scheduled lesson might not fit my schedule. On a few occasions a teacher scheduled a new lesson, in order to give the pupils extra time to finish their work, and then forgot to inform me. This empirical design means that there are many reasons for why some of the LDSs are not complete. I valued remaining as close to everyday school life as possible in the face of these obstacles, since the design perspective focuses on the forming processes that pupils and teachers are usually involved in (Selander, 2009:24). Observing an educational setting that has been formed by researchers would not be rational for my study, since my intention was to document situated learning (Lave & Wenger, 1994).

Initially the teacher was video-documented at a distance, since she or he usually begins a lesson with an introduction or by giving information. The teacher often communicates in a loud voice with big gestures in front of the class, which makes this kind of interaction easy to document. In the map below this is illustrated as sequence 1. Thereafter a pupil, or more commonly a group of pupils, is followed and their work with the digital learning resource is closely documented (sequences 2, 3 and 4 in the map below). A new sequence (not to be confused with a Learning Design Sequence) begins when I press the record-button on the video camera. Reasons for shutting the camera off can be that the video tape was full, that the pupils sat down at another table or that a pupil for whom there was no filming authorization began to interact with the video-documented pupils. What is filmed in close-up is of great importance for how the material can be analyzed and understood. The camera is situated behind the pupils and sometimes the screen activity is zoomed in on.



The most common scenario was to film pupils working with a digital learning resource from behind with one video camera, since that rendered it possible to see the digital learning resource, the pupils and their gestures, as well as activities with the resource.



The camera was fixed on a tripod to ensure picture quality. It is important to find a balance between being close enough to get qualitative sound and picture but being at a reasonable distance so as not to disturb the ongoing interaction (Heikkilä & Sahlström, 2003). For that reason a microphone was put in front of the pupils to catch, for example, pupils' speech and sound from the computer. Sometimes an Mp3 player was used for this instead. The latter resulted in problems in synchronizing images and sound and hence only material where video and audio was synchronized has been transcribed. I positioned myself as far away from the pupils as I could, while still being close enough to be able to recognise the interaction. When I was standing close and looking into the camera the pupils were more aware of my presence, sometimes turning around and looking into the camera or mentioning the fact that they were being filmed. The closeness also encouraged them to engage me in the interaction, asking me questions or showing me pictures on the screen; something that I wanted to avoid.

The interaction between pupils and digital learning resources and teachers is documented. When pupils were using other mobile digital learning resources (such as digital cameras) the smaller portable video camera was used without a camera tripod, to allow a more flexible movement around the educational setting. These sequences do not have the same image or audio quality as I valued the integrity of the pupils over the quality of the film and then did not come close enough to the pupils to be able to get quality audio. Furthermore I zoomed rather than moved physically closer to the pupils, which

means that the image quality of these sequences is also lower. The sequences with low audio and image quality are for these reasons often used as explanatory material, rather than being transcribed.

The digital video camera used is a large professional camera; a Sony DSR-PD 150P. A smaller semi-professional camera, a Canon 405, has also been used for some sequences. In this thesis, the material documented with the large professional camera has been used for transcription as the images and sound is of better quality. Material documented with the smaller camera has mainly been used as additional research material to gain a better understanding of the interaction(s) involved.

### After the video documentation

Video-filmed interviews were made with most pupils after the last lesson in a Learning Design Sequence. They took place in the classroom and can be regarded as institutional (Linell & Korolija, 1995). The interviews were characterized by focus groups (cf. Geijer, 2003), as the pupils were given an issue to discuss. The issue they were asked to discuss was what they did and what they learned during the LDS. The questions were not posed one by one; instead a question was posed and discussed until the theme seemed to be talked through, whereby another question that corresponded to the earlier conversation was posed. The prepared questions were:

1. Tell me what you have been working with during this lesson.
2. How did you work?
3. How did the digital learning resource (computer/digital camera etc) work?
4. How have you cooperated (with peers/teachers)?
5. Is it a difference to work with digital learning resources (computer/digital camera etc) to tools such as paper, pencil and books?
6. What did you learn (subject related/tool related)?
7. Would you like to tell me something else? Is there something you would like to ask me?

The interviews have been used as background material except for in article 4 where critical incidents<sup>36</sup> (Flanagan, 1954; Tripp, 1993) in an interview have been multimodally transcribed and used in four of the nine short excerpts. The interview was video-documented and parts of it were selected and transcribed multimodally in a transcriptions chart. The transcription chart was the same as the one used for video observation in the classroom, although the column for screen activity was excluded.

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<sup>36</sup> The notion of critical incident is thoroughly presented and discussed under the headline “*Organization and selection of empirical material*” further on in this chapter.

Pupils use different modes to, for example, photograph different objects to represent what they normally do during a school day, write a text in a booklet and draw images to symbolise different celestial bodies or design a PowerPoint presentation with images found on Google to illustrate a country. Some of these physical representations are collected or copied after the LDS. They are not transcribed or analysed, but in article 1 they are used as background material to facilitate the analysis of the transcriptions. If the text in the PowerPoint was difficult to see on the video documentation, for example, I have been able to reclaim that information from the final representation.

### Ethical considerations in the data collection phase

Research is an ethical business and people involved have the right to expect a research method that is characterized by accuracy (Cohen et al., 2003). When children are under observation ethical aspects are of even greater importance. I have tried to meet the demands on ethical issues as accurately as possible in respect to the individuals. The research is implemented in accordance with the ethical guidelines set by The Swedish Research Council and HSFR's ethical rules for Social Science research (Vetenskapsrådet, 2004); *the demands on information, the demands on consent, the demands on confidentiality and the demands on usage*<sup>37</sup>.

The demands on information say that I must be straightforward in how I present the study. I have presented the project to participants orally as well as in written texts (Bohlin, et al., 1996). Information meetings have been held with head teachers, teachers and pupils. Information letters<sup>38</sup> have been sent to parents, regardless of whether the pupil was of age or not. We have been keen on establishing a dialogue with the informants and they have been able to ask questions about the project and the research method. I have persevered with the research questions I have provided information about, and I have not used the material to study a new set of questions.

The demand on consent tells me that it is of greatest importance that the informant has agreed to participate in the project. Within the project an authorization form<sup>39</sup> for parents (or students who have come of age) has been designed. The informants were able to choose between three different levels of participation in the study. Level one was represented by *no*; the pupil does not want to be filmed under any circumstances. Level two was represented by *yes*; the pupil agrees to be filmed. If I want to show the film to other people certain permission must be given (Bohlin, et al., 1996), and level three

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<sup>37</sup> The demands on usage will be presented later in this chapter, under the headline "Ethical considerations in the phase of data analysis".

<sup>38</sup> See information letters in appendix 2a and 2b.

<sup>39</sup> See authorization form in appendix 3.



corresponds to this *extended yes*; the pupil agrees to full participation in the project where she or he allows us to use the film to display examples at seminars or the like. Many authorized consents were signed at level three. Since I have tried to document groups of pupils working with digital learning resources, all group members have agreed to participation, which meant that if an authorization form was not handed in or a pupil said no to participation I often had to redesign the video documentation that had been planned beforehand.

The demands on confidentiality are a complex issue in video documentation since the material is rich in detail and at the same time intrusive. Personal information has been kept confidential according to *The Personal Data Act* (1998:204). I will present how I have worked to keep my informants confidential during the analytic phase of the research below.

## The LDS model as a tool for data analysis

The Learning Design Sequence model does not only guide me in how to collect data, I also use the model as a tool to analyse interaction. See the model on page 62. From a design theoretical perspective, interaction is understood as being dependent on the setting and the LDS model helps to frame the documented activity. The purpose of the video-documented situations is that pupils shall learn, and the situation is affected by different norms. Hence it is important for me to know what frames the specific situation. Resources for interaction are the different modes. Modes are the results of a historical and social shaping of materials chosen for representation (Kress, 2003); the mode of, for example, reaching one's hand up in the air means something specific in a school setting. The same mode can also mean different things depending on the transformation unit in which the mode is made. Raising a hand in the primary transformation unit is most likely made to ask a question to get help, whereas in the secondary transformation unit the same gesture is likely to be a call to get approval on a representation, or to pass a comment on a peer's representation. In the following I will explain how the analysis of empirical material has been organized.

## The phase of empirical data analysis

The empirical and the analytical phases are integrated in this study. Preferably I would present everything simultaneously but since a written text builds on chronologic logic (Kress, 2010) the phases will be presented in the most representative order.

### Pre-conceptions in the data analysis phase

When I first began analysing my material I considered my genuine pre-conceptions to be beneficial in the analysis of the material since I, unlike many researchers, know what it is like to work in a school. I was at that time working part-time in a school, with my own class, and felt comfortable in my research milieu. After a while I realized that instead of being an asset, my pre-conceptions made me a cannibal, as Bruns (1992) refers to it. This means that I have not reviewed my understanding but instead incorporated information into my earlier understanding. I have thought to understand my material but instead I have seen myself in the informants and therefore perhaps have not been able to pose the right questions for the material. An example of this is that I, as a dedicated Social Science teacher, at the beginning of the analytical phase searched for units of interaction where the pupils were interacting about something that answered to the subject area as I understood it as a teacher. As a result my pre-conceptions narrowed what I could recognize as learning. During my doctoral studies I've belonged to both a research project (Digital learning resources and Learning Design Sequences in Swedish Schools – Users' Perspective) and a research group (DidaktikDesign) which means engaging in two arenas, each with a set of understandings of, for example, the phenomena as well as the notion of learning. This most likely affects how I experience empirical material. The analysis builds on choices made by me as a researcher; I choose what headlines to use in the cataloguing of Learning Design Sequences, I choose parts to analyse, I choose how to analyse them and what framework to use. Even the act of transcription is a matter of choice, since not every micro detail is brought to the fore and transcribed. It is a "situated act" (Green et al., 1997).

### Organization and selection of empirical material

As the video material is substantial, an all-embracing overview has been taken in cataloguing the material. This has been done through describing the video sequences according to the school subject, age of pupils, length of LDS and the stage in the LDS the part corresponds to. This information is to be found in field notes, on the tapes, on folders containing pupils' representations or on the DVDs with video material, for example. The material has been saved in a folder on the departmental intranet and in a large safe. Two

external hard drives were purchased to store material on but I did not use these. The following table presents the selected material that has been analysed in this thesis.

<b>L D S</b>	<b>Class/ year</b>	<b>Pupils</b>	<b>Teacher</b>	<b>Theme</b>	<b>Nonofficial Social Sci- ence subject</b>	<b>Minutes of film</b>
1	Pre-school class	1 girl, 5 boys	1 female	My pre-school day	Social Studies	264
2	Year two	2 girls, 1 boy	1 female	The history about me	History/ Social Studies	685
3	Year four	2 girls, 2 boys	1 female	Myths about Sweden	Geography/ History	234
4	Year five	2 girls, 2 boys	1 female	A year	Geography	200
5	Remedial class, year one to four	1 girl	2 female	The dolphin's travel to other countries	Geography	307
6	Year seven	3 girls, 2 boys	1 female, 2 male	Fears – handicap	Religion	495
7	Year eight	3 boys	1 female, 1 male	Europe – the escape to Poland	Geography/ Social Studies	251
8	Year one, Upper Secondary	2 girls	1 female	Authors in the Middle Ages	History	694

As multimodal transcription is very time consuming it would be impossible to transcribe the entire material. As a result I have had to pick out small units from the films to analyse. I refer to these units as “critical incidents” (Flanagan, 1954; Tripp, 1993), and these are selected according to prerequisite criteria. A sequence is selected according to a special research question depending on which article the sequence will be used in. This is further described in the respective article. To begin with the critical incident is selected because it is framed by the research question. If the research question, for example, has to do with assessment, sequences where the teacher and the pupils are interacting are selected for analysis. A selected sequence can be several minutes long. The notion of site of engagement (Matusov, 2007; Scollon, 2001) can be used to outline the part of the critical incident that shall be transcribed. According to Goffman (1981), social interaction is framed by a clear opening and a clear closing of the interaction between the participants (Norris, 2002). A site of engagement, gives me the opportunity to focus on concrete real-time processes in the material instead of abstract selected parts of the material (Scollon, 2001). A site of engagement can be of various lengths. It can, for example, begin when a pupil points at the screen and asks the teacher: “Is this good?” and ends when the teacher leans towards the computer screen, reads and points at the text and formatively assesses the pupil with words like “Yes, you can. Try to find an image in Clip Art now.” In the first articles I interpreted the sites of engagements to be opened by pupils’ or the teacher’s speech, but in the latter articles modes such as movement and gestures have been more and more recognized as the opening and closing of transcribed sequences. This change is related to the notion of *modal configuration* (Norris, 2009:78) which serves to explain the relationship between modes that are at play in a given moment of what Norris calls a “higher-level action”. In my material I have come to see modes such as gestures and movement as hierarchical, positioned higher than the verbal modes, hence these kinds of modes have more often been understood as the opening and closing mode in a site of engagement. Roughly each site of engagement embraces from a half to a few minutes in this study.

## Transcription

In order to explain the phase of transcription, I have been much helped by Jewitt’s “The Routledge Handbook of Multimodal Analysis” (2009).

It is crucial not to let the didactic question of how the pupils interact cast a shadow on what they interact about. This priority has the consequence for the mode of transcription that it is not a microanalysis. Another reason for not making a microanalysis is presented by Flewitt et al. (2009), who states that transcriptions with a high level of detail can be time consuming and

challenging, as well as impose different disadvantages for research dissemination. This work also states that:

...it is the research interest that determines the choice of transcription. (Flewitt, et al., 2009:51)

Video material is dense and repeated studies with different research questions can open several layers of meaning in the same section. With a multimodal approach it is necessary to consider different modes, but it is important to keep in mind that transcriptions are reduced versions of observed reality (Flewitt, et al., 2009). Some modes such as speech have been thoroughly transcribed whereas a mode such as smell can possibly be mentioned but not transcribed. Jordan & Henderson (1995) highlight the importance of researchers thinking seriously about the analysis before deciding what to transcribe, since what is transcribed determines what can be analysed.

Transcription is a complex and extremely time consuming task in this study. I have used an editing room with a DV-tape player especially designed and bought for transcription. The test transcriptions and the transcriptions that the first article is based on were made in this editing room. In order to facilitate the transcription process the material on the DV-tapes was copied to three sets of DVD-discs. The transcriptions that the other articles are based on were made with these DVD-discs, which have slightly poorer image-quality and sound. Two computers have been used simultaneously for transcription, one for the display of the video film and one for writing the transcript.

A specially designed multimodal analytical and dynamic framework or transcription chart was designed in order to facilitate the transcription process. This was used to be able to analyse the chosen critical incidents and sites of engagements. Each site of engagement has been broken down into meaningful units of analysis that are possible to handle (Rosenstein, 2002) and understand. Designing a transcriptions chart with columns is a common approach in social semiotic multimodal studies (Insulander, 2010; Kress et al., 2001; Lindstand, 2006; Rostvall & West, 2005). With a multimodal perspective activities can be divided into different modes, and different columns are designed in the transcription chart for different modes. Multimodal analysis offers the opportunity to focus on details in interaction. A multimodal perspective approaches classroom interaction considering the socially and culturally formed resources pupils are using to organize and make meaning. An activity like “search for information” on the Internet includes modes like gestures, speech, body movements, gaze, text and images on the screen, key pressings and mouse movements. The analytical chart includes different columns corresponding to modes such as sounds, movements and digital learning resource activity. The modes that are relevant to transcribe in each critical incident are selected using inspiration provided by Kress’ questions

about what a mode is (Kress, 2009:59): which modes in this sequence can represent what “goes on” in the interface interaction? If, for example, pupils’ speech, gestures, body positions, mimics and writing are visible/audible in the critical incident caught on the video film they are given columns in the transcript, as they are viewed as possible representations of what “goes on” in the interface interaction.

The following is an example of the columns chosen<sup>40</sup>.

<b>Time/ image</b>	<b>Pupils’ speech</b>	<b>Pupils’ movements and gesture</b>	<b>Teacher’s speech</b>	<b>Teacher’s movement and gesture</b>
<b>Pupils’ writing</b>		<b>Pupils’ images</b>	<b>Screen text, colour, image etc.</b>	<b>Surrounding sound/speech/ movements</b>

If the pupils, for example, are only audible but not visible in the selected critical incident, there is no column for gesture/mimic/body movement etc. The selection of columns also has to do with the respective research question(s) in each article. That selection process has been further described in the respective article.

In different situations different modes are of different importance (Kress et al., 2001) and pupils choose the modes that seem to fit the situation best and make use of them to give form to a message. The affordances and restrictions in the educational setting guide teachers and pupils to decide what mode to use for what (Kress, 2003). Speech is not predominant despite being presented first in the chart. The transcription of modes has been done separately, meaning that when transcribing the mode of speech I have not watched the film and when transcribing the gestures I have not listened to the speech. Unlike microanalysis every detail must not be transcribed. Instead I am content with Linderöth’s standpoint that the modes necessary to create logic in the flow of interaction ought to be transcribed (Linderöth, 2004). These analytical schemes are read from top left to bottom right (Linderöth, 2004; Lindstrand, 2006; Rostvall & West, 2005).

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<sup>40</sup> The columns and transcriptions are presented here in English although the transcription has been made in Swedish and then translated into English as explained under the headline *Data analysis and finalising into findings and excerpts*.

Test transcriptions were made in two different transcription softwares; Transana och Videoanalyzer, but due to hardware problems, the transcriptions used in the articles were transcribed using a combination of QuickTime<sup>41</sup> and Microsoft Word<sup>42</sup>.



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<sup>41</sup> Information on <http://www.apple.com/quicktime/>

<sup>42</sup> <http://office.microsoft.com/en-gb/word/>

Sko_A_âkF_01 00.19.35	Pupils' body position/gesture	Teacher's body position/gesture	Pupils' mimic/gaze	Teacher's mimic/gaze	Pupils' speech	Teacher's speech	Image/text/colour etc. on screen	Surrounding sound/speech/movements
Time 11.15.50 	A is sucking his thumb. C leans on his hand.	The teacher sits on her heels on the floor behind the pupils. She leans forward and points at the bottom right of the screen.	The pupils are looking at the screen.	Looks straight at the icon she is pointing at.	B: Yes. B: [laughs]	Would you, would you, would you like to see your pictures? Click there, finish...	The computer is connected to a digital camera. An image program is opened. A large, multicoloured photo of a landscape is at display.	Other pupils are talking to each other in the same classroom behind the pupils.
11.15.51 	C is moving his body up and down. B is nodding. A lifts his hand.	Keeps pointing. Jumps up and down while crouching.	Looking at the screen.	Looks at A.	C: laughs A: Yes, but then we want to [look at all] [xx]	If you are ready to see the photos. And then [you can go] [xx]	The large image.	Other pupils' talk.
11.15.56 	A points at the screen.	Stands up a little. Keeps pointing.	C looks at A's hand.	Looks at the screen.	A: Oh, yes, THAT ONE, THAT ONE! [mumbling] C: Yes.		About 60 miniatures of photos from the digital camera is on display.	Other pupils' talk.
11.15.58 	C stands up and points at an image. B leans forward.	Points at the upper right corner.	Looking at the screen.	Looks at the screen.	C: No, this image. B: Ah.	Mmmm.	Miniatures.	Chairs are slamming in the background.



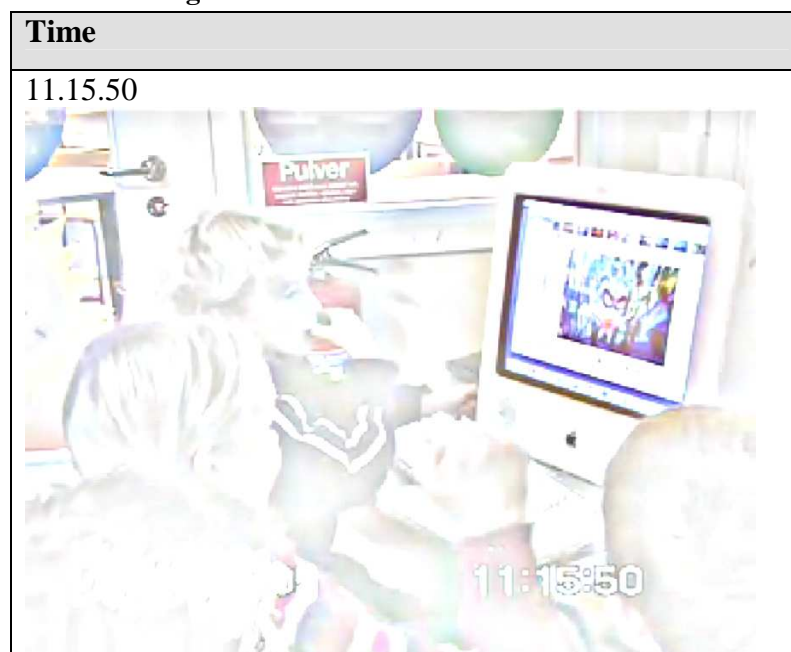
11.16.00		C stands up.	Holds her hand at the front of the screen. Sits down crouching again.	B opens her mouth and makes a funny face, nodding a little.	Looks at the screen.	B: Computer [xx]	Yes, all images that are saved on this computer.	Screen is not visible.	Chairs are slamming in the background.	
11.16.06		C sits down.	Lower her hand and nods.	B pretends to laugh.	Looks at the screen.	C: Yes, Nadja. B: [ooaaahaa] Bad!	Hm... Yes. A small image of Nadja.	A small image of a girl's face is displayed on a white background.	Other pupils' talk.	

The modes have been as equitably reproduced as possible in the transcription, but being entirely objective is not possible since research is a matter of choices. According to Green et al. (1997) it is impossible to transcribe speech, for example, objectively since transcription is a political act. The process of transcription is considered an interpretative and representative process which means that the text I write in the transcription chart is a text that interprets and represents an event – it is not the event itself (Green et al., 1997; Rostvall & West, 2005).

The names used in the transcription are fictitious, or *assumed* (cf. Løkken & Søbstad, 1995:34). In the first articles a name with the same first letter as the one in the pupil's real name was selected. In the later articles, the anonymous names have been selected according to a principle where the pupils have been named for example A, B and C or D, F and G, according to how they are positioned at the beginning of a critical incident. Names that correspond to the pupils' age, sex and ethnic background have been chosen with the same first letter as A, B and C, resulting in names like Alex, Beatrice and Caesar. The teacher is referred to as "the teacher"<sup>43</sup>.

In the following the different transcription approaches in the respective columns will be discussed.

### Time and image



<sup>43</sup> Except for in article 4, where the teacher is called "Kristina", due to that this article presents a longer empirical description of the educational setting.

The time column indicates how far into the tape the sequence is. Most often this also indicates how many minutes into the lesson the pupils are. The main reason for having a time slot is to indicate how long the sequence is. The time of the day is visible within the image, at the bottom right.

In some of the articles, images have been inserted in the time column. The images are copied from the film editing software QuickTime to the image manipulation software program Gimp 2.6<sup>44</sup>. A filter called “find frames” was selected to de-identify pupils and teachers, but still keeping the screen activity focused enough. A special manipulation called “gaussic difference” has been used in order to create blurriness.

### Modes such as speech

Speech
If you are ready to see the photos. And then [you can go] [xx]

Speech is transcribed inspired by a method called Jeffersonian Transcription Notation<sup>45</sup> (Jefferson, 1984). Although this transcription method is not fully used, some aspects of it are appropriate to the video material. These categories are, for example, pauses, overlapping speech and loud speech.

Transcription notes	
text	speech as in written language
!?	signs as in written language
[text]	overlapping speech
(text)	unidentified speech/sound
...	pause
xx	interrupted speech
TEXT	loud speech

To mention a few examples, exclamation marks and question marks are used as in written language, a pause is transcribed as ... and overlapping speech is denoted using square brackets whilst unidentified speech is in parenthesis. If a pupil speaks loudly her or his words are in capital letters and if a pupil is interrupted xx represent the interruption. Speech is transcribed as in written text although suffixes, for example, are not always fully articulated. An attempt has been made to maintain grammatical inconsistencies in the translation from Swedish to English.

<sup>44</sup> More information available at: <http://www.gimp.org/>

<sup>45</sup> Named after Gail Jefferson. More information on the system is available at: [www.transana.org](http://www.transana.org)

### **Modes such as body position and gestures**

<b>Body position/gesture</b>
The teacher sits on her heels on the floor behind the pupils. She leans forward and points at the bottom right of the screen.

When viewing the selected parts of the material, I have tried to objectively document what I see and hear, free from interpretations. This is especially important when transcribing the non-verbal modes such as gestures, body movements, facial expressions etc., as these modes would be easier to describe interpretatively. To mention one example it would be less space and time-consuming to write “he shakes his head in surprise” than “he moves his head from side to side, opens his mouth, stares and raises his eyebrows”. Interpretative text is consequently avoided and an image is inserted in the transcription to emphasize the meaning of the written word.

### **Modes displayed on the screen such as colours, images, symbols and animations**

<b>Image/text/ colour etc. on screen</b>
An image program is opened. A large, multicoloured photo of a landscape is at display.

Transcribing the screen activity is a hard task. If the digital interface interaction represents a pupil navigating through hypertexts on a Wikipedia page, for example, it is impossible to transcribe all the information as this is too dense. Therefore the selection in that column is more subjective. I have transcribed what I understand as important in the specific critical incident (c.f. salience, van Leeuwen, 2005). Sometimes several digital learning resources, such as digital cameras or projectors, have been used and all of these have been transcribed.

### **Modes such as mimic and gaze**

<b>Mimic/gaze</b>
Looks straight at the icon she is pointing at.

The video documentation made by one camera made modes such as mimic difficult to recognise, since pupils are often filmed from behind. If mimic and gaze have been possible to see in the film this has been transcribed. I

have been careful not to interpret mimic, meaning that I have tried to write “smiles” instead of “looks happy” for example.

### Surrounding sound/speech/movements

Surrounding sound/speech/movements
Chairs are slamming in the background.

In some articles a transcription chart column called “other” has been used, but in the more recent articles the last columns have presented surrounding sounds and movement – sometimes in one, sometimes in two different columns. Surrounding sounds and movement may occur if another pupil enters the classroom, a beep sounds from a mobile phone or if some other pupils are talking to each other.

## Analysis of transcriptions

Some of the notions in the LDS are used as conceptual tools for analysis when analysing the transcriptions. These conceptions differ between the articles in the thesis, while the research questions differ as well. When I analyse transcriptions from the LDS primary transformation unit, examples of conceptual tools for analysis are: *transforming*; *forming*; *teachers’ interventions* and *design*. When I analyse transcriptions from the LDS secondary transformation unit two important conceptual tools for analysis are: *representation* and *summative assessment*. How the conceptual tools for analysis are understood was thoroughly presented in the chapter above and how they are used to analyse the empirical material is explained and discussed in the chapter “Summary of articles” as well as in the articles themselves.

## Ethical considerations in the data analysis phase

As previously mentioned the research has been implemented in accordance with the ethical guidelines set by The Swedish Research Council and HSFR’s ethical rules for Social Science research (Vetenskapsrådet, 2004); the demands on information, the demands on consent, the demands on confidentiality and the demands on usage.

The demands on usage embrace ethical considerations when analysing material. The demands on usage prohibit me from using the research material for purposes other than those I have provided information about. The authorized consents provided by the pupils and/or parents helps me to continue within the framework set by my project commissioner, The Knowledge

Foundation. No one except project members are allowed to use the material and, according to Bohlin et al. (1996), it is important that the material is kept safe. Tapes, questionnaires, pupil's representations, authorizations and DVDs are kept in a safe in a locked room with double sets of codes.

While transcribing and analysing the video material I have met the demands for confidentiality at different levels. The schools are coded and the informants are renamed using *assumed names* (cf. Løkken & Søbstad, 1995:34). The photos presented have been rendered non-identifying by means of image manipulation.

Personal information has been separated from the films and transcriptions and it is not possible to trace the schools or classes that are included in the study. The participants have been de-identified in images presented at conferences or published in articles.

## Methodological discussion

In this section the methods and accomplishment of the study will be discussed, with an emphasis placed on validity and reliability.

### Qualitative research

This thesis belongs to the qualitative research field as it mainly builds on video observations, and also utilizes, for example, focus group interviews and pupils' representations such as PowerPoint slides and films – none of which are possible to quantifiably analyse. The research material and the analysis should be both reliable and valid; a delicate issue when it comes to qualitative research. Qualitative research material is not possible to analyse in the same standardized and generally accepted way as quantitative data (Starrin, 1994). Reality cannot be described as absolute and objective; instead reality is described through the interpretation of the researcher. Qualitative research does, on the other hand, focus on perspectives on reality rather than reality itself (Merriam, 1994). It is also important to notice the fact that reality changes, which leads to reliability through exact points of reference being difficult to find (Cohen & Manion, 1994).

### Validity

Rosenstein's (2002) ethical guidelines of observations have been useful in the complex issue of the validity of the study. She states that the observed activities shall be representative for activities and principals within the frame of reference that the documentation focuses on. I study how pupils use digital learning resources in education with a focus on Social Science. Digital media is used in most schools by pupils of different ages in Sweden. Accord-

ing to a recent report, ICT is used by all pupils in secondary school and the subjects where it is used most are Social Science and Swedish (Skolverket, 2010a).

I circumvent the representativeness a little here, since I only study schools that have a pronounced ICT-profile and that are at the forefront of ICT-development in Swedish schools. This is compensated by the fact that some time has passed since the video observations were made, which implies that an average contemporary school in Sweden today is more developed in terms of ICT than it was four years ago. This means that the results should be valid for an average Swedish school today.

Pupils surrounded by researchers and video cameras are not representative of the average school setting. I try to study pupils' ordinary activities in their ordinary educational setting, but I am aware of the risk that my presence may affect them, as I have discussed previously in this chapter. I've tried to diminish this affect by positioning myself at a distance from the pupils and I have been careful not to interfere in the learning discussions, to mention some examples. Filmed material showing me taking an active part in the interaction (if I have had to help the pupils with something for example) has not been selected for analysis.

## Reliability

The study is characterized by triangulation in that sense that complementary research material, such as interviews, field notes, Mp3 recordings and pupil's representations have been gathered along with the video observations. These parallel methods result in a more detailed and complete – but also varied and complex – picture of the interactions involved in the Learning Design Sequences. In this study, the material other than the video recordings has been used as background material, to be able to more correctly describe as well as to provide a complex understanding of the interactions on the video film. The interviews and the Mp3 recordings have, for that reason, not been transcribed (except in article 3 where the critical incidents from the interview with the pupils have been multimodally transcribed).

According to Jordan & Henderson (1995) some important nuances in actions will always pass unnoticed by a researcher, however precise the transcription that is made. Since I belong to a team of researchers which implies that we discussed our objectives in the collection of data as well as in the analysis of the collected material, analysis validity is augmented. We view, discuss and analyse video material together in data sessions<sup>46</sup>. This strategy is a time-consuming process of cooperative review of empirical material. The reflective dialogue that ensues is thought to deepen our understanding,

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<sup>46</sup> Research project meetings every second week, annually conferences organized by LearnIT and a few, by us, organized workshops with national and international invited researchers.

as we approach the material from different angles. The results are more reliable since they are not likely to be a product of one single person's reflections (Jordan & Henderson, 1995; Rosenstein, 2002). An original idea was that we should use and analyse each other's transcriptions, but this was complex, as we had different research questions and thereby framed the units of analysis differently. Not knowing the whole situation also complicated the analysis. On a few occasions the same critical incident was selected for transcription by different project members. We discovered that the interaction was similarly transcribed (although we sometimes had different columns in the transcription chart), but the analysis and the results differed accordingly with the respective research question.

I have approached the material from different angles, a method that, according to Rosenstein (2002), makes modes such as movement, gestures and sounds easier to understand. The research material has been used for different articles with different research questions. In the next chapter the articles will be summarized.



## 6. Summary of the articles

The included five articles have been written and published over a time span of five years, from 2006 to 2010. In 2007 I was on maternity leave and as a result no article was published during that year. As described in the methods chapter the same methodology for data collection has been employed in the empirical material used in all of the articles, while slightly different methods for data analysis have been used in each article. Methodology in this summary will therefore emphasize the different methodological analytical operations in each study. The reason for this variation in analytical approach is that the theoretical perspective – Designs for Learning – has been built up and advanced during these five years. Some suppositions and notions were brought into this research process and many of these have followed the whole research process, while others have been transformed, identified or explored while interacting with, for example, teachers or pupils in the research field, i.e. the digital learning environment or while interacting with the empirical video-documented material. One way to approach reading the five articles (Engström, 2006; Engström, 2008; Kjällander, 2009; Kjällander & Selander, 2009 and Kjällander, under review) is hence to read them in order to see the advancement of the theoretical perspective and to see what have been the most central questions during these five years – something that will also be discussed in the discussion chapter of this compilation thesis.

Another way to approach reading the five articles is to read them chronologically, in order to see the relationship between them. Such a reading reveals a pattern where a notion or a finding in each article connects to the next article in turn. The first article (Engström, 2006) has a broad scope and aim and focuses on pupils' interactions with each other and learning in the digital learning environment. The result of the article shows, among other things, how the digital learning resource provides pupils with affordances and a large part of the article's discussion deals with this notion. The linkage to the next article (Engström, 2008) is then the notion of affordance and this article deals with affordances in the digital interface and how they are utilized by the users. One finding in the article is that the digital learning resources add something to the learning process and what this adding embraces, in terms of the subject of Social Science, is studied in the next article (Kjällander, 2009). The interest for the subject content connects with the

next article (Kjällander & Selander, 2009), where three traces in an empirical example are followed and discussed; the pupils' trace; the subject knowledge content trace and the teacher's trace. The teacher's trace is associated with the focus of the last article (Kjällander, 2010) where the teacher's formative and summative assessment of pupil's learning is highlighted.

As I have published three more articles during these same years, but decided not to include them in the compilation thesis, each article summary will conclude with the motivation for the inclusion of the article in the thesis.

## Article 1

The digital learning resource – a tool, content or a peer? Pupils' interaction and learning in four Social Science Learning Design Sequences. (Engström, S. 2006, Stockholm Library of Curriculum Studies 16).

The first article was written based on a general interest in pupils' interaction and learning using digital learning resources in Social Science. The article was written while I was still gathering material in schools, thus the article has an empirical comprehensive approach, aiming at describing how digital learning resources are used in social science. The aim of the article was to find specific patterns in pupils' subject related interaction and learning when they work with digital learning resources.

This article is based on a massive amount of empirical material from four different LDSs: altogether more than 15 hours of video-filmed material and about 50 transcriptions. The first LDS is called *My preschool day*, a two week project filmed in a preschool environment with nine 6-year-old children. Three children are documented while designing a film about their school day using a digital camera and iMovie. The second LDS is called *The dolphins travel to other countries*, an LDS documented in a class of eight pupils with children from years 1-4 with special needs. They work in an integrated language/social science/textile craft-project that runs for the greater part of a semester. Each pupil finds facts about an animal, makes up a geographical scene, writes a story, photographs the animal in these scenes and presents the text and photos in a PowerPoint presentation. The third LDS is called *The history about me*. It is filmed in a class of about 20 pupils in year 2 over a couple of months. The pupils are supposed to make a PowerPoint presentation about their own life and family using photos, Clip Art and PowerPoint. The fourth LDS is called *Myths about Sweden* and is filmed in year 4 over approximately ten weeks. Four pupils cooperate regarding statements about Sweden and they use the Internet, digital cameras, a scanner and music to make a presentation in a computer photo program.

At the phase of transcription, which in this article is referred to as the second part of analysis, the conceptual tools for analysis were not yet developed. The interest in what digital learning resources were used for; how pupils interacted with each other and with the digital resources and how they learned, led to a whole semester of watching the video documentation (this phase is referred to as the first part of the analysis), trying to make meaning of what was displayed, before actually beginning to transcribe. When the transcription phase was over, the search for patterns in the transcriptions was initiated. This was done through reading the transcriptions, often watching the video film simultaneously. During this time-consuming process, the conceptual tools for analysis were gradually developed. The tools for analysis in this phase are three different ingredients in the transcribed interaction; 1) *the nonverbal parts*; 2) *the paraverbal parts* and 3) *the signals of structure* (Buhl et al., 2005). When such a grid is laid over pupils' interactions it is possible to discover patterns. In this article I used the LDS model as a tool to understand how learning can be organized, rather than studied, in schools.

The third part of the analysis is the analysis of the patterns; an analysis made by means of theories about learning and earlier research in the field of digital learning resources and education to find reasons for these patterns and also possible consequences. This process is a reflective process and a reciprocal action as I went back and forth between theoretical reasoning in research literature and the empirical material.

A central conceptual tool for analysis in this article is *group climate*, as this is a notion in the LDS anno 2006. This concept suggests an analysis of how pupils interact, how they help and instruct each other and how they talk to each other. Group climate can also be thought to frame the digital learning resource as a participant in interaction. Linked to this is the significance of agency, although the actual notion itself is not used as a tool for analysis in the article. An analysis of the interface interaction is made, where a search is made for patterns in how pupils talk to and refer to the computer or the digital camera. In the interface interaction illustrated in the transcriptions a pattern of responses from the digital learning resources emerged – *affordance* – which becomes an important conceptual tool. It is used to be able to analyse pupils impulsive and rushed interaction and the deictic expressions and gestures they make while keeping their eyes focused on the screen.

A small part of all transcriptions have been selected in order to illustrate 1) what digital learning resources are used for in schools; 2) the patterns found in pupils' interaction and 3) the patterns found in pupils' learning. These transcriptions have been transformed into excerpts and a focus is placed here on speech, although other modes are to be found in the excerpts as well. Special attention has been paid to translating the speech into English. Due to the pupils' low age and other language issues, an effort was made to make the speech as closely representative of the pupils' language as possible. This has been done in terms of using approximate meaning equiva-

lents, trying to match words with content (Duranti, 1997). All names are erased and personal information (except age and sex) has been encrypted. The images have been rendered unrecognisable. Each excerpt is visualized by an image that corresponds to something central within the timeframe of the original transcription.

The result divides the usage of digital learning resources into four categories; 1) search for; 2) document, 3) process and; 4) present information. Pupils' interaction in the digital learning environment is described as being characterised by impulsiveness, co-operation and instructiveness, but also by stress. The interaction between pupils and teachers is described as being characterised by equality. Learning is, in the study, illustrated as affordance-driven and is facilitated by different modes.

The article concludes with a discussion on how pupils' signs of learning indicate that learning occurs regardless of if the digital learning resource is used for searching, documenting, processing or presenting information. Sometimes the specific learning is not expected or desired by some of the participants in the learning process. Even if they don't always communicate the subject with each other, they constantly pay attention by means of words, cries of delight, gestures, laughs, sighs and questions about their own or others' representations – the pupils design their representation, view it, alter it, and view it again, and so on, in interaction with each other, the digital learning resource and the teacher and by being inspired by each others' representations. Pupils interact and learn by means of affordances provided by the digital learning resource. Sometimes they are faced with facts with different subject content to the one in the task, which leads to peripheral or incidental knowledge and the skill of thinking "out of the box". The result shows how digital learning resources enable children to understand and explain complicated information not achievable using only spoken language. Still the results indicate that pupils' writing and reading is facilitated by the digital learning resource. Pupils act, think and learn in interaction with the affordances provided by the digital learning resources and they assign the digital learning resource an agency. The article sums up with a discussion about the role of the digital e-learning resource in Social Science. It is used as a tool to design the Social Science material at the same time as it is the Social Science material, since ICT is included in Social Science course objectives. Since pupils talk to the digital camera as if it is a participant, for example, and think that the computer makes things on its own, it can also be seen as a peer. A conclusion is thus that the digital learning resource can be understood as a tool, content *and* a peer. This article is included in the thesis because it embraces a huge amount of empirical material, with four LDSs and hundreds of transcriptions. It serves as an important starting point for the following articles by illustrating how digital learning resources are used in Social Science and by initiating several questions that are further investigated.

## Article 2

Eh, they even have a special tool, did you see that? Affordances in digital learning resource mediated interaction. (Engström, S. 2008, Digital kompetanse, Nordic journal of digital literacy, vol. 3, 1-2008).

The background of this article is the interest in affordances, which was set in motion while writing article number one. The aim of this study was to find characteristics in digital resource mediated interaction. One such characteristic answers to the use of affordances. An avenue of access to the article is the European Parliament's recommendation of digital competence as one of eight key competences for lifelong learning. *The Nordic Journal of Digital Literacy*, which is also called *Digital Kompetanse*, was therefore a given choice for submission. The purpose with the journal is to establish a forum for digital literacy. In the editorial of a special issue the skills that pupils need in the future, are discussed and the question of if school is in danger of creating a distinction between school knowledge and everyday knowledge, is raised.

In the theoretical part of the article digital interface interaction is described as digital learning resource mediated interaction: actions that take place at the cross-over boundary between the pupil and the computer screen or digital camera. Interface interaction is described as multimodal, since different modes such as text and hypertext, pictures, icons, moving images and sounds are used simultaneously in interaction. Learning in the digital interface is described as: being able to understand and make use of different modes.

The methods part of the article introduces the model Learning Design Sequence. Affordances, such as assignments or challenges, as well as tools of digital learning resources, are described as being introduced to the pupils in the setting. The empirical material transcribed in this study is two Learning Design Sequences in Social Science with 13-15-year olds. The first LDS is a three month project introduced by the teachers by the question of what children are afraid of. The pupils are supposed to relate their representations to the United Nations Children's Convention. Three pupils are documented, while writing a film manuscript about what they think it would be like to be physically handicapped. The second LDS is a one month project introduced by the teachers within a narrative framework. The pupils are given the topic of suddenly having to leave Sweden and escape to another country in Europe. They are supposed to design a narrative about this trip, including information about the country's Geography, History, Religion and Social Studies. Three pupils are documented while working with Poland, designing a PowerPoint with information from Google and the website 'The Country Guide', their own written narrative and digital photos.

The second article focuses on one of the findings in article one; that pupils' interaction and learning in a digital learning environment depends on affordances made by the digital learning resource. The selected critical incidents in the empirical material in this article show interface interactions where affordances are offered by the digital learning resource. Affordance is thus the central conceptual tool for analysis in this article. The analytical work is described as divided into four steps: 1) selection of sequences to transcribe; 2) transcription; 3) analysis of transcriptions in order to find patterns and 4) categorization of patterns and an attempt to understand reasons and consequences compared to theories and earlier research. Units of analysis are described as special features of interaction selected according to notions and transformation units in the LDS model anno 2007.

When the transcriptions have been finalised into excerpts they have been rewritten into fluent text and translated into English using the same approach as described in article one. The focus of attention is the pupils' speech and on what is displayed on the screen. On some occasions all gestures have not been considered as meaningful to the specific situation at hand, for that reason they have been detached from the excerpts.

The results are divided into three paragraphs. In the first, *The digital learning resource*, results indicate that pupils are confused about the role of the digital learning resource in the educational setting and that they are uncertain of what they are supposed to use the digital learning resource for – they have different views on what the digital learning resource can offer. The results also show how pupils refer to themselves as not being in control of the learning situation. They interpret the digital learning resource as taking decisions and acting independently – as if the computer or digital camera has an agenda and an identity on their own. The results in the second paragraph, *Digital interface interaction*, indicate that pupils experiment with their identities. For example they act as if positioned from digital identity; they pretend to be native English and they let their role-playing characters make jokes in the digital representation, jokes that they are not willing to defend in face-to-face discussions. Further, the results reveal that pupils of this age are aware of ICT ethics, which influences how they choose and manipulate images found on the Internet. The results also show how pupils are using a semi-digital work procedure, where they only make use of some of the affordances on offer in the digital interface. To mention one example, they are probably aware of the computer's technical affordances for transferring information between computers. Despite this, they apply a traditional and time-consuming approach, copying modes on the screen manually. Another example shows that although pre-existing digital tools to compare countries are displayed in the digital interface, the pupils engage in making their own comparison tables. The third and last paragraph is called *Affordances*, and focuses on the abundance of possibilities that the digital learning resource offers digital interface interaction. The results show how pupils make use of

a lot of affordances, such as copying images, back-up saving documents, as well as duplicating and redesigning digital representations. But this is just a fraction of the many affordances offered. The results illustrate how digital representations are active documents used as a basis for meta-reflection; transformed before, during or after the presentation due to new information, assessment actions or interaction; and reused in other situations.

The discussion in the article elaborates pupils' interactions in the digital interface, and discusses, for example, how a pupil, who is just observing another pupil clicking and typing, can still be just as active and learn in the digital interface, using modes such as gestures and speech. The article discusses how pupils appreciate themselves as part of a "natural framework" when using digital learning resources. This means that they regard events as something that just happens without the influence of their own or other human actions. Instead, they handle the computer or digital camera as if it is acting on its own and they confer the agency to the digital learning resource. The discussion implies that it is important for pupils to enter a "social framework" in order to progress and learn in the digital learning environment. The discussion further highlights the importance of attuned teacher interventions. Pupils constitute different identities in the digital interface, and this negotiation process is discussed as entailing potentials for their active meaning-making. The greatest part of the discussion concerns affordances and how just a fraction of them are utilized by pupils in the digital learning environment. One reason for this can be that they are unaware of the affordances, another that the initial cost in time and effort to learn how to use the affordances is perceived to be too high. The multimodality and authenticity that digital learning resources supply the educational setting with is elaborated by most pupils and teachers in many different situations. The authentic and large flow of information offered in the digital learning environment is discussed as fortifying ethical discussions; stimulating different learning styles and forcing pupils into engaging, exploring and to make meaning of texts that they are interested in, although they at many times are not adapted for children. The article concludes in the statement that the learning proposal in the digital environment is open, and pupils' learning is not strictly delimited by the subject, nor by the school. This article contributes to the thesis by its focus on the central concept of affordances. The article focuses on pupils in upper level compulsory schooling and illustrates what digital learning resources add to the subject.

## Article 3

What does Social Science become in a digital learning environment? Kjällander, S. (2009) In: Selander, S & Svårdemo-Åberg, E (red.) *Didaktisk design i digital miljö – nya möjligheter för lärande*. Stockholm: Liber.

The third article is published in an anthology. The article originates from me being invited to write an article by a journal in Rhetoric, where I was supposed to look at the subject of Social Science from different points or places of view – topos (Wolrath Söderberg, 2006). Topos as an analytical tool did not match the aims of the thesis and so the article was rewritten for the anthology. The idea to write for the anthology came from the interest for didactic design and multimodality, ideas that emerged within the project *Digital Learning Resources and Learning Design Sequence in Swedish Schools – Users' Perspective*, and that were later developed in cooperation with other national and international research environments. The aim of the article was to analyse what the subject of Social Science develops into in a digital learning environment. The article studies how the subject's didactic design is affected by digital learning resources.

The article is preceded by an empirical example, where four pupils in year five are writing a manuscript on a computer for a digital film about the different seasons. The article is introduced by arguing for how digital learning resources have a special and prominent position in Social Science, compared to other subjects in the Swedish curriculum. Digital learning resources are, in Social Science, not just regarded a tool to be used in order to learn the subject content, but instead as a content in itself. In the curriculum text about the subject's character and structure, the society of today is described as offering an endless amount of information that can be downloaded from more or less trustworthy sources, and that pupils, by surfing the net, can get an insight into the problems and possibilities that the IT-society can offer. Similar examples from the Education Act, the National Curriculum (Skolverket, 2006a), the syllabus or the course outlines for Geography, Social Studies, History and Religion as well as local syllabuses are drawn on and discussed. The theoretical part of the article deals with the multimodality of digital interface interaction and the expanded notion of text, which means that text is not only understood as letters and sentences on a piece of paper or at the computer screen but also as images, speech or actions. Learning is described here as being able to utilize these different modes in new ways.

The methodological part concentrates on describing the empirical material analysed in the article. The two boys and the two girls focus on the contradictions of winter and summer and search for information about and reasons behind the four seasons, on the Internet. They illustrate the earth's orbit and rotation around the sun with models made from paper. Three pupils act as



celestial bodies while the fourth records their movements with a digital video camera and also acts as narrator. Learning is, in this article, described as multimodal. Examples of signs of learning are pupils' new digital skills and use of new words or body movements to show how the celestial bodies move around.

The analysis of transcriptions in article three builds on the multimodal design theoretical perspective on learning. The video-filmed observations are transcribed and – uniquely for this article – the focus group interviews with pupils have been transcribed as well. The video-filmed interviews took place in the classroom and are therefore regarded as institutional (Linell & Korolija, 1995). In line with focus group interviews (cf. Geijer, 2003), the pupils were given an issue (their own learning and actions during the LDS) to discuss<sup>47</sup>. Since the methods for transcription of video observations and interviews have been designed to be as similar as possible<sup>48</sup> they have been analysed in the same way.

Out of the three didactic questions “what?”, “how?” and “why?”, “how” has been used as a tool to analyse what information the pupils choose to engage with within the digital learning environment. The text in the curriculum of Social Science is used to compare and analyse what Social Science becomes in a digital learning environment. The central conceptual tools for analysis are *transforming* and *forming*. The concept of *transforming* is used to look at how pupils, in different situations, meet existing representations of the world in the media they are using and how they transform these modes to their own representations in a meaning-making process, where their own interest is guiding their focus of attention. The concept of *forming* is used to analyse how pupils meet and embrace the transformed information with their own experiences, knowledge and intention of designing their own representation. The concepts help me to analyse what goes on when the pupils are present in a negotiation process of interaction on a sliding scale between transforming and forming. When their attention begins to aim at forming their own representation, in order to show their learning, they enter the secondary transformation unit. The transformation units are used as tools for analysis in this article. Due to the kind of publication this article was published in, a longer, and less detailed, multimodally represented example introduces the article, whereas the results are illustrated by very short excerpts. The transcriptions have been shortened and it is mainly the mode of speech that is represented in the excerpts.

The results of the article are presented by means of nine examples illustrating how pupils transform information and form their own representations about the four seasons. The result show how two parallel learning processes

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<sup>47</sup> For a precise presentation of the methods for focus group interviews please go to the methods chapter.

<sup>48</sup> A discussion about this is presented under the heading “*After the video documentation*”.

and texts are negotiated and developed simultaneously, where two of the pupils focus on the design of the presentation (the didactic question of *how?*) while the other two focus on the didactic question of *why?* (*i.e. why do we have different seasons?*) This division is confirmed in teacher interventions and in pupils' speech, but taken together with other modes they show how they view the design as part of the subject content. Another interesting result that emerges in the article concerns pupils' reluctance to redesign the digital representation due to documented inadequacies. On several occasions the pupils discuss the year as having only two seasons. They discuss this inadequacy on several occasions too, but they do not change this until their representation is displayed by the digital video camera. At the end of the LDS, the pupils are meta-reflecting on the LDS. The results illustrate how they reflect on their work accordingly if they have focused the *how?* or the *what?* In this meta-reflection they show, with different modes, how their discontent with their own achievements is transformed to satisfaction when they align what they have learned to include the *how?* and the *what?* The text they build up together in this meta-reflection indicates that they have met the double set of objectives of Geography, History, Social Studies and Religion on the one hand and ICT on the other, as described in the National Curriculum. Furthermore it illustrates how the pupils appreciate that they have the mandate to form their representations according to their own interests and the information in the digital interface, and that their representations are therefore not staked out in advance by the school.

The discussion of this article begins with stating that pupils in this LDS are didactic designers. Thereafter the discussion is divided into six conclusions and a concluding reflection. The first conclusion concerns how ambiguous the targets set by the schools are in the seemingly chaotic digital learning environment. The subject area appears to be ruled by the pupils' own interests and the digital learning resources, rather than by the local objectives and targets. This chaos can, on the other hand, be appreciated as a prerequisite for pupils to develop the ability to reach the objective of acquiring insights into the possibilities and the problems that the IT-society inherently brings. Furthermore the chaos can be a prerequisite for pupils to develop the ability to assimilate knowledge in a complex society. A second conclusion is that the relationship between pupils and teachers is less formal, and more equal, as Social Science becomes a subject influenced by the pupils, where pupils are given the possibility to challenge the teacher's precedence of interpretation. The third conclusion develops the thoughts about what happens when the pupils become involved in didactic design and choose their own paths of learning through the learning process, forming their own text. Although pupils might split the assignment according to ICT/Social Science objectives, and design parallel learning paths, they can as a group jointly reach the double set of objectives. The fourth conclusion is that the flow of information is great in a digital learning environment and

that Social Science becomes rooted in reality, since pupils are using sources not apt for children and thus not “cleaned up” to suit pupils or the specific subject area. The fifth conclusion concerns how pupils’ text becomes exposed by the digital learning resources, such as the digital video camera as discussed in the example above, and how this exposition is used as a resource for developing thoughts and representations. The last conclusion is that pupils design their texts in cumulative, circular processes by combining different modes. By peer feedback and teacher’s intervention the text is altered, developed and redesigned over and over again. The digital representation is, by the pupils and the teachers, appreciated as active and is readily updated and reused. This facilitates other potential uses of the representation in later works in the same subject, as well as in other subjects. The article concludes with the statement that the form of the representation is significant for the content. Despite that claim of pupils that they are unaware of the double set of objectives in Social Science, their interactions prove that they work in order to meet both of these, which means that objectives concerning Social Science and ICT are mixed in the curricular texts as well as in the digital learning environment.

This article is included in the thesis because it focuses on the subject of Social Science, with discussions on curriculum, school law, the double set of objectives and course criteria. One LDS in year 5 is analysed because curricular objectives are written for year 5. The article also has a visible focus on transforming and forming – two very important concepts in this thesis.

## Article 4

Designs for learning in a digital multimodal environment. (2009) Kjällander, S. & Selander, S. In: Jonas Linderöth (red.) *Individ, teknik och lärande. LearnIT*. Stockholm: Carlssons.

Article four was published in a similar publication to the one in which article three was published. The anthology was presented in four volumes which jointly summarized one of the largest educational ICT-investments in Sweden – LearnIT, funded by the Knowledge Foundation. The article has three aims. To begin with, the project from which all material for this thesis derives is thoroughly presented. Within this project the perspective *Designs for Learning* has been developed and this perspective is presented and discussed. The third aim is to exemplify the perspective by means of a multimodally illustrated more comprehensive empirical example from the educational environment.

Following the project description, the article presents *Designs for Learning* as focussing on three aspects, where the first is the learning sequence where an assignment or a challenge is introduced to the learner. The next focus is the process where the learner meets the challenge or tries to solve the assignment. A final focus is the discussion, assessment and meta-reflection. Learning is described as a series of transformation processes that are illustrated in the LDS model. The model describes a complicated learning process, with multiple possible messages and options, where the learner is a searching, creative and redesigning individual.

The empirical material comes from a LDS in history in the first year of upper secondary school, where the pupils are assigned to work with the lives of three medieval authors in Florence, London and Paris. Two girls are working together with laptops in a large open office-like area. When it comes to methodology, learning in this article is described as something that becomes what the observer chooses to focus on from a certain perspective, to understand a phenomenon. A first conceptual tool for analysis is learning sequences that are described as: 1) a task being introduced; 2) the process where the pupil transforms information and forms a representation and 3) the discussion, meta-reflection or assessment that follows the presented representation. The concept outlines what is embraced and analysed, in order to illustrate a digital learning environment. The most central concepts for analysis in this article are three traces: 1) the pupils' trace; 2) the trace of content in terms of knowledge and 3) the teacher's trace. These traces are used as grids in the analysis. The respective grids have been laid over the same empirical transcribed example and thus different phenomenon stand out. To understand these phenomenon, concepts from the multimodal design theoretical perspective on learning has been used in order to understand and explain the different traces. To analyse the pupils' trace the most central conceptual tools are: *interaction*; *transforming*; *forming* and *identity*. To analyse the trace of content in terms of knowledge the most central conceptual tools are: *choice*; *interpretation* and *didactic design*. Finally the most central conceptual tools for analysis of the teacher's trace are: *inclusion*, *didactic design*, *scaffolding* and *assessment*.

Concerning the pupil's trace, the results show pupils as active knowledge producers, engaging in multimodal affordances that they use to make representations. Their own interests, together with the affordances of the digital learning resources, rule the learning processes and design the frames of teaching. The results show how pupils position themselves in relation to each other as, for example, amateurs or instructors. The results also illustrate how learning can be a negotiation of identities in a digital learning environment.

The results of the trace of content in terms of knowledge, illustrates how knowledge is negotiated in the digital interface. This negotiation process includes aspects that are not apt school activities and negotiation occurs by

different modes and media simultaneously. The results show how the design of the representation matters in terms of the knowledge – by giving something a form, the content is formed as well. Pupils are selective and view the information they encounter in the digital interface critically, but sometimes, their choices are random and often lead to pupils engaging with peripheral information that discharges knowledge that has not been anticipated by the teacher. The article shows how this unexpected learning is an important aspect in the digital learning environment, but is not yet acknowledged in a digital school setting. Complex skills such as being able to select and merge multimodal information into representations, is not included in curricular texts and then risks being neglected.

The analysis of the teacher shows how the teacher interprets curriculum and other policy documents and how she sets up quite loose frames for learning situations. She chooses how to furnish the room and what teaching aids to use – she participates in the forming process of the schooling and is a didactic designer. The results illustrate how the teacher must multi-task in order to on the one hand inspire, inform, challenge, help and assess pupils in the social science subject area and on the other hand support pupils technically with their digital learning resources. The results also indicate that the teacher almost positions herself as an equal to the pupils.

The article concludes by highlighting that the pupils learn a lot while interacting with the digital interface. They learn a lot about what the teacher introduces and assesses, but they also learn a great deal about what they themselves choose to engage in; knowledge that is not noticed, nor assessed by the teacher.

This article is an important publication as the result is a conclusion reached by the entire project, which this thesis is part of. The article is included in the thesis because it scrutinizes all notions in the two transformation units, as well as discusses the concept of design. The article also clarifies three traces of importance for the thesis; the pupils, the subject and the teacher. The analysed LDS is from an upper secondary school and expands the frames of the thesis.

## Article 5

Assessment in the digital divide: Teachers' and pupils' multimodal interaction. (Kjällander, S. Submitted in December 2010)

The fifth article was not written for a particular academic book or journal. It instead springs from my interest in assessment because of two factors. Firstly, an interest in assessment has sprung from the earlier articles as their results have indicated that assessment of unexpected learning, learning which is quite common in digital learning environments, is a very complicated issue and that a lot of learning risks becoming invisible when pupils are using digital learning resources. The other factor is that simultaneous assessment at this point became an important issue in designs for learning discussions, partly because of research results indicating that teachers are didactically designing the subject area together with the pupils.

The article is introduced by discussing the concept of digital natives and complications for assessment in the digital divide between teachers and pupils. The primary aim of the article is to find out what assessment of learning can be in a digital learning environment where pupils and teachers are designing the subject area together. Other aims of the article are to scrutinize how pupils make meaning in assessment actions, to find out what is recognised as learning and to identify the consequences of assessment.

The theoretical part of the article discusses some central notions, such as modes, meaning-making, learning and prompts; all based in a multimodal design theoretical perspective on learning. The notion of assessment is discussed from different perspectives and a common strategy in assessment is presented as being to define course criteria that correspond to different grade levels that often begin at the novice level and end at an expert level. Formative and summative assessment is discussed in relation to the LDS model.

The studied subject area is a one-month project in Social Science, in year 8, with the all-embracing theme of Europe. The teacher in this study didactically designs the project as a narrative, with a setting reminiscent of what is referred to as an epistemic computer game. The teacher sets up rules about what the pupils are supposed to "experience" during their journey through Europe. In this article, three pupils who are designing a PowerPoint-presentation are followed and analysed. They create a digital presentation by transforming information from search engines including Google and a website displaying comparisons between countries, constantly using three or more different digital arenas simultaneously. Their work is formatively assessed in the classroom. The PowerPoint is presented in front of the whole class and a summative assessment is performed by the teacher immediately afterwards.

The notion of the teacher's interventions is central in the analysis in this study. The unit of analysis is the interaction between pupils and teachers in the digital learning environment and the variables are the modes they use to interact with each other. The modes the teacher uses when assessing the pupils formatively, as well as summatively, are analysed and compared to theories on assessment as well as to earlier research about assessment in a digital learning environment. By a comparison of the teacher's simultaneous modes, an analysis of contradictory modes in assessment actions – and how these are appreciated by the pupils – has been conducted. By comparing the teacher's modes to the pupils' responding modes an analysis is made of what modes the pupils choose to make meaning of and design their own learning by means of. To be able to analyse what is recognized as learning the notions of *representation*, *formative* and *summative assessment* are used as tools for analysis. The transcriptions are read in order to find what modes the teacher chooses to assess. The notion of signs of learning is also used here, as the material is read in order to find what pupils have learned, to be able to compare if this learning is recognised as learning or not by the teacher and/or by the school system.

The transcriptions have been read in order to identify examples to highlight interesting features of interaction in assessment actions. The selected transcriptions have often been cut at the beginning or the end when finalizing them into fluent text excerpts to be published in the article. Considerate carefulness has been made to present the same text that was written in the columns of the transcription chart. The text excerpt has been translated into English, which adds yet another dimension to the selection process as I have selected English words that correspond as much as possible to the Swedish word. This selection is made in terms of approximate meaning equivalents, trying to match words with content (Duranti, 1997). If there are grammatical faults in the pupils speech or spelling mistakes in their writing an attempt has been made to mirror this in English. The images in the excerpt presented in the article have been manipulated in order to make pupils and teachers unrecognizable, but still keep the screen activity as readable as possible.

The results of the article embrace both formative and summative assessment and are divided into four themes; 1) the modes the teachers are using to assess the pupils; 2) pupils' modes that are subjected for assessment; 3) modes that the pupils use to make meaning; and 4) recognition of learning in the respective LDS transformation unit. Finally the results show the consequences of assessment for the didactic design of the subject area. The article indicates that measurement of results is less regulated in the digital environment and that this is characterized by flexibility. The relationship between pupils and teachers becomes horizontal and interaction between them is more egalitarian and less formal. What is to be learned in the digital learning environment is constantly new and assessment becomes a matter of grading something unknown. Formative assessment concerns pupils' PowerPoint-

texts, engagement with ICT, choices and oral arguments. Summative assessment concerns pupils' ICT skills, oral speech, PowerPoint-text, engagement in information searches and creative solutions. Pupils' engagement with images, photos, colours and layout is not recognized as learning although this is something that the pupils deeply engage in. The article shows how the teacher's didactic design aims at pupils reaching the highest grade criteria, while formative assessment aims at the lowest grade criteria. This means that pupils are left without adequate guidance and support in the important transforming and forming of information. Despite this, summative assessment aims at an expert level. The article concludes by arguing for the need to move beyond modes such as speech and text in order to be able to recognize and assess the complexity of learning when pupils are using digital learning resources – assessment should consequently be designed as exploratory, or innovation risks becoming inhibited by assessment.

The last article is included in the thesis because it casts light on three notions not elaborated in any other article; teachers' prompts and formative as well as summative assessment. The article illustrates how modes in assessment actions are studied in detail and it presents consequences for subject design. The digital divide, which is not mentioned in the other articles, is discussed as well and this divide is something that will be considered in the next chapter as well: The discussion and conclusions.



## 7. Discussion and conclusions

The purpose of this thesis is to describe and analyse, from a multimodal design theoretical perspective, how pupils interact, make meaning and learn with digital learning resources in the Social Science classroom. The purpose of this discussion is to sum up central results and conclusions presented in the different articles and to discuss them further. Three specific research contributions were mentioned in the introduction; 1) the understanding of formal learning with digital learning resources in Social Science; 2) the possibility of acquiring an overall picture of pupils aged 6 to 17<sup>49</sup> in digital learning environments and 3) a theoretical perspective on pupils' learning, essentially developed to conduct and to understand research concerning learning in digital environments. These aspects will be discussed within the frames of the research questions.

The chapter is divided into three sections. Initially the four overall research questions of the thesis will be discussed one by one. After that a discussion about complexities for education in *The Online Learning Paradigm*, follows. The discussion concludes with a presentation of new questions that derive from the thesis.

### Didactic design of Social Science

*Research question 1: How do teachers didactically design for pupils' learning with digital learning resources in Social Science, and how do the digital learning resources influence the subject design?*

The articles in this thesis testify to how the teacher, according to her or his interest, selects and assembles the material and orchestrates (Kress, 2010) Social Science. The teacher chooses what to emphasize in relation to the LDS setting (Kress & van Leeuwen, 2001). The teacher is thus a didactic designer (Holm Sørensen, et al., 2010; Selander, 2008a).

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<sup>49</sup> Here “younger” is referring to pupils in Preschool Class and years 1-6 in Primary School, whereas “older” refer to pupils in years 7-9 in Secondary School, as well as year 1 in Upper Secondary School.

## Teachers' different approaches in the setting and in the two transformation units

All articles show how the teacher, in the LDS setting, has an exclusive role in designing the subject area. The didactic design of the setting is aligned curriculum and course criteria and pupils are made aware of the frames of the subject area. Here pupils are not given the opportunity to influence the didactic design. Teachers' didactic design is characterized by offering the pupils choices, especially regarding the first two didactic questions of *what?* and *how?* The teachers serve the pupils with several options on what are to read and learn about – if the subject area is a continent, for example, they are allowed to choose a country. The *what?* is reduced here to what is focused on by the pupils and brought into the foreground. The pupils are given options on how to plan the presentation of their knowledge and can, for example, choose to make a PowerPoint or a film about the country. In the setting the teachers present the digital learning resources pupils are supposed to work with, but are open for suggestions for other resources as well. The resources the pupils choose to use influence their learning in the LDS and thus also influences the subject design. To give an example, in the LDS “Europe – the escape to Poland” in articles 2 and 5, the pupils are using a digital camera to take their own photos, whereas in the LDS “Myths about Sweden” in article 1, a group of pupils are searching for images on the internet. Both groups are working with photos, but since they use different resources, the course objectives are interpreted differently by the teachers as well as the pupils. As a result, the subject design when pupils are using a digital camera is characterized by personality and the possibilities to represent something they planned to represent. On the contrary, subject design when pupils are using images from Google is characterized by rhizomatic learning (Dahlberg & Bloch, 2006; Deleuze & Guattari, 1999), where pupils are introduced to a photo in the digital interface and then design the representation to fit the photo.

As soon as the pupils become engaged in the primary transformation unit, results in all articles show how they are didactically designing the subject rather independently. To mention some random examples, pupils in article 1 are allowed to choose their own statements or myths about Sweden to prove or refute. Pupils in article 2 are encouraged to make a digital presentation about something they are afraid of, while pupils in article 5 choose a European country to make a narrative trip to. Teachers in all articles, design for learning by establishing a didactic design in the primary transformation unit characterised by openness, flexibility, participation and freedom. As visualized in article 5, and as will be discussed later on in this discussion, the didactic design of “teach to the test” (McFarlane, 2003) is not an alternative in the digital learning environment, as the pupils' own interests guide their learning. In a few LDSs (as seen in articles 1, 2, 4 and 5) the teachers give

hints on specific resources on the web, but most often teachers encourage pupils to explore the internet on their own. This can be understood as a rather common didactic design in the Swedish school today (Vinterek, 2006), especially in Social Science where pupils are often engaged in “their own research” or “their own work”, which in Sweden has its own term: *Eget arbete*, which according to Vinterek (2006) is used too unproblematically in Swedish governmental documents as well as in classrooms. The discussion in article 5 brings up the issue that the teacher is present and designs for learning, aiming for pupils to reach the highest grades in the setting and in the secondary transformation unit. In contrast to this, the teacher designs for less advanced learning in the primary transformation unit. The results in article 3 reveal that the absence of the teacher in the primary transformation unit causes a state of confusion and dejection among the pupils. The teachers’ didactic design of the primary transformation unit, where the important transformation process takes place, can thus be understood as not supportive enough of pupils’ learning. There are different reasons for the teachers’ absence in the primary transformation unit. In many LDSs it seems to be a consequence of technical problems with the digital learning resources. Another reason can be that teachers, who are digital immigrants (Prensky, 2001), assume that pupils, who are digital natives (Prensky, 2001), are highly skilled in ICT and therefore can navigate in the digital interface on their own. A third reason can simply be that teachers are given an almost impossible role (cf. Dillenbourg, 2008) in the extended digital interface where their duties include a wealth of work assignments concerning everything from descriptions of objectives to technical support. A fourth possible reason is that the teacher didactically designs for pupils to be able to produce their own Social Science material (Jewitt, 2008a). This latter reason will be further discussed below.

A crucial finding in this thesis is that the didactic design by the teachers is also flexible regarding the didactic third question of *why*? The results in articles 3 and 5 prove that subject aims are developed in interaction between pupils and teachers in the Learning Design Sequence’s secondary transformation unit. The 5<sup>th</sup> article discusses that pupils, in the act of assessment, appreciate the final aim as something negotiable and, as long as the pupils can argue why they want to learn something, the teacher accepts this and didactically designs for learning the subject area accordingly. During the Learning Design Sequence the subject frames are negotiated in interaction between pupils and digital learning resources, as well as in the formative assessment actions between pupils and teachers. Pupils’ interpretation of Social Science is a key to this phenomenon. An interpretation means not only that pupils form an understanding of their own and that this understanding increases within the framework, such as the grade criteria presented by the teacher in the setting, but it can also mean that the framework for interpretation is changed by means of the interpretation (Kress, 2010), as seen in

an empirical example where the teacher alters the course objectives to align it to pupils' final representations. This didactic design does of course have didactic consequences for the subject. If learning that is not framed by the original subject frames of assignments, criteria and curriculum, is accepted in the secondary transformation unit, Social Science content could be almost everything. This is not unique for the digital learning environment; instead it is quite common that Social Science embraces a lot of odd school activities, which do not have an obvious 'home', such as for example morning assembly, celebration of birthdays or theme days. The Swedish Social Science Syllabus for the Compulsory School has for many years included written knowledge demands for years 5 and 9, but these have now been augmented by knowledge demands for year 3 as well (Andersson, 2011). This, along with the fact that National Standardized Tests in Social Science might be developed<sup>50</sup> will possibly make Social Science a subject that is more strictly framed. Today however, Social Science, in the extended digital learning environment, is characterized by informality. This will be further discussed below.

### Subject design with informal features

This thesis, along with a lot of earlier research (for example Holm Sørensen et al., 2007) and reports (for example Hansson, 2010), shows how learning has informal features when pupils are using computers in the classroom. Informal learning is characterized by being, for example, voluntary, haphazard, open-ended, learner-led, unplanned (Wellington, 1990) and participatory and occurring where meaning is intrinsic to context (Martin, 2004). This kind of learning is especially visualized by the empirical examples in articles 1 and 5 in this thesis, but also in the other articles. Social Science can here be explained as being in part the objective of the didactically designed activities (cf. formal learning), but it is also the means for reaching the Social Science objective (cf. informal learning) (Holm Sørensen, 2009). For example, every article in this thesis shows how the relation between teachers and pupils is significantly horizontal in the digital learning environment, where pupils as well as teachers are engaged in exploring the digital interface. An empirical example of the horizontal relationship from article 2 illustrates how the teacher suggests that a pupil should use a specific website, while at the same time admitting that she has not tried it herself. She sits down at the pupil's desk, trying to meet his gaze and gesticulating vividly, but despite this the pupil does not care about the advice. Article 4 illustrates an educational setting where the teacher's workroom is next to the pupils' and where teachers and pupils send e-mails to each other and use the same information

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<sup>50</sup> According to a radio interview with Björklund (2011-02-12), The Swedish Broadcasting Company.

channels. According to Kress & Adami (2010) digital learning resources unsettle former patterns of communication, since these are developed with former social givens. The social framing of the subject does not only influence learning processes, but also the character of the subject. The results in, for example, article 3 and 5 suggest that pupils are less concerned about the assessment which means that pupils' activities are less empowered by the teachers and their didactic design. Despite the pupils' perception of the social framing, their signs of learning are, at the end of each Learning Design Sequence, always in some aspect, assessed. At this point the teachers again encourage their pupils' strategies to be open to what is presented in the digital interface, by embracing the pupils' signs of learning – even if they do not fit within the given frames or task assignment, nor answer to the specific course criteria. If the pupils choose to engage in, learn about and present something outside the frames they can still have learned and forwarded useful Social Science knowledge to teachers and peers, although this was not the knowledge the teacher had in mind in the setting. Another, less sustainable scenario for the subject design is discussed in article 3, where the pupils are aware that they are forming a presentation of the year as divided into two seasons, although they know that the year has four seasons. The phenomenon of pupils misunderstanding and presenting something that is directly incorrect has also been noticed in earlier research. According to Lantz-Andersson et al. (2009) pupils in a digital learning environment sometimes frame their mistakes wrongly, which means that they blame the digital learning resource for the mistake. This is devastating in terms of subject design, as pupils thus can miss opportunities to learn. In articles 1 and 2, similar examples show how pupils argue as if the computer or digital camera does things “on their own”, leaving the pupil powerless (and blameless). A lot of other research (for example: Birmingham et al., 2002; Holm Sørensen et al., 2006; Lindwall, 2009; Wheeler, et al., 2002) shows how pupils are focused on completing the digital assignment and “keeping up with one's work” and choose to go on to the next task instead of going into a discussion about the discrepancies in their representations. This too, is visible in this thesis where pupils on many occasions claim that they are short of time and for that reason put less effort into, for example, critically reviewing information, which is a core subject matter in Social Science (Skolverket, 2006a).

### Didactic designers as producers of digital Social Science material

The results in, for example, articles 2, 3 and 4 show how the Social Science material and information the pupils are faced with, and that they engage with to learn the subject in the digital learning environment, is not designed for children. This might be the teachers' conscious choice (Jewitt, 2008a).

Teachers could very well direct their pupils to a selection of websites designed for learning Social Science (as there are plenty of such Swedish websites where the information has been selected and angled for children), but most often they didactically design learning situations where the pupils are free to surf the net, trying their best to find suitable information on all kinds of different websites. When pupils try to make meaning of the multimodal information presented on different types of information sources, Social Science is negotiated and developed between them. According to Jewitt (2008a), this is a desired didactic design of a subject, since consumption of ready-made information risks directing pupils' attention from active knowledge production, i.e. learning. All articles in this thesis illustrate how pupils, instead of consuming Social Science material, are producing Social Science material (Hylén, 2010; Jewitt, 2003a). They appreciate the material as *their own* (cf. *ownership*, Ramberg & Tholander, 2006:167). A tangible example is presented in article 2, where a pupil designs his own digital comparison table between countries, instead of using one presented on a website. On the other hand, pupils in many articles show that they prefer 'cleaned up' information sources and too many hits on, for example, Google is not appreciated. While searching for information on the Internet, in what can be viewed as a chaotic learning situation, two crucial abilities are at work, framed by the objectives in Social Science (Skolverket, 2000). The first of these is the ability to see into the possibilities and the problems brought by the IT-society, while the second is the ability to assimilate knowledge in a complex society. The Social Science subject is, by being carried out in a digital learning environment, designed to open up for the world outside the school, something that is prominent in the curriculum (Skolverket, 2000). Another example of how teachers and pupils are producing their own Social Science material is discussed in the 2<sup>nd</sup> and the 5<sup>th</sup> articles, where the teachers' didactic design is reminiscent of a computer game<sup>51</sup>. Learning is organized here as a project work with specific rules, where pupils engage in designing their own narratives framed by a set of questions or assignments. They are supposed to pretend to take part in the narrative, experiencing some predetermined events, such as meeting some important person or cooking a national dish. According to Chu et al. (2009) it is beneficial for teachers to design a series of lessons that combine real and virtual learning settings. Concerning the subject of Social Science, it is transformed into a game or a play where facts can be set aside on account of, for example, imagination. Knowing facts by heart is not prioritized in the Swedish curriculum; instead this kind of didactic design is aligned with course criteria, since pupils become in-

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<sup>51</sup> These games can be called for example epistemic computer games (Shaffer, 2006) or serious games (Gee, 2008; Holm Sørensen & Meyer, 2007).

volved in the subject with empathy. This kind of didactic design answers to the very first sentence in the aims and the role of Social Science in Swedish compulsory schooling: “*Knowledge in Social Science gives the pupil opportunities to see the environment in relation to him/herself and to understand him/herself in relation to the environment, i.e. how the individual forms his/her world and how he/she is formed by the world.*” (Skolverket, 2000).

### The double set of course objectives

The double set of objectives in Social Science – on the one hand Geography, History, Social Studies and Religion, and on the other hand ICT – makes Social Science a subject that is somewhat hard to grasp. In the new National Curriculum Lgr-11, which takes effect as from 1 July 2011, and in the Social Science Syllabuses (Skolverket, 2010b) the double set is still present. But, considering that the knowledge demands for year 3 in Social Science are totally new, I expected ICT to be incorporated here and the digital competence expressed more explicitly, as in for example the Norwegian curriculum (L06). What is emphasized is that pupils shall be able to acquaint themselves with simple information in common media and I am surprised that tools such as, for example, the earth globe are mentioned, while a tool such as the computer is not. All of the articles included in this thesis show how Social Science in the digital learning environment mainly is didactically designed as group work. Article 3 indicates that the double set of objectives results in groups with younger pupils dividing the task, so that, for example, two pupils work with the Social Science content while the two other pupils concentrate on the design of a digital product. In their interventions, teachers often confirm this division. A possible consequence, discussed in the 3<sup>rd</sup> article, is that the group as a whole might very well reach the objectives, at the same time as each individual only reaches one of the double set of objectives. As I consider content and form to be two sides of the same phenomena, to choose a form also means to choose content – I trust that the pupil shows her or his understanding by showing *how* it is understood (Selander, 2009) and all pupils can thereby still reach the goals at the end of the LDS, irrespectively of how they have divided the task. This is more visible among older pupils, in article 4 for example, where the pupils divide the work (one is searching for information while the other is documenting it) but they are still both as much engaged in the transformation process, forming their social science knowledge together. Kress’ expression that something to be meant is brought together with a form which can carry and express that meaning (Kress, 2010), is guiding in this instance. The analysis of the empirical examples in this thesis vividly illustrate how pupils both express meaning with the factual text they write about the country, the year or a historical event, as well as with the choice to present the text in a colourful PowerPoint or in a digital film.

## Up-to-date Social Science information sources

Something has to be said about the changeability of information presented on the Internet, as this has implications for the subject of Social Science. According to Jewitt (2006) the “new” about digital media is the speed – the flow of information is fast, massive and constantly modified. The information the pupils engage with within the digital interface is relentlessly configured by the modes and their arrangements on the computer screen (Jewitt, 2003a), which means that a webpage about an important historical person can have another content and layout today, compared to tomorrow. Of course, the changeability of sources on the Internet also means that information is recently updated, which is crucial for the subject content of Social Studies, but is also important for Religion, History and Geography. Concerning Social Studies, teachers in 1:1 schools in Sweden report that they appreciate the updated information in Social Studies and other subjects when using digital learning resources as a significant surplus value with computers in school (Åkerfeldt, in print).

In a Social Science subject area where textbooks are used as the main source of information, the teacher knows exactly what information the pupils will engage in. In the digital learning environment the information the pupils are deluged with is impossible for the teacher to survey and control. This has didactic implications for assessment, which will be discussed later on, but first the affordances in the extended digital learning environment will be discussed.

## Interaction and affordances

*Research question II: How do pupils interact with the digital interface and with what affordances do they engage in the digital learning environment?*

In the 1<sup>st</sup> article, interaction in a large number of LDSs was studied in order to find general patterns in digital interface interactions. A few patterns were found and discussed. Some of them will be further elaborated on here and confirmed or refuted by the results in the other four articles, as well as by other research. The notion of affordance was the focal issue in the 2<sup>nd</sup> article, but this has also been analysed in the other articles and a small selection of all the affordances that the pupils engage with within the digital interface will be further discussed below.



## Multimodal, super-responsive and cooperative interaction

First of all, pupils' interaction in the 8 LDSs proves to be multimodal in the digital interface, which aligns with a design theoretical perspective. Multimodality is described, for example by Kress (2010), as the normal state of human communication. But since the focus in this thesis is on orchestration (Selander & Kress, 2010), production and composition (Kress, 2010; Latour, 2005), rather than reception, the multimodal character of pupils' interaction with the digital interface is prominent. All articles in this thesis discuss how pupils use gestures, pictures, sounds, symbols, texts, body positioning, mimics and layout in interaction to make meaning. Another pattern that has already been discussed, as it is also part of the teacher's didactic design, is that pupils are cooperating and helping each other significantly in the digital learning environment. This pattern, which is explicitly illustrated in article 1, is confirmed by other research as well (for example Alexandersson, 2002; Birmingham et al., 2002; Farkell-Bååthe, 2000; Karlström et al., 2005; Kroksmark, 2011; Loveless, 2003; Russel, et al., 2002; Svärde-Åberg, 2008; Åkerfeldt, in print). Pupils are what Birmingham et al. (2002) calls "super-responsive" to each other's actions. They constantly respond to each other's representations by cries of delight, gestures and laughter. They inspire each other and they quickly accept new suggestions, making interaction in a digital learning environment rather impulsive. Among younger pupils (in article 1) this is especially visible as the pupils are changing physical positions in the classroom, stopping by at each other's computers and passing comments to their peers. Pupils constantly offer to help each other. When they help each other, they are organized or organize themselves in *learning hierarchies* (Holm Sørensen et al., 2006; cf. Svärde-Åberg, 2008), which means that beginners learn from more experienced pupils. Whether a pupil positions her/himself as experienced or not depends on the specific situation or the task they are to solve – positions thus change constantly. Likewise, asking for help from a peer is common in the digital learning environment. A reason for this can be that learning in the digital interface is appreciated as a collective responsibility (see for example Kroksmark, 2011). Not surprisingly, pupils work more independently the older they are and they need less help from the teacher concerning the digital learning resource or the Social Science content.

The common belief, that the pupil who is managing the digital learning resource, learns more than those who are just observing their peers activities in the digital interface (Ellis & Blashki, 2007), is discussed and disproved in article 2. The observing pupils are just as actively interacting as the pupil clicking the mouse and typing on the keyboard, but with other modes such as gestures, speech and laughter. At times an observing pupil can be the one giving orders about what the peer should type or click on. The digital interface is, as described earlier in this thesis, not restricted to the physical inter-

face of screen, mouse and keyboard, but extended to all sign-making that occurs in and around the interface, whether it is mouse clicks, a group member singing or a teacher passing by and giving the group an approving smile.

### The digital learning resource as a participant in interaction

The last interaction pattern to be discussed here is visible in all articles and relates to the concept that pupils view the digital learning resource as an important participant, or a third element (Birmingham, et al., 2002) in the interaction. A difference between older and younger pupils can be seen here. To the younger pupils the digital learning resource is not viewed as an obvious participant at all times, instead the results, for example in article 1, show how pupils discuss whether to use the computer for a specific activity or not. Among the older pupils using the computer is a matter of course, as seen in article 4, where pupils cannot even find a pen or a piece of paper to take notes with, since they are using their own laptops for all kinds of activities. In the digital interface pupils keep their eyes focused on the digital learning resource. Digital screens thus impair eye contact, which is often considered an important condition for interaction. Older research indicates that people fail to share a common framework, or a common ground (Hanks, 1992), when interacting in front of a screen, but more recent research testifies to how pupils interact by deictic expressions (Duranti & Goodwin, 2000). This means that pupils take for granted that they and their peers are viewing the same information on the screen and although they are never facing each other, research by Klerfelt (2007a) shows how the screen works as a visual basis for pupils' interaction. Article 1 in this thesis discusses how scattered interaction seems to be when focusing on verbal modes, but that with a multimodal approach, interaction comes out as attuned. Several articles in this thesis confirm that pupils have no problems in understanding each other and that the resource facilitates communication; something that is taken up in other research fields as well (for example in the socio cultural: Säljö, 2000; 2005). Pupils interact via the screen, allocating the digital learning resource an agency (Kress et al., 2001). As mentioned earlier they interpret the digital learning resource to act independently and they refer to the computer or the digital camera (in for example article 1) with pronouns such as *you* or *they*. Agency is, from a design theoretical perspective, understood as the participation or space of action (Selander & Kress, 2010) and the role in meaning-making (Jewitt & Kress, 2003). The results in articles 1 and 2 in this thesis indicate that pupils understand the digital learning resource as a participator that plays a decisive role for meaning-making, and that has its own space of action. I do not consider a digital learning resource to have an agency or an identity on its own, since it is just performing functions humans have designed, but Latour (2005) claims that it can be fruitful to point out how different kinds of artefacts in a wide sense act as agents. Instead of separating

material and immaterial worlds, the connections between them can be analysed. As the criterion of a prompt (van Leeuwen, 2005) is that it becomes a prompt when the learner notices it as a prompt, I think that a digital learning resource can offer potential prompts, for pupils to choose to, or choose not to, engage in. From this point of view I study pupils' interaction with affordances provided by the digital learning resource. This is addressed in the next paragraph.

### Pupils' engagement with affordances offered by the digital learning resource

The results in the different articles illustrate how affordances can consist of material and social possibilities, and how they influence pupils' meaning-making (Kress, 2010). Although different pupils recognize and comprehend different affordances depending on needs, interests and the situation (van Leeuwen, 2005), some conclusions can be drawn about pupils' engagement with affordances in these eight LDSs. Each article holds several examples of how pupils make use of software affordances, as well as hardware affordances, when engaging in digital texts. To mention recurring affordances when pupils are working with computers, there is red and green underlining in Word-documents to facilitate spelling and grammar, and there is the affordance of copy&paste text and image. These affordances are so familiar that one might not think about the fact that they actually initiate quite advanced transformation and forming processes of composition (Latour, 2005; Selander & Kress, 2010). The results in all of the articles illustrate how the digital interface affords multimodal interaction, by offering engagement in modes such as sounds, images, colours, music, text and symbols. All articles show how pupils navigate via multimodal menus displayed on the screen. Their activities are selection-driven (Kress & Adami, 2010).

A familiar affordance that makes interaction selection-driven is hypertext. By entering a text on the Internet, a possible relation with all other existing digital texts is conducted (Kress, 2003). Hypertext affords pupils the possibility to navigate between texts simply by clicking on a word, sentence, image or a symbol. Pupils in this study are often clicking rather randomly at different links – they are engaged in surfing the net. Statistics from Medierådet (2010) indicate that younger pupils surf the net in order to have fun and that they, more than older pupils, welcome surprises while doing so. In several articles, this phenomenon is visualized by young pupils who search for specific information but come across other texts and images that they appreciate as salient (van Leeuwen, 2005). This means that the image or text attracts their attention, and thus they choose to engage with it. Salient to the pupils in this study is, for example, images of people, words in Swedish, images that they recognize beforehand, images that are appreciated as “cool”

and texts presented as something exciting or provocative. Something that is not appreciated as salient is text in English. English texts are ignored by younger pupils, as seen in article 1, and commented on by the older pupils as involving too much hard work, as seen in article 4. Affordances appreciated in the digital interface result in the fact that pupils change the aims of their work, in order to be able to incorporate salient texts or images into their representations.

Another specific affordance, discussed for example in articles 1 and 2, is how digital learning resources afford visualisation; they can gestalt information and make abstract concepts concrete (Price & Rogers, 2004) in more varied ways than can other resources (Alexandersson, 2002). Simulation, visualization and concretization can, according to for example Naeslund (2001) hold the richest possibilities for learning. One affordance, which is used significantly by the pupils in this study, is the search engine Google's option to search for images, instead of words. Digital natives choose to search for images, instead of searching in a traditional encyclopaedia, if unsure of what a word means (Kress, 2010), and these articles also show how pupils search randomly for images to get inspiration for their work. Another aspect of visualisation involves how digital learning resources afford the presentation of pupils' own learning paths and representations, by for example the possibility to view a film or a PowerPoint while it is being formed. In article 3 a group of pupils are confronted with their text when it is transduced (Kress, 2010) from written text to moving image. At the moment they watch the film in the digital video camera, they all become aware of the text's inadequacy. Digital learning resources afford transduction and in this thorough yet common process meaning is dragged from one mode to another. In the process the logic is changed (Kress, 2010), which in this example seems to make pupils see their presentation with new eyes and depict shortcomings. A final aspect of how digital learning resources afford visualization in this material is how explanations of, for example, an object's movement, as exemplified in article 1, is facilitated by affordances such as animations or operating schedules in computer programs. Digital learning resources are well known for enabling children to explain, as well as to understand, complicated information not reachable only with spoken language (Säljö, 2000).

All articles in this thesis discuss how digital learning resources afford modifications of representations. This affordance holds a crucial difference to traditional representations, where for example a painting or a poster, or even a text written with pencil, is difficult to modify. The same applies to an old-fashioned photo, which can't be viewed on the camera screen, nor retaken. On the contrary, pupil's presentations in the digital learning environment are dynamic and pupils redesign them constantly. They take, delete and retake plenty of digital photos, they are deeply engaged in altering headlines in Word documents until they have the desired font, and they try many dif-

ferent background colours in a PowerPoint, before choosing one that represents the desired atmosphere. A digital representation is viewed as an active document. Article 2 presents an example where pupils alter their representation at the same time as displaying their PowerPoint in class. The result in article 3 indicates that digital products are reused in circular, cumulative processes and this dynamicity renders it possible for traces from one digital presentation to be found in another one, perhaps years later.

The authenticity that digital media can offer education is often highlighted in educational literature about ICT, especially regarding simulations and computer games. Papert did already in the 1990s predict that computer games would make pupils “*grow up with the opportunity to explore the jungles and cities and the deep oceans and ancient myths and outer space*”. (Papert, 1993:9). According to Alexandersson (2002), digital learning resources can support pupils to handle reality in different ways than other resources can; something that is illustrated in this thesis, for example in article 5, where pupils engage and position themselves in a subject area as if they were experiencing it for real. The authenticity can also be appreciated as a prompt for ethical dilemmas, as illustrated by an example in article 2, where some pupils are discussing the ethics of using photos of real people in their digital product. In the 1<sup>st</sup>, 2<sup>nd</sup> and 5<sup>th</sup> articles, pupils are using digital cameras to take photos to make a digital film. According to Kress & Adami (2010), the function the digital camera affords pupils is to see the world around as reality to be selected and captured. Once represented, the reality is framed (Bateson, 1972) and achieves a new meaning (Kress & Adami, 2010). Images afford a documented event to represent something new and different. To give an example, a pupil in article 1 is making a PowerPoint about her family. She inserts a digital photo of her dad lying in a hammock, which is used to represent her dad as being a lazy man, a couch potato, although this clearly was not the original idea with the photo.

## Paths and signs of learning

*Research question III: How do pupils design their own paths of learning in Social Science in the digital learning environment and with what modes do they represent their learning?*

All pupils studied in this thesis are digital natives (Prensky, 2001), which means that they approach information in the digital learning environment and solve problems or assignments differently to earlier generations. A crucial finding, discussed in all five articles of this thesis, is that pupils' paths of learning are designed in an abundance of modes in the digital learning environment. In all but one of the LDSs studied in this thesis, pupils are working

together in pairs or groups. This is not only because that is how teachers most often didactically design for learning with digital learning resources, but also because pupils cooperate substantially in the digital learning environment (Kroksmark, 2011). The results in article 1, for example, show how pupils cooperate constantly, also when working on individual digital representations, as in the LDS “The history about me”. They form their paths of learning together, by asking each other questions, by getting involved in and inspired by peers’ representations and by telling each other about what they are doing in the digital interface. The results of the articles illustrate how pupils make their own paths of learning (Selander, 2008a) in the digital interface. They choose how, when and why to enter a text and they choose how to navigate in the digital learning environment. In the following a selection of interesting features in pupils’ design in learning will be discussed. The most prominent finding in this aspect is that pupils design their learning paths by means of affordances offered by the digital learning resources.

### Design of learning paths by affordances

Pupils in these articles are constantly seen using affordances to learn. Sometimes pupils’ activities in the extended digital interface are described as an activity of “copy&paste” information found on the Internet instead of learning (Perkel, 2008). For example the 1<sup>st</sup> article in this thesis expresses that the affordance of copy&paste can include learning. When learning is understood as a process of transforming and forming, a strategy such as copy&paste includes learning, since the information is transformed into something new. The text found on the internet is selected and delimited, put into a new context such as for example a PowerPoint slide, probably redesigned regarding size, colour and layout, introduced with a headline and possibly illustrated by an image. Pupils here show an increased ability to use and elaborate a set of signs in a meaningful way (Selander, 2009) and by such a copy&paste strategy the pupils can be seen to form their own knowledge. The results of primarily articles 1 and 5 in this thesis indicate that pupils’ learning in the digital learning environment is what Wheeler et al. (2002) calls peripheral or incidental. The pupils make meaning and learn by means of affordances offered by the digital learning resource. What is regarded as salient by the pupils in the digital environment attracts their attention. Even if the attended image, sound or text has little, or even nothing, to do with the given task or the subject area setting, the pupils still try hard to make meaning of the information and make use of it to form some kind of representation of their learning. As discussed above, the teacher is not always present in this transformation process and this thesis presents several occasions where pupils seem to be very eager to make meaning of quite irrelevant information, leading to peripheral or incidental learning. To mention an example, pupils in article 1 design a PowerPoint about Sweden as a safe country. They search

for “safe+Sweden” in Google images and get lots of hits, where one of them is an image of a Volvo. As a result they let an image of a Volvo represent Sweden as a safe country. Pupils highly value the information presented by the digital learning resource and tend to trust a fact – although they discuss that it seems to be incorrect, or the suggested spelling of a word – although it is a word other than the word intended. They have an open attitude to what appears on the screen and use the information very creatively. They transform their own intentions according to their engagement in the digital interface and aim their interest at something that is, at the moment, feasible. This is for example illustrated in article 1, where pupils are elaborating on the “myth” about Sweden that it is not possible to swim in Sweden in the winter. Suddenly the pupils become engaged in transforming information about “swimming in the summer” due to hits about outdoor bathing places, although their representation is only supposed to concern “swimming in the winter”. This leads on to how pupils’ interests carry their design in learning, which will be discussed below.

### Pupils’ interest carries their learning path

An important finding in this thesis is that pupils are designing their paths of learning steered by their own interest, i.e. what they choose to focus on. According to Kress (2010) it is always the learner’s interest that frames her or his attention to what becomes that which is to be learned, which functions as a curricular prompt. What makes this central in this thesis is that pupils here are left to work independently in the primary transformation unit, and thus given an ample space of action. All articles in this thesis show how pupils are introduced to a specific subject area – including some sort of an assignment or a prompt – in the LDS setting, and how their interest guides them to choose what to engage in. This thesis shows how pupils’ desires are a core issue in the digital learning environment. Instead of trying to tame pupils’ desires, teachers in a digital learning environment try to accommodate pupils’ desires and interests. According to Dahlberg & Bloch (2006) the desires of children encounter the desires and wishes of the teachers too. In some examples in this thesis pupils are interested in achieving high grades and therefore their interest makes them focus on completing all assignments correctly and in time in order to satisfy the teachers’ wishes (for example article 4). In other examples pupils are interested in making an aesthetically attractive digital film (for example article 3) and in yet other examples pupils are interested in designing an entertaining presentation, with a provocative content (for example article 5). Their interest is thereby the starting point of their own learning path, at the same time as it makes the subject-related content meaningful in that specific situation. Pupils’ interest is not consistent; instead the results show how it constantly changes direction, due for example to a technical problem with the digital learning resource, an attractive

image on the screen, a teacher's formative assessment or a new group member. As a result pupils' learning paths in the extended digital interface are far from straight. They are more of a tangle, or a rhizome (Dahlberg & Moss, 2005; Deleuze & Guattari, 2004). According to Deleuze & Guattari (1999) the rhizome operates by variation and expansion, and a map – or a learning path – is modifiable, constructed with multiple entryways. A predetermined path of learning does not exist (cf. Dahlberg & Bloch, 2006), instead it is designed in learning (Selander & Kress, 2010) in the transformation and forming process in the LDS where pupils design their own learning in relation to the conditions of the learning situation. Pupils' interest also reveals something about how they choose to position themselves – how they negotiate their identities in the extended digital interface.

## Negotiation of multiple identities

Pupils' designs in learning are dependent of how they position themselves. Position has to do with identity, and although identity was not the focal issue in any of the articles included in this thesis, it is something that lies alongside the discussions of each article, since negotiation of identities, from a design theoretical perspective is one aspect of learning (Kress, 2010; Selander, 2008a). The concept of identity is also presented in the theoretical chapter of this thesis and used as an analytical tool in article 4.

Article 4 shows and discusses how pupils position themselves in the school setting and how a pupil can, for example, identify herself or himself as someone, for example a person who is untalented in Social Science or a person who is an ICT expert. The pupils negotiate with themselves about which identity is possible or apt in different situations and their identity is constantly built anew. All articles, in one way or another, illustrate how pupil's interest is of high importance in this negotiation process, as it frames the world around the pupil in order to make it meaningful to the pupil in that specific situation, as outlined by the LDS purpose. It is impossible to avoid aspects of power and dominance in relation to identities (Selander & Aamotsbakken, 2009). Article 4 brings up peers, and especially teachers, as playing a decisive role, since pupils constitute their identities according to the responses or comments of other – such as the teacher's interventions and assessment actions.

Identity work here is not about creating or finding a true identity but about finding different identities to position from (Bauman, 1991; Ben-yamine, 2008). This thesis shows how each pupil simultaneously has multiple identities (Davies, 2003) and chooses to position her- or himself from different identities in different contexts or situations. Article 4 discusses how pupils make an image of themselves in each situation, due to their own wishes, ideal pictures and also due to their own knowledge, and how they then act according to that. Article 2 shows how the pupils are experimenting



with their identities. They pretend to be English and they make jokes with each other positioned from a digital identity as if participating in a “virtual” world; jokes they would not make face to face in the “real” world. According to Montola et al. (2009) this kind of division is problematic since a virtual world and a physical world can be argued to be equivalently real (Montola, et al., 2009). Pupils in this study are acting differently depending on how they position themselves, something that is shown in Hernwall’s (2001) research as well where the possibility of anonymity influences the topics of communication. In the above mentioned example pupils appraise the situation as acceptable to make jokes with a peer when positioned from the virtual world (by text and images in a PowerPoint), but when questioned about the joke, when positioned from the physical world in the classroom, they do not find this justifiable. Such examples indicate that pupils interpret and value their digital actions as less serious.

In the didactic design, reminiscent of an epistemic computer game (Shaffer, 2006), a serious game (Holm Sørensen & Meyer, 2007) or a pervasive game (Montola, et al., 2009), as illustrated in two of the thesis’ articles, pupils are encouraged to act from different positions. Drawing on Shaffer’s (2006:158) work, pupils in these articles can be understood as positioning themselves from three different identities simultaneously (cf. Gee, 2003): 1) *the real identity* is the physical pupil in the classroom, designing a narration in accordance with the teacher’s didactic design; 2) *the virtual identity* answers to the identity that is given by the teacher in the setting of the specific LDS and means that the pupil is supposed to engage in the situation *as if* she or he is actually there; and 3) *the projective identity*, which is the type of character the child wants to be in the specific situation; perhaps a more hazardous, provocative and mature pupil. The first two identities are authorized by the teacher, whereas the third one lies out of the teacher’s control. Here a complex and complicated situation turns up and other research on the same empirical material (Kjällander, forthcoming publication) shows how pupils, when acting from the projective identity, for example experiment with drugs. These kinds of narratives are complicated for the teacher to accept as well as to assess.

### Significant signs of learning in modes other than speech and text

A hypothesis in this thesis is that learning in a digital environment is multi-modal. Pupils’ learning paths are characterized by pluralism and multiplicity, opposed to traditional learning paths where much of reality such as sound, light and movement are left out of education (for example Dahlberg & Bloch, 2006; Jewitt, 2003b; Kress, 2003). This leads on to the modes by which pupils design their learning paths and represent their signs of learning in. The empirical material this thesis builds on has been collected within a school context, and since reading and writing is prevalent in school (Kress,

2003), so is reading and writing in the teachers' didactic design of the subject area as communicated in assignments and grade criteria too. Pupils' signs of learning in speech and written text are always present and often analysed in the different articles. The articles also show how pupils talk about their modes of reading and writing as the primarily representation of knowledge, but in their learning paths and in their signs of learning, other modes are as much, or even more, significant. I want to mention a few empirical examples. When pupils are using digital tools such as cameras and video cameras their gestures, skills and touch holds explicit signs of learning. This is especially prevalent in articles 1 and 4. In article 1 the pupils' signs of learning in body movements, gestures and speech are specifically explicit when they loudly explain – as if talking to the camera – why different objects are documented. In a digital film, analysed in article 3, the physical actions at the scene with modes such as body position, mimics and gestures, holds evident signs of learning, other than for example the written text or the speaker's narrative voice. Empirical examples illustrating information searches on the Internet are presented in all articles. When pupils are searching for information on the Internet the cursor on the screen, as well as pupils' clicking with the mouse, can indicate their interest and give an idea about the pupils' signs of learning. In a PowerPoint, as seen in the 1<sup>st</sup>, 2<sup>nd</sup> and 5<sup>th</sup> articles for example, an image, a sound, the background music, an object's movement on the screen, the fonts of the headlines or the colour of the slides hold specific signs of learning, since they are not chosen randomly. The notion of *motive effect* (van Leeuwen, 2011:23) helps to reveal pupils' signs of learning in the LDS Europe – The escape to Poland, where they spend time and energy on choosing a dark background affectively to communicate the suitable feeling or frame of mind of the country's politics. Pupils can design different learning paths by different modes in one single PowerPoint slide. The following paragraph further discusses the simultaneous meaning-making activities pupils are engaged in, in the extended digital interface.

### Simultaneous, parallel learning paths on the Internet

Many examples discussed in this thesis illustrate pupils using the Internet. When pupils search for information on the Internet their learning path, almost without exception, begins at Google. This is a common approach today and is expressed by Auletta: "*We don't search information, we Google it.*" (2009:xi). Pupils search for one or several words on Google and irrespectively if they search by images or not they get a wealth of search results. Pupils often choose the first alternative link and engage in the presented information and form their learning paths by, for example, images and hyperlinks. According to van Leeuwen (2005) our brains are perfectly capable of understanding the same text or communicative event at two or more levels

simultaneously, and this is how I understand pupils' design in learning in these LDSs.

Pupils simultaneously design parallel learning paths in the digital interface, where the first one represents the formalized education which is the path initiated, promoted and assessed by the teacher. This path answers to assignments and curricular aims. The other path represents the extended learning that goes on below the surface. This learning can, by drawing on Olsson's (2009) work, be understood as undisciplined, random and wild and motivated by pupils' desires. These learning processes can be profound and creative (cf. Naeslund, 2001) and hold significant signs of learning. An empirical example here is when pupils in the LDS "Fears – handicap" in article 2 engage in quite advanced ethical discussions on whether it is morally defensible to use a photo of someone copied from the Internet or not. The learning that occurs in such moments is often invisible for the teacher and for that reason falls outside of the frames for assessment. In the following section assessment in the digital learning environment will be discussed.

## Assessment of learning

*Research question IV: What is recognised as learning in a digital learning environment, how is this learning assessed and how do pupils make meaning in assessment actions?*

Assessment is the focal issue of article 5 and is additionally also more or less discussed in all of the articles, since teachers often participate in pupils' interactions. Drawing on Björklund Boistrup's (2010) work on assessment discourses in Mathematics classrooms, assessment in the eight Learning Design Sequences studied in this thesis can be understood from a discourse called *Anything goes* (Björklund Boistrup, 2010:167). The discourse is used here to create a general comprehensive picture of assessment in a digital environment. The assessment focus is on the task, rather than on the process. Feedback is mainly from the teacher to the pupil, but the pupil is encouraged to contribute to the discussion. The teacher is mostly active but sometimes she/he leaves what the pupil has presented unchallenged, even if it is inadequate. This discourse is a great step from skill-and-drill that used to be a common approach in digital environments and that has proved not to support learning, but according to Gee (2008:200) neither does the strategies of "anything goes" or "just turn learners loose in rich environments" (cf. Kirschner et al., 2006). Still, a general finding that I would also like to point out is that pupils in these LDSs do make meaning and learn in the assessment actions *together* with their teachers (cf. Lundahl, 2006).

## Recognition of learning – depending on the transformation unit

Before entering into a discussion about the assessment of learning, the concept of power must be considered for many reasons. All assessment actions are related to the context, or cultures of recognition, where they occur (Selander & Kress, 2010). First of all, something has to be defined as knowledge in order for learning to be assessed. In most of the eight LDSs transcribed and studied in this thesis, knowledge and what is to be assessed is, by the teachers and pupils in the setting, understood as “completing the assignment”. The assignment is to make a digital presentation, such as a film or a PowerPoint, with a Social Science-related content. The older the pupils, the more the assignments correspond to course objectives and syllabus and the more the assessment act is aligned to this too. From a design theoretical perspective, the choices of the form or configuration of the Social Science material is immensely significant for how something can be understood as meaningful and acquire the status of knowledge (Selander & Rostvall, 2008). ICT has a prominent position in Social Science syllabuses as well as in Social Science work in the classroom, but not in course objectives or grade criteria in these LDSs. From my researcher’s perspective “completing an assignment” cannot be considered as learning. Instead learning, from a design theoretical perspective, is viewed as the result of the transformative engagement with something, leading to a transformation of the pupil’s semi-otic or conceptual resources (Kress, 2010). Learning is understood as the increased ability to use and elaborate a set of signs within a certain domain in a meaningful way (Selander, 2009). Article 5 shows how learning is slightly differently appreciated by the teacher depending on what LDS transformation unit the pupils position themselves from. In the primary transformation unit, pupils’ texts, ICT engagement and their choices and arguments are recognized as learning in modes such as body position, gaze and voice. In the secondary transformation unit, pupils’ ICT skills, speech and text, their engagement in information searching and creative solutions are recognized as learning. In the digital learning environment the outwardly signs (Kress, 2010), formed in for example a digital product, are more and more appreciated as learning the further on the pupils are positioned in the LDS. In the process of forming their representations, pupils show that they are members in what Lave & Wenger (1994) would call a “community of practice”, where both the understanding of what must be done as well as the activity itself is recognized as learning. A slight difference in the recognition of learning depending on age is seen in the different LDSs. Secondary school pupils’ representations in physical products are appreciated as holding signs of learning more than are preschool pupils’ representations. Preschool pupils’ interaction with the digital interface is understood as learning, probably because the teacher here is more present in the primary transformation unit than she/he is in the older pupils’ transformation process.

Secondly, power is always present in situations of the kind studied in this thesis (Foucault, 1982), and therefore it is important to consider that sometimes leaning is actually not the issue, but power is (Kress, 2010). In article 5, one example illustrates how the teacher, in a formative assessment act, corrects a pupil's grammar. Probably he does not do this because grammar is appreciated as knowledge in the LDS. Instead it is possible that he does it to show who is in charge. The different articles show how this kind of assessment of details is more likely to occur in the primary than in the secondary transformation unit, where focus is laid on more physical characteristics of pupils' learning paths.

### Assessment purposes – depending on the transformation unit

Not only is knowledge appreciated differently at different stages of the LDS, the assessment actions have different intentions too, depending on what transformation unit this is carried out in. Article 5 discusses how teachers' intentions with the didactic design of the subject area aim at pupils reaching a high level of knowledge – cf. Lindström's (2002) novice/expert level in assessment – whereas teachers' formative assessment in the primary transformation unit aims at pupils reaching a lower level of knowledge. Despite this, summative assessment in the secondary transformation unit is accomplished with the highest grade criteria in mind. This phenomenon is reoccurring in the different articles, where the teacher is very attendant at the introduction of the LDS and then she or he lets the pupils explore the digital resources independently, only to yet again play a decisive role at the end of the LDS at the time for summative assessment. According to Kress & Adami (2010) the former stability of genres, discourses and knowledge can no longer be assumed in the digital learning environment; thus social conditions are unstable and provisional. They mean that each occasion of communication in principle therefore requires an assessment act in the moment. The lack of qualitative teacher's intervention and formative assessment is discussed in several of the thesis' articles, but it is not analysed. Sometimes it appears to be a conscious didactic design (Jewitt, 2008a), sometimes it seems to be related to technical problems that occupy teachers' time and engagement, as illustrated in article 4, where the teacher must leave to go and find some laptop cables, as well as finding out why the Internet is down, instead of continuing the formative assessment act that she began.

## Assessment as grading something unknown

It is impossible for teachers to predict the information the pupils will be confronted with in the digital interface as what is to be learned is constantly configured by the modes on the computer screen (Jewitt, 2003a), and since teachers only participate to a certain extent in the transforming and forming process of the LDS's primary transformation unit. As a result, pupils' final representations time and again come as a surprise to the teacher in the end of an LDS. Assessment becomes a matter of grading something unknown. Their learning might be unknown, but it is not independent from processes of assessment (Selander, 2009), as this is framed by the school. As assessing the unknown by a traditional test would be complicated, assessment is conducted in relation to the pupils' representations instead, as illustrated in article 5. This is one aspect of the school as an institution, that was earlier characterised by excluding, now being characterised by including, as discussed in article 4. According to Erstad (2008) digital technology has brought about an interest for measuring the non-measurable as the complexity of digital resources can be used to assess skills such as problem-solving that are difficult to assess with more traditional assessment actions. In a few LDSs the teachers simplify pupils' learning by ticking off that they have finished all assignments (as the assignment is often recognised as the main representation of knowledge), but in the major part of the LDSs teachers show a very advanced capacity of apprehending and including pupils' signs of learning. Instead of correcting and checking pupils, and acting as the one that sits on all the keys, they open up for their own curiosity and exploration. They show their epistemological uncertainty (cf. Deleuze, 1995) in relation to the pupil by viewing this unknown as an asset. This is especially obvious in article 5, where the teacher at the end of the LDS praises the pupils' representation of a politician, although the assignment was to present a scientist. Listening makes visible here what is unattributable and new (Dahlberg & Bloch, 2006). Listening as a didactic design has gained ground in several research fields (for example Dahlberg & Bloch, 2006; Åberg & Lenz Taguchi, 2005), and this is true in the multimodal research field as well (van Leeuwen, forthcoming publication). But since learning, from a design theoretical perspective is an increased ability to use and elaborate an established set of signs within a *certain domain* in a meaningful way, this assessment approach of *anything goes* (Björklund Boistrup, 2010) is problematic.

## Multimodality in assessment actions

According to Forsberg & Lindberg (2010), classroom research on alternative assessment actions calls attention to the importance of the development of multimodal tools for teachers' assessment of pupils' learning. In this thesis, the 2nd, 3rd, 4th and 5th articles illustrate how teachers assess multimodally.

They use for example nods to approve the pupils' imaginative experiences, frowns to disapprove of the pupils' engagement in the design of a digital table, mouse movement to indicate a preferred layout or a recommended resource with the indicator on the screen and smiles to show approval of a map. They also use oral speech to praise or criticise and written texts to give feedback to or to grade the pupils' work. The results in article 5 illustrate how teachers' modes can be contradictory, where the teacher with his words for example accepts the pupils' representations, while other modes, such as long pauses, staring gaze and touching of his face communicate the opposite. Multimodality is a core issue also in pupils' meaning-making in assessment actions. Article 5 shows how pupils use their body, gestures, gaze and voice, as well as tools such as course objectives and criteria to make meaning of the teacher's assessment. Although the teachers' assessment actions and the pupils' reactions are multimodally represented, teachers do not always succeed in reaching the multimodality in their pupils' signs of learning, which will be discussed in the next paragraph.

### Invisible learning

Pupils' multimodal interaction, that is so prominent in the digital interface, causes implications for assessment, since the assessment system, according to for example Underwood (2007), is trapped in the book age and inappropriate in the digital age. To be precise, school cultures of recognition have not been able to keep up with the new cultures of production (Selander & Kress, 2010). From a design theoretical perspective assessment represents the understanding of signs of learning, as shown by different communicative modes (Björklund Boistrup & Selander, 2009). The pupils' engagement with modes such as layout, music, colours and sounds is seldom recognised as learning in these LDSs, although that is something that the pupils, being digital natives, prefer to engage in (Prensky, 2001). According to Jewitt (2003b), assessment will ignore and negate much of what is learnt if assessment is restricted to speech and writing. To provide an example, the results in article 5 illustrate how neither the formative, nor the summative assessment actions concern the design of the PowerPoint, although the pupils have, for example, designed the background colours of the slides to represent specific moods. The results in the articles illustrate that there is a digital divide between the digital natives and the digital immigrants (Prensky, 2001). A significant part of pupils' learning in the digital learning environment thus disappears in the digital divide.

Pupils' learning is not only made invisible by being represented in modes that are not perceived by the school. As pupils are designing their own, and sometimes parallel, learning paths in the digital environment, and since the teachers are not intervening in the pupils' forming of knowledge in the primary transformation unit, mainly (and at times only) their learning that is

represented in the final product is visible. This visible learning represents only a small part of what the pupils have learned, for many reasons. For example their digital texts are redesigned over and over again (as seen in for example article 3), items are cut out and other items are lost (as seen in article 5) because of technical problems. As discussed earlier, pupils design their learning paths in response to affordances and prompts in the digital interface, which means that they often engage in websites and facts that they choose not to include in their final product. Article 1 discusses the fact that pupils learn a great deal that is not noticed or assessed by the teacher and article 5 suggests that assessment can be designed to be exploratory, to embrace new knowledge to acknowledge innovation (OECD, 2005). This directs us to the concluding discussion of this thesis, where the challenges the schools of today are confronted with will be elaborated.

## Didactic complexities in The Online Learning Paradigm

As discussed in and confirmed by this thesis, learning in school takes place in a *digital divide* (Prensky, 2001) between digital natives – pupils – and digital immigrants – teachers – when digital learning resources are used. This divide has been discussed before, but is of immediate interest right now, when most pupils have their own mobile phones, when 1:1 initiatives are emerging in schools around Sweden and when children for the first time ever are claiming that they spend more time on the Internet than they spend with their friends in their spare time (Medierådet, 2010). These are all signs that we have entered a new paradigm.

In the introduction to this thesis, four international paradigms in the development of, and research about, ICT for learning in schools over the last 40 years (Koschmann, 1996) were identified and explained. In addition, a contemporary paradigm was suggested. I call this contemporary paradigm *The Online Learning Paradigm*, since learning, communication and design in the extended digital learning environment presently occur online with digital resources. According to an often cited report called “Skola 2021”<sup>52</sup> (Myndigheten för skolutveckling, 2007a), one of the largest challenges schools stand before is to make the most of new digital resources in order to develop pedagogy and this paradigm has been noticed in different surroundings by different researchers. It is by Hylén (2010) described as based on four trends. Three of the trends have a direct bearing on learning in contemporary educational environments; *users are producers*; *informal learning increases in importance* and; *learning is independent of time and space*. These trends will be discussed here with a focus on how they can be under-

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<sup>52</sup> In English: “School 2021”.



stood by means of my thesis, as well as what the implications can be for didactics in the schools of today.

### Trend: Users are producers

One of the core issues in the thesis concerns how pupils and teachers are designing the digital learning environment. Children grown up in the 1990s have no problems to actively engage in production of digital material and the meeting between children and grown ups can be immense productive when the child is allowed to be an expert in the digital interface activity (Häilä-Ylikallio, 2009). Since teachers and pupils cooperatively produce digital media and Social Science material they are didactic designers (Selander, 2009). This notion answers to one of the trends in The Online Learning Paradigm, *users are producers*, which implies great possibilities for meaning-making and learning as well as didactic complexities. All articles in this thesis, more or less, illustrate how pupils are encouraged to design their own learning paths, based on what they are interested in, in that specific situation – paths that are digitally designed according to pupils' own wishes. Pupils' possibilities to learn by independently experimenting with the digital learning resources are increased (cf. Naeslund, 2001). The results in this thesis show how pupils' learning and representations are embraced in the secondary transformation unit, although they do not always fit the setting with course objectives and curricular aims. Since teaching and learning cannot be detached from assessment (Lundahl, 2009) and since there is a need for new strategies for assessment in digital learning environments (Erstad, 2008; Selander & Kress, 2010; Underwood, 2007), this has profound didactical consequences, because if everything is accepted, what does the role of the school with teachers, curriculum and grades then become?

In policy documents, articles and literature about digital learning resources in schools, the concept of *New Millennium Learners*<sup>53</sup> frequently recurs. Characteristics of the new millennium learners are that they are digital natives and that they enter the Web 2.0<sup>54</sup> as producers rather than users. A lot of research suggests that schools must change their traditional goal orientation with a teacher as an instructor and assessor, in order to meet these pupils' desires. Research suggests that schools aim their activities at what is often referred to as *21<sup>st</sup> Century Skills*; that is knowledge needed to be able to live and work in the society of tomorrow (Hylén, 2010; Law, et al., 2008). These skills are described as the capacity to engage in lifelong learning and

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<sup>53</sup> More information available at: Centre for Educational Research and Innovation (CERI) – New Millennium Learners: [www.oecd.org/edu/nml](http://www.oecd.org/edu/nml)

<sup>54</sup> The second generation of web services, characterised by interactivity where the user is producing the content of the site, i.e. Facebook, Wikipedia etc.

in connectedness in activities such as teamwork to solve open-ended real world problems, and collaborative work with local as well as international contacts to develop global understanding and cultural sensitivity. The teacher is here supposed to act as a facilitator in the learning process (Kroksmark, 2011; Law, et al., 2008). Concerning school's democratic commission, this kind of didactic design suits the curriculum. There are similarities in the didactic design of these suggestions and the didactic design analysed in this thesis and there are a lot of discussions going on about if pupils' learning is enhanced or not when given a larger space of action as well as more responsibility. A recent research survey (Skolverket, 2010c) shows ambivalent results: on the one hand pupils with weak home support are not favoured by such a didactic design, but on the other hand flexible individualization, based on pupils' needs, promotes pupils' results generally. An interesting passage here concerns the fact that pupils' results tend to drop during the first years of this kind of didactic design that 1:1-schools implement (Silvernail & Lane, 2004). A didactic question is here whether pupils' knowledge actually declines or if other kinds of knowledge are practiced in this didactic design? Possibly the *invisible learning*, discussed earlier in this chapter, results in knowledge that is not recognised in standardized tests as they are formulated today? Irrespectively, this kind of didactic design is a clearly outspoken demand of society today. This is a contradiction compared to current international political demands on pupils, where measurable results are the focal issue (such as for example PISA<sup>55</sup>). Besides, the political demands on Social Science are about to get more focused on measurable results. According to an interview with Sweden's Minister for Education and Science Jan Björklund, Swedish National Standardized Tests will soon, for the first time, be launched in Social Science (Björklund, 2011-02-12). The paradox between the demands of society on pupils' *21<sup>st</sup> Century Skills* and the political demands on measurable results has dramatic didactic implications. If the teacher is not acting like an assessor and if goal orientation is out of question in the extended digital environment then is the assessment of learning even possible? According to Erstad (2008), research about assessment in a digital learning environment is limited and so are initiatives to change assessment practises. Since formative and summative assessment must be performed in relation to learning objectives, possibly some of the LDSs presented in this thesis are, in a stricter sense, not formally assessed in relation to curriculum and other policy documents at all. National and international research in 1:1 schools reveals that teachers are worried that their pupils do not learn what is stated in the goals (Kroksmark, 2011) and perhaps teacher's interventions are better understood as feedback or feed-forward (Björklund Boistrup, 2010) in these LDSs. This reasoning is linked

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<sup>55</sup> Programme for International Student Assessment. More information on: <http://www.pisa.oecd.org>

to the next trend in The Online Learning Paradigm, because if pupils produce their own learning and digital material in the digital environment, and if this learning is not assessed according to course objectives, then the importance of informal learning is likely to increase.

### Trend: Informal learning increases in importance

This thesis shows how learning in a digital environment has informal features. According to Pedró (2007), education is challenged because of pupils' massive use of digital media outside school. Stocklmayer et al. (2010) mean that the informal sector has only recently been recognized as a possible educational provider. Today pupils' informal learning is increasing in school, since pupils, for example, use informal communities for their formal learning (Hylén, 2010). The informal learning increases in importance in relation to learning in school, and formal learning in this paradigm aims at catching elements of spontaneous informal learning to incorporate into formal learning. In my empirical material such approaches are conducted in several LDSs, such as in article 2 where pupils are encouraged to make presentations about their own cuddly animal and their own family, or in article 2 where they are supposed to represent their own fears, or in article 5 where the subject area is didactically designed as a roleplaying computer game. Without having compared the LDSs with each other, I dare say that pupils, in these formal subject areas with informal features, are very engaged. Their engagement is also visible in their final representations. According to Ramberg & Tholander (2006) bridges built between pupils' expansive knowledge development outside school in interaction with and about digital learning resources in school, are linked to that what concerns and engages children should also be acknowledged and integrated in school to be critically used. A challenge for schools here can be to find a balance between formal and informal learning so that pupils are kept interested at the same time as engaging in the Social Science material. The science area in this respect is ahead of the social science area. They are talking about the development of a *third area* (Stocklmayer et al., 2010:30) that is bridging the gap between school and community. This third area can be understood as the interface between formal learning in school and informal learning outside school. Since it is hard, on a daily basis, to teach pupils outside school, ICT with video-conferences, web-lectures and didactically designed web resources made by museums, science centres and zoo's, for example, serve as educational out-reached arms that understand and respond to local curricula and build up a third area. If this third area is to be exploited also in Social Science, schools need to acknowledge that they will benefit from external involvement and the informal sites must engage in designing their activities so that they are aligned to curriculum and school demands. Thus not only are schools sup-

posed to change their attitudes towards informal learning, but the informal sector must also change.

This thesis illustrates how the teacher is given an almost unmanageable position in the interface between formal and informal learning. Someone else who has acknowledged the complex role of the teacher in a digital learning environment is Dillenbourg (2008). He claims that the teacher cannot be a “sage on the stage” nor a “guide on the side”, instead the teacher must orchestrate an integrated scenario with flexibility concerning time, space and resources to be able to support learning. Although all teachers studied in this thesis are far more interested, experienced and skilled in digital learning resources than the average teacher, the empirical examples time and again point out the teacher’s insufficiency in, for example, appreciating pupils’ signs of learning in modes other than the lingual (article 5), or failure in motivating the pupils to use adapted digital resources (article 2) or absence during the transformative activities in the primary transformation unit (articles 1, 2, 3 and 5). Here the notion of the *digital divide* comes into play. Since the pupils, or *digital natives*, are engaging in the digital interface with perspectives, knowledge and skills that the teacher, or *digital immigrant*, cannot grasp, they communicate in different ways, making it difficult for them to understand each other. Despite the communication barriers in the digital divide, I think it is fantastic to see how teachers strain to meet, understand and use their pupils’ interests, needs and desires in the extended digital learning environment. The teacher’s designs for learning are getting closer to the methods of work of a researcher, where the step towards learning on scientific grounds in the practises of schools is approaching (Kroksmark, 2011). Still, the current digital divide will continue to cause complexities for schools, since digital immigrants will not be able to catch up with digital natives, but by taking the differences into consideration, perhaps the digital divide will narrow. And in the near future, perhaps teachers will be natives as well and the divide will thereby be united?

### Trend: Learning is independent of time and space

Some schools studied in this thesis are 1:1 schools, where all pupils have their own laptop that they use both at home and in school. This dramatically changes learning, making it independent of time and space (Hylén, 2010; Kroksmark, 2011; Tallvid & Hallerström, 2009). The independency of time and space extends the learning environment further. In the current paradigm, the extended learning environment regarding the age group of pupils in this thesis (6-17), can thus be even more extended than perceived in this thesis. It does not only concern what goes on in and around the digital interface of the computer screen in the classroom. Instead, the extended digital learning environment might very well include the pupils’ every waking hour of the day,

where the pupil, for example, finishes her/his History presentation in bed on a laptop, just before falling asleep. Questions of this kind of *mobility in learning* represent a large research field. Reports are often focused on high-tech solutions and apps. Many digital resources make it possible for the learner to control when and where the learning takes place (Dahlqvist & Ramberg, 1999). This is excellent for many reasons, but I also think it is important to consider that school has a social assignment too. Dahlqvist & Ramberg (1999) mean that mobile learning in some aspects can decrease the chances of developing some social relations which are important for help and cooperation. This is important to consider in schooling, especially since children are spending more and more of their spare time on the Internet (Medierådet, 2010).

Research indicates that digital natives can view their offline world as peripheral, in favour of the online world (Kress, 2010). According to Kroksmark (2011) children can appreciate the online world as real, also in the offline world. He refers to Baudrillard (1988) and explains this as that the pupils experience “true fantasy”. In school this *stretchness of learning* (Kroksmark, in print) means that pupils and teachers thinking is stretched by the movement between the offline and the online worlds, which results in their experiences being drawn between the different worlds. In the empirical material analysed in this thesis, pupils do not use portable digital devices in the same way as they will in the near future, where pupils in primary school will probably have constant Internet access via their mobile phones. How young people position themselves in communities such as Facebook, blogs or in online games can then be of greater importance to them, than how they position themselves in the offline world in the classroom, since children today spend a major part of their spare time on the Internet (Medierådet, 2010). According to Kress (2010) life lived offline may become (or probably already is to some people) subordinate to life lived online, or it can possibly even be lived *for* life online. This development brings didactic implications, such as that the school must learn to appreciate pupils’ multiple identities in their online life as just as “real” and important as their positioning in their offline life. In some aspects, school has developed to embrace this. Such an example is net bullying, which today is appreciated to be equally as serious as bullying in the classroom (Skolverket, 2011). There are also many examples from 1:1 initiatives where pupils are encouraged to work with blogs, Wikis, YouTube, Facebook and similar Web 2.0 resources on the internet. At the moment less than 5% of Sweden’s approximately 30 000 schools are 1:1 schools, but many ICT strategists (for example TÄNKOM, 2011) prophesize that in a few years half of all pupils will have their own computer. According to Kroksmark (2011), one third of Sweden’s municipalities will launch 1:1 projects in their schools already during 2011. How will schooling be able to adjust to all the changes that the new paradigm involves? Many other countries are developing national ICT strategies at the

moment, such as Sweden's neighbour Finland (Lindén & Lankinen, 2010), and perhaps a national ICT strategy is needed also for Swedish education to be able to develop in The Online Learning Paradigm?

## New research derived questions

There are, of course, issues about interaction, meaning-making and designs for learning in the extended digital learning environment that I have not engaged in within the framework of this thesis. To begin with, this thesis does not have an intersectional perspective at all. To analyse the material once more with a gender or multicultural perspective would probably give totally different, yet very interesting, research results. Another phenomenon that grew in importance during the work with this thesis, and that was also analysed by the end of it, is assessment. This research interest evokes a lot of new questions about assessment, such as how aligned the goals and the grades are in the digital learning environment. How do teachers think about assessment in the extended digital interface?

When speaking of the teacher's assessment in the digital learning environment – something that, according to Forsberg & Lindberg (2010) is very underrepresented in research about assessment – I would like to examine the strategies of teachers that are positioned in the middle of a seemingly chaotic, speedy digital divide but still professionally plan or improvise, for their pupils' learning in ways that are motivating, challenging and embracing didactic design. It is all very impressive and I think these kinds of teachers have lots of experiences to share. On the other hand, the lack of qualitative teacher's intervention and formative assessment in the primary transformation unit is discussed in several articles. I would like to know if this is a conscious didactic design by the teachers in order to, for instance, practice criticism of sources and other 21<sup>st</sup> century skills or if it is a didactic design that inevitably develops due to, for example, too many pupils and too little time, the Internet's educational and communicative possibilities, the digital divide or something else. This leads on to another research derived question: How can school take advantage of the informal learning that occurs in forums such as blogs, communities and online computer games?

At the time I collected the empirical material for this thesis, pupils with mobile phones with Internet connections were not so common and iPads were not even invented. During these years mobile digital devices have increased dramatically and a study on such digital learning resources in the Social Science classroom would be very interesting, especially with young children, since they are used to them from the beginning, being even more digitally native than pupils studied in this thesis. For this reason young children generally are very interesting within this research field. New statistics from Medierådet (2010) show that internet users in the age group 2-5 years

of age are increasing rapidly at the moment. It would be interesting to study their learning in the extended digital environment, both at home, by means of the informal Learning Design Sequence; and in preschool, by means of the semi-formal Learning Design Sequence<sup>56</sup>

Finally, I also want to finish this thesis by citing Kress (2010:134), who raises what is from my point of view a central issue that is far too large to discuss here, but which very well could serve as a research question in another type of research; *When knowledge is made by anyone, anywhere, what is, what can and what should be the place of the school?*

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<sup>56</sup> These two versions of the Learning Design Sequence are described, for example, in Selander, (2008a) and Insulander (2010).





## 8. Summary in Swedish

Detta kapitel sammanfattar avhandlingskappan samt de fem artiklarna. Tanken med kapitlet är att även de som inte är så bevandrade inom forskning om lärande i en digital lärmiljö ska kunna göra sig en bild av vad avhandlingen handlar om. Via fotnoterna samt vidare läsning i avhandlingens olika delar ska läsaren sedan kunna fördjupa sig i det som framstår som intressant.

### Design för lärande i en vidgad digital miljö. Fallstudier av social interaktion i SO-klassrummet.

Föreliggande avhandling handlar om hur elever interagerar, skapar mening och lär sig i klassrummet då de använder sig av digitala lärresurser<sup>57</sup> i SO, det vill säga samhällsorienterande ämnen<sup>58</sup>. Studien koncentrerar sig på de multimodala aktiviteter som pågår i det jag kallar för *det vidgade digitala gränssnittet*<sup>59</sup>. Detta innebär att alla elevers aktiviteter bedöms som meningsbärande, oavsett om det rör sig om att de skriver in ett sökord på Google på Internet, pekar på och skrattar åt ett foto som visas på digitalkamerans display, går iväg för att be läraren om hjälp eller ändrar layout i en PowerPoint-presentation.

Förutom att bidra med förståelse av elevers interaktion, meningsskapande och lärande mer generellt i en vidgad digital lärmiljö, så bidrar avhandlingen specifikt med kunskap om elevers formella lärande i just SO, vilket hittills varit ett relativt outforskat område. Till skillnad från forskning som fokuserar på en åldersgrupp så bidrar det unika åldersspannet från förskoleklass till och med gymnasiet till en möjlig överskådlig helhetsbild av elevers lärande i SO med digitala lärresurser. Slutligen bidrar den här avhandlingen med en presentation och en beskrivning av ett nytt perspektiv på lärande, speciellt utvecklat för att studera elevers lärande i lärmiljöer såsom skolan. Detta perspektiv kallas *Design för lärande*<sup>60</sup> och bygger på en syn på interaktion, me-

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<sup>57</sup> Med digitala lärresurser avses till exempel datorer med hård- och mjukvara, Internet, digital kameror och mobiltelefoner.

<sup>58</sup> De samhällsorienterande ämnena är geografi, historia, religion och samhällskunskap.

<sup>59</sup> På engelska: the extended digital interface.

<sup>60</sup> Se till exempel Selander, 2008a.

ningsskapande och lärande som teckenskapande multimodala aktiviteter. Detta multimodala designteoretiska perspektiv möjliggör beskrivningar, tolkningar och analyser av detaljerade aspekter av teckensystem såsom gester, tal, skrift, bilder, kroppspositionering, ljud och färger<sup>61</sup>. Perspektivet betonar kommunikation i situerade aktiviteter och avhandlingen fokuserar den transformationsprocess<sup>62</sup> som eleverna engagerar sig i. *Produktionen* eller *representationen* av information och kunskap, snarare än *receptionen* av detsamma är således studiens fokus. Följande fyra frågeställningar har utmejslats för att möta avhandlingens syfte:

- Hur designar lärare didaktiskt för elevers lärande med digitala läresurser i SO, och hur påverkar de digitala läresurserna ämnets design?
- Hur interagerar elever med det digitala gränssnittet och med vilka meningserbjudanden engagerar de sig i den digitala lärmiljön?
- Hur designar eleverna sina egna lärvägar i SO i den digitala lärmiljön och med vilka teckensystem representerar de sitt lärande?
- Vad erkänns som lärande i en digital lärmiljö, hur bedöms detta lärande och hur skapar elever mening i bedömningssituationerna?

Avhandlingsarbetet har delvis ingått i ett projekt vid namn *Digital Learning Resources and Learning Design Sequence in Swedish Schools – Users' Perspective*<sup>63</sup> finansierat av *KK-stiftelsens*<sup>64</sup> forskningsprogram *LearnIT*<sup>65</sup>. Inom projektets ramar samlades ett omfattande empiriskt material in bestående av bland annat videoobservationer, fokusgruppsintervjuer av elever och lärare, fältanteckningar och enkäter på nio olika skolor som alla ansåg sig ligga i framkant avseende informations- och kommunikationsteknik – IKT. På varje skola har ett eller flera arbetsområden valts ut för videodokumentation och dessa har sedan följts från lärarens första introduktion till elevernas presentation av sina arbeten och bedömningen av dessa. En sådan lektionsserie kallar jag för en Learning Design Sequence – LDS (se LDS-modellen på sidan 62) och den kan omfatta allt från två lektioner i rad till alla SO-lektioner under en hel termin. En LDS består av en iscensättning följt av en första och en andra transformationsenhet och ger en bild av hur lärande kan organiseras i skolan.

Ett av avhandlingens kapitel ägnas åt att presentera Sverige och svensk utbildning ur ett IKT-perspektiv. Texten är till stor del hämtad ur en publice-

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61 Se till exempel Kress & van Leeuwen, 2001.

62 Se till exempel Selander, 2009 eller Selander & Kress, 2010.

63 Se <http://www.didaktikdesign.nu/learnit/>

64 Se <http://www.kks.se/>

65 Se <http://www.learnit.org.gu.se/>

rad artikel<sup>66</sup> som inte ingår i avhandlingen. Ett annat kapitel ägnas åt att beskriva tidigare forskning om elevers interaktion och lärande i det vidgade digitala gränssnittet.

Avhandlingens teoretiska kapitel inleds med en presentation av de underliggande antaganden om interaktion och lärande som teorin vilar på och mynnar sedan ut i en teoretisk karta som ger en bild av det teoretiska ramverket som bygger på socialsemiotik<sup>67</sup>, multimodalitet<sup>68</sup> och designteori<sup>69</sup>. Det designteoretiska perspektivet på lärande har vuxit fram parallellt med denna avhandling inom min forskargrupp *DidaktikDesign*. Design är här ett viktigt begrepp. Design omfattar transformationsprocessen där elever och lärare agerar *didaktiska designers*<sup>70</sup> i interaktion med varandra och det vidgade digitala gränssnittet. *Design i lärande*<sup>71</sup> motsvarar elevens design av den egna lärvägen, det vill säga hur eleven transformerar meningserbjudanden och formar sitt eget lärande i relation till lärandesituationens villkor. *Design för lärande* handlar om villkoren för lärande och i förgrunden står här hur läraren arrangerar teckensystem och media för elevers lärande. Inom perspektivet har en modell som också kallas LDS utvecklats (se sidan 62). Den illustrerar inte bara perspektivet utan används såväl som en guide för materialinsamling som ett analytiskt verktyg, vilket avhandlingens metodologiska kapitel ägnas åt att beskriva. Utvalda delar, så kallade ”critical incidents” av det insamlade videomaterialet har analyserats multimodalt med hjälp av speciellt utformade transkriptionsscheman där olika teckensystem transkriberats i olika kolumner. Dessa har sedan tolkats med hjälp av konceptuella analysverktyg ur LDS-modellen. Resultaten är beskrivna i avhandlingens fem artiklar.

Artikel 1 heter ”*The digital learning resource – a tool, content or a peer?*” och grundar sig i ett generellt intresse för elevers interaktion och lärande i SO i den digitala lärmiljön. Artikeln syftar till att beskriva hur digitala lärresurser används i SO samt att finna mönster i elevers interaktion och lärande. Artikeln visar bland annat hur förskoleklassbarn, elever i år 2, i en klass 1-4 samt i år 4 använder digitala lärresurser för att: 1) söka; 2) dokumentera; 3) bearbeta och; 4) presentera information. Resultatet visar hur tecken på lärande synliggörs oavsett vad eleverna använder den digitala lärresursen till. Elevers interaktion karaktäriseras av impulsivitet, samarbete, instruktivt språk men även av jäkt – de kommunicerar konstant med varandra och uppmärksammar ideligen sina egna och andras representationer.

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<sup>66</sup> E-learning in Sweden. Publicerad i *E-learning practice. Cases on challenges facing e-learning and national development: Institutional Studies and Practice. Volume II*. Skriven av Edman-Stålbrandt, E. & Kjällander, S. (2009).

<sup>67</sup> Se till exempel van Leeuwen, 2005.

<sup>68</sup> Se till exempel Kress, 2010.

<sup>69</sup> Se till exempel Selander, 2008a.

<sup>70</sup> Se till exempel Selander, 2009 eller Selander, 2008a.

<sup>71</sup> Se till exempel Selander & Kress, 2010.

Elevers lärande beror på meningserbudanden i det digitala gränssnittet vilket leder till perifert eller oförutsett lärande. Resultatet visar även hur olika teckensystemen hjälper eleverna att förstå och förklara information som inte kan nås enbart med talat språk. Resultatet visar även hur relationen mellan elever och lärare karaktäriseras av jämställdhet

Artikel 2 heter "*Eh, they even have a special tool, did you see that? Affordances in digital learning resource mediated interaction.*" och handlar om just meningserbudanden. Syftet är att hitta karaktäristika i gränssnittsinteraktionen samt beskriva de meningserbudanden som erbjuds i situationen. Bland annat så lyfter resultatet fram elevernas förvirring kring vad de ska använda den digitala läresursen till samt hur de tolkar den digitala läresursen som om den har en agens då den "verkar göra saker av sig självt", som eleverna uttrycker det. Vidare visar artikeln hur eleverna, som går i år 7 och 8, experimenterar med identiteter och hur de ibland väljer att positionera sig i relation till en digital identitet. Resultatet visar också att trots att eleverna använder en mängd av den digitala läresursens meningserbudanden, så är det bara en bråkdel av alla dem som faktiskt erbjuds i den digitala lärmiljön.

Artikel 3 heter "*Vad blir SO i en digital lärmiljö?*" och syftar till att illustrera hur SO-ämnet påverkas av att elever använder digitala läresurser. Artikeln beskriver IKT's framträdande position i SO jämfört med andra ämnen och resultatet visar hur eleverna, som går i år 5, förhandlar fram två parallella läroprocesser där den ena rör det SO-relaterade innehållet och det andra den digitala presentationens design. Resultatet visar att eleverna är ovilliga att erkänna felaktigheter i representationen av sitt lärande, men att de, då de konfronteras med felaktigheterna via den digitala läresursen förflyttar sin förståelse. Vidare visar resultatet att eleverna uppskattar att de får skapa sina egna lärvägar i den digitala lärmiljön.

Artikel 4 heter "*Design för lärande i en digital, multimodal miljö.*" och syftar till att beskriva forskningsprojektet och det multimodala designteoretiska perspektivet på lärande. Artikeln syftar även till att exemplifiera designteorin med ett empiriskt exempel som analyseras utifrån tre olika perspektiv som benämns; *elevspåret*, *kunskapsspåret* och *lärarspåret*. Resultatet avseende elevspåret lyfter fram hur elever som aktiva kunskapsproducenter, engagerar sig i multimodala meningserbudanden då de designar sina representationer med olika teckensystem och medier. Eleverna uppmuntras att tillsammans tolka uppgifter och deras intressen blir styrande för hur arbetet utvecklas. Resultatet visar hur eleverna positionerar sig i förhållande till varandra samt hur framförhandlandet av identiteter kan ses som en form av lärande. Resultatet avseende kunskapsspåret visar hur elevernas lärande utvecklas i interaktion med det innehåll som erbjuds dem via den digitala läresursen – genom att välja uttryckssätt väljer de också ett innehåll: de visar *vad* de förstår genom att visa *hur* de förstår det. Kunskaper framförhandlas här då informationen eleverna engagerar sig i inte är tillrättalagd för skoländamål samt när flera olika teckensystem och flera olika typer av informa-

tionskällor används simultant i lärprocessen. Gällande lärarens spår så visar resultatet bland annat att läraren själv deltar i att forma skolvärlden i alla dess olika aspekter och att den didaktiska designen kännetecknas av inkludering. Läraren tar själv rollen som handledare och upprättar en mer jämställd relation med sina elever genom att till exempel använda samma informationskanaler som sina elever och arbeta i anslutning till deras arbetsplatser.

Artikel 5 heter "*Assessment in the digital divide: Teachers' and pupils' multimodal interaction.*" och syftar till att finna vad formativ och summativ bedömning av lärande kan vara i en digital lärmiljö där elever (*digitala infödingar*) och lärare (*digitala immigranter*)<sup>72</sup> designar arbetsområdet tillsammans. Artikeln avser också att studera hur elever skapar mening av bedömningen samt att identifiera bedömningens konsekvenser för ämnets design. Artikeln visar hur läraren, i en klass 8, didaktiskt designar ett arbetsområde som till sin karaktär påminner om ett dataspel. Resultatet visar till exempel att lärare ibland använder motstridiga teckensystem då de bedömer elever och att elevers tal och text erkänns som lärande i större utsträckning än deras lärande i teckensystem såsom foton, färger och layout. Resultatet visar även hur bedömningen sker med olika syften och mål beroende på var i LDS'en eleverna positionerar sig; i arbetsområdets iscensättning och i den andra transformationsenheten syftar den didaktiska designen och bedömningen till att eleverna ska nå de högre betygskriterierna medan interventionerna och bedömningsakterna i den första transformationsenheten syftar till de lägre betygskriterierna. Eleverna förväntas i den första transformationsenheten självständigt transformera och forma sin förståelse. Resultatet visar slutligen hur läraren i denna summativa bedömningsakt möter och accepterar elevernas representation genom att förändra arbetsområdets ramar.

Avhandlingens resultat diskuteras i respektive artikel men även i en mer generell mening i avhandlingskappans diskussionskapitel. Kapitlet är organiserat enligt avhandlingens frågeställningar i fyra följande sektioner.

Diskussionens första avsnitt berör *didaktisk design av SO-ämnena* och inleds med en diskussion om lärares didaktiska design av en LDS. I ämnesområdets iscensättning står läraren själv för den didaktiska designen, men i LDS'ens första transformationsenhet tillåts eleverna göra val avseende de didaktiska frågorna *vad?* och *hur?*. Eleverna designar således ämnet självständigt. Lärares didaktiska design karaktäriseras av öppenhet, flexibilitet, deltagande och frihet. Elevers egna intressen guidar deras lärande och de uppmuntras att utforska Internet på egen hand, vilket påminner om det som brukar kallas "Eget arbete", en didaktisk design som används oproblematiserat i svensk skola<sup>73</sup>. Lärares frånvaro i den första transformationsenheten där den viktiga transformationsprocessen till stor del äger rum gör eleverna förvirrade och situationen kan förstås som att eleverna inte får tillräckligt med

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<sup>72</sup> På engelska *digital natives* och *digital immigrants* (Prensky, 2001).

<sup>73</sup> Se Vinterek (2006).

stöd i denna del av arbetet. En viktig upptäckt är här att lärare även är flexibla avseende den tredje didaktiska frågan *varför?* vilket betyder att ämnesområdets syften och mål utvecklas i interaktionen mellan elever och lärare i den andra transformationsenheten. Om lärande som inte ramas in av olika styrdokument ändå accepteras i slutet av ett arbetsområde så kan ju SO vara i stort sett vad som helst, ett förhållningssätt som även finns till SO generellt, något som kan komma att förändras i och med nya utbildningspolitiska beslut<sup>74</sup>. Denna avhandling visar dock att SO-ämnet har informella drag och att elever inte bekymrar sig om bedömning trots att deras tecken på lärande alltid bedöms på ett eller annat sätt. En annan viktig upptäckt i den här avhandlingen handlar om hur eleverna engagerar sig i att designa digitalt SO-material istället för att konsumera detsamma, när de självständigt interagerar med webbaserad information som inte är avsedd för barn. Detta förfaringsätt bidrar till att eleverna engageras i aktiv kunskapsproduktion samtidigt som det på många sätt motsvarar SO-kursplanens intentioner, något som även gäller online-informationskällornas aktualitet och föränderlighet. Den dubbla uppsättningen mål i SO: geografi, historia, religion och samhällskunskap å ena sidan och IKT å andra sidan möts i elevernas tecken på lärande i och med att eleverna visar *vad* de förstår genom att visa *hur* de förstår.

Diskussionens andra avsnitt fokuserar på *interaktion och meningserbudanden*. Den här avhandlingen visar att elevers interaktion är signifikant multimodal. Elever engagerar sig i det digitala gränssnittet med olika teckensystem vilket gör att även en elev som sitter bredvid och tittar på interagerar i gränssnittet med teckensystem som tal, gester och ljud. Elever, särskilt de yngre, är mycket lyhörda och intresserade av varandras representationer – de inspirerar, uppmärksammar och hjälper varandra och de uppfattar lärandet i den digitala lärmiljön som ett kollektivt ansvar. Den digitala lärresursen uppfattas som *ett tredje element*<sup>75</sup> i interaktionen. Eleverna fokuserar sin interaktion mot den digitala lärresursen och för de äldre, till skillnad från de yngre eleverna, är det en självklarhet att använda den konstant. Eleverna tillskriver ofta den digitala lärresursen en agens, möjligtvis för att den ger eleverna interaktionserbudanden som uppmuntrar eleverna att agera på ett visst sätt. Vissa av dessa interaktionserbudanden är så vanliga, såsom hypertext på internet, röda och gröna understrykningar i word eller ikoner på digitalkamerans display, att de avancerade transformerande och formerande processer de initierar inte uppmärksammas. Den här studien visar att eleverna engagerar sig i det som de uppfattar som *framträdande*<sup>76</sup> i det digitala gränssnittet. Yngre elever tenderar att engagera sig i det som dyker upp och uppfattas som framträdande på skärmen och väljer att ändra sina ursprungli-

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<sup>74</sup> Lp11 presenterar kunskapsmål även för år 3 i SO och skolministern talar om att införa nationella prov även i SO.

<sup>75</sup> *A third element* (Birmingham et al., 2002).

<sup>76</sup> *Salient* (van Leeuwen, 2005).

ga intentioner därefter för att kunna inkludera den information de hittat i sina representationer. Exempel på vad som uppfattas som framträdande och som eleverna väljer att engagera sig i är bilder på människor, ord på svenska, bilder som de känner igen sedan tidigare eller som uppfattas som coola och texter som presenterar något spännande eller utmanande. Digitala lärresurser erbjuder visualisering av abstrakta koncept, till exempel genom bilder på Google men även genom att visualisera elevernas eget lärande i de digitala representationerna medan de arbetar med dem. De erbjuder även transduktion<sup>77</sup> där mening dras från ett teckensystem till ett annat genom att eleverna till exempel tar digitalfoton för att representera en text de skrivit. Ett viktigt och ofta använt meningserbjudande berör hur digitala lärresurser erbjuder modifiering av representationer på ett helt nytt sätt, där till exempel layouten i en PowerPoint eller texten i ett worddokument lätt kan ändras och dessutom återanvändas. Autenticiteten i det digitala gränssnittet är också något som utmanar och engagerar elever, såväl som ger dem anmodan<sup>78</sup> att engagera sig i etiska diskussioner.

Diskussionens tredje del handlar om *lärvägar och tecken på lärande*. Alla elever i den här studien är att betrakta som digitala infödingar vilket innebär att de interagerar i det digitala gränssnittet på ett annat sätt än tidigare generationer. Avhandlingen utgår ifrån och visar att elever designar sitt lärande multimodalt. Ett exempel är här hur elevers tecken på lärande återfinns i olika teckensystem i en PowerPoint eftersom bakgrundsfärger, layout, bilder, bakgrundsmusik, ljudeffekter och text väljs med stor omsorg för att rättvist representera det de just lärt sig. Eleverna använder sig oavbrutet av den digitala lärresursens meningserbjudanden. För att nämna ett exempel så använder eleverna funktionen *copy&paste* då de designar sina lärvägar. Denna aktivitet brukar inte räknas som lärande<sup>80</sup>, men i denna avhandling där lärande förstås som en transformationsprocess, bedöms aktiviteten som lärande i och med att informationen transformeras och formas till något nytt med olika teckensystem då eleven väljer ut till exempel en text, avgränsar den, klistrar in den i ett nytt sammanhang, såsom en PowerPoint, inleder den med en rubrik samt illustrerar den med en bild. Digitala infödingar väljer hur, när och varför de går in i en text. De besitter simultankapacitet och bygger upp två parallella lärvägar i det digitala gränssnittet; en som representerar den formaliserade undervisningen med uppgifter och kriterier vilken uppmärksammas och bedöms av läraren och en som representerar det vidgade lärandet som hela tiden pågår under ytan och som ofta är odisciplinerat, vilt och som drivs av elevernas begär<sup>81</sup>. Dessa lärvägar är ofta kreativa och djupgående och innehåller signifikanta tecken på lärande som dock inte blir

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<sup>77</sup> Se Kress, 2010.

<sup>78</sup> *Prompt* (Kress, 2010).

<sup>80</sup> Se Perkel, 2008.

<sup>81</sup> Se Olsson, 2009.

synliga för läraren. En viktig upptäckt i denna studie är att elevers intresse, alltså vad de väljer att fokusera på, styr deras lärvägar och att lärare i den digitala lärmiljön, istället för att försöka tämja elevers begär försöker möter dem. Elevers intressen är dynamiska till sin karaktär; ena stunden kan det ligga i elevens intresse att göras klart uppgiften och få bra betyg medan hon/han i nästa stund intresserar sig för att göra en visuellt attraktiv presentation med ett provocerande innehåll. Elevers lärvägar är därför långtifrån utstakade och raka utan designas i lärande mer som en *rhizom*<sup>82</sup>. En aspekt av lärande är att elever framförhandlar olika identiteter i den digitala lärmiljön beroende på de egna intressena. Den här avhandlingen visar att elever positionerar sig från *multipla identiteter*<sup>83</sup>, de väljer till exempel att ibland positionera sig från en digital identitet med ett uppfattat större handlingsutrymme. I ett av arbetsområdena, som didaktiskt designats som ett datorspel, positionerar sig elever från *en verklig, en virtuell och en projicerad identitet* simultant<sup>84</sup>.

I diskussionens fjärde del diskuteras *bedömning av lärande*. I det empiriska materialet i denna avhandling förstås bedömningen av lärandet inom en diskurs som kallas "*allting går*"<sup>85</sup> vilket bland annat innebär att bedömningens fokus förläggs till uppgiften snarare än till processen. Bedömningen består av feedback där läraren ibland lämnar det eleven presenterar outmanat, men där eleverna skapar mening och lär *tillsammans* med läraren. Skolans erkännandekultur<sup>86</sup> gör att lärande i dessa åtta LDS'er kommuniceras som att det handlar om att göra klart uppgiften. Beroende på vilken transformationsenhet som eleverna befinner sig i så erkänns olika saker som lärande och ju längre fram i LDS'en eleverna kommer desto mer räknas deras yttre tecknen. Ju äldre eleverna är desto mer erkänns lärandet som representeras i fysiska digitala representationer medan förskoleklassbarnens gränssnittsinteraktion erkänns mer som lärande. Bedömningen har olika syften beroende på transformationsenhet och trots att lärande behöver bedömas kontinuerligt i den digitala lärmiljön<sup>87</sup> så bedöms, i synnerhet de äldre elevernas lärande inte alls i den första transformationsenheten. Detta, i kombination med att det är omöjligt för läraren att förutse informationen som eleverna engagerar sig i på nätet, gör att elevernas digitala presentation av sin förståelse kommer som en överraskning för läraren som därav förväntas bedöma något på förhand okänt. Ett traditionellt textbaserat kunskapstest skulle därför vara ogenomförbart. Istället bedömer läraren elevers lärande

<sup>82</sup> Se till exempel Dahlberg & Moss, 2005 eller Deleuze, & Guattari, 2004.

<sup>83</sup> Se Davies, 2003.

<sup>84</sup> Den verkliga identiteten är den fysiska eleven i klassrummet medan den virtuella motsvarar den identitet som läraren förser eleven med och som förväntas engagera sig i situationen "som om". Den projicerade identiteten motsvarar den typ av karaktär som eleven vill vara i den specifika situationen (jfr. Shaffer, 2006; Gee, 2003).

<sup>85</sup> Se Björklund Boistrup, 2010:167.

<sup>86</sup> Se Selander & Kress, 2010.

<sup>87</sup> Se Kress & Adami, 2010:185.



med olika teckensystem som ibland är motstridiga. Läraren lyssnar och intar ett nyfiket och utforskande perspektiv för att möta och inkludera elevernas representationer. Interaktionen som uppstår i bedömningsakten förändrar på detta sätt arbetsområdets ramar så att de anpassas till det lärande som eleverna presenterar. En stor del av elevernas lärande presenteras dock aldrig utan förblir osynligt i den digitala lärmiljön eftersom skolans erkännandekulturer inte hängit med i de nya produktionskulturerna<sup>88</sup>. Elevers engagemang och lärande med teckensystem såsom layout, musik och bilder uppmärksammas inte vilket innebär att en stor del av deras lärande försvinner i den digitala klyftan. Även det lärande som inte finns representerat i den digitala produkten osynliggörs.

Avhandlingens sista del ägnas åt att, med hjälp av avhandlingens slutsatser, diskutera de utmaningar som skolan står inför i det som jag kallar *The Online Learning Paradigm*<sup>89</sup>. I detta paradigm producerar elever själva sitt digitala material och i slutet av en LDS erkänns deras representationer som lärande. En utmaning handlar här om att behålla något slags ämnesdidaktiskt fokus, för om elevers representationer accepteras oavsett hur väl de svarar mot uppsatta mål, vad blir då skolans roll med lärare, styrdokument och betyg? Denna del lyfter också fram något av en paradox i detta paradigm. Den gäller det som ofta kallas *21st Century Skills*<sup>90</sup> som på många sätt stämmer överens med den didaktiska designen i avhandlingens empiriska material och som också motsvarar samhällets efterfrågan på framtidens arbetskraft, men som står i motsättning till den politiska efterfrågan på mätbara resultat. En annan utmaning gäller det faktum att det informella lärandet ökar i betydelse i skolan genom att elever använder informella webbresurser för sitt formella lärande. Här gäller det för skolan att hitta en balans mellan det formella och det informella och att behålla elevers intresse samtidigt som de engagerar sig i SO-relaterat innehåll. För att det formella och det informella ska mötas kan ett tredje område<sup>91</sup> byggas upp där inte bara skolan blickar ut mot den informella sektorn utan där även den informella sektorn anpassar sig till skolan och designar sin verksamhet så att den möter skolans krav samt överensstämmer med dess styrdokument. I gränssnittet mellan det informella och det formella ges läraren en nästan ohanterlig roll. Resultatet i denna avhandling visar hur lärarna på ett professionellt sätt lyckas guida elever i och väcka

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<sup>88</sup> Se till exempel Selander & Kress, 2010 eller Underwood, 2007.

<sup>89</sup> Ett paradigmskifte har uppmärksamrats i utvecklingen av och forskningen om IKT i utbildning av flertalet forskare internationellt såväl som nationellt och jag har valt att kalla det nya paradigmet *The Online Learning Paradigm* eftersom lärande i skolans digitala lärmiljö nu till stor del pågår online.

<sup>90</sup> Kunskaper som behövs för att kunna leva och arbeta i framtidens samhälle, såsom till exempel kapaciteten att engagera sig i livslångt lärande och i samarbete för att lösa öppna reella världsproblem, kollaborativa arbeten med lokala såväl som internationella kontakter för att utveckla en förståelse för det globala såväl som för att utveckla en kulturell känslighet (Law, et al, 2008; Hylén, 2010).

<sup>91</sup> *A third area* (Stocklmayer et al. 2010:30).

deras intressen för ett kunskapsinnehåll och samtidigt möta, förstå och använda elevernas egna behov, intressen och begär genom att designa för lärande med ett angreppssätt som påminner om en forskares<sup>92</sup>. En annan utmaning handlar om att det vidgade digitala gränssnittet kan bli än mer vidgat i detta paradigm där lärande är oberoende av tid och rum. Förra året uppgav svenska elever för första gången att de på fritiden spenderar mer tid vid Internet än med vänner<sup>93</sup> och mycket tyder på att elevers online-liv kommer att öka i betydelse i förhållande till deras offline-liv – vilket i sig innebär omvälvande didaktiska utmaningar för skolan, särskilt under 2011, då en tredjedel av Sveriges kommuner kommer att sjösätta 1:1-projekt i sina skolor<sup>94</sup>.

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<sup>92</sup> Se Kroksmark, 2011.

<sup>93</sup> Se Medierådet, 2010.

<sup>94</sup> Se Kroksmark, 2011.

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# Appendixes

- Appendix 1
- Appendix 2a
- Appendix 2b
- Appendix 3
- Appendix 4

## Included articles

- VI. Engström, S. (2006). The digital learning resource – a tool, content or a peer? Digital media in Learning Design Sequences. *Stockholm Library of Curriculum Studies*. Vol 16, p 2-21. Stockholm: HLS Förlag.
- VII. Engström, S. (2008). Eh, they even have a special tool, did you see that? Affordances in digital learning resource mediated interaction. *Digital Kompetanse, Nordic Journal of Digital Literacy*, Vol. 3, 1-2008, p. 5-20. Oslo: Universitetsforlaget.
- VIII. Kjällander, S. (2009). Vad blir SO i en digital lärmiljö? In: Selander, S & Svärden-Åberg, E (Eds.) *Didaktisk design i digital miljö – nya möjligheter för lärande*, p. 127-143. Stockholm: Liber.
- IX. Kjällander, S. & Selander, S. (2009). Design för lärande i en digital, multimodal lärmiljö. In: Jonas Linderöth (Ed.) *Individ, teknik och lärande*, p. 239-262. Stockholm: Carlssons.
- X. Kjällander, S. (submitted). Assessment in the digital divide: Teachers' and pupils' multimodal interaction.



This compilation thesis studies designs for learning in the extended digital interface in Social Science. Together with the thesis a theoretical perspective has developed: *Designs for Learning*.

The five articles indicate, among other things, that:

- Teachers and pupils are didactic designers and Social Science acquires informal features when pupils are designing their own digital material;
- Pupils' interaction and learning is significantly multimodal and cooperative and the digital learning resource becomes a third element in interaction;
- Pupils are simultaneously designing parallel paths of learning. One path represents the formalised education which is the path initiated and assessed by the teacher. The other path is often represented in modes other than text and speech and guided by pupils' interests and by affordances in the digital interface. This extended learning goes on below the surface and becomes invisible.

The thesis ends with a discussion about didactic complexities that schools face in the *The Online Learning Paradigm*.



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