The digital learning resource
– a tool, content or a peer?

Pupils’ interaction and learning in four
Social Science Learning Design Sequences

Abstract

This article concerns the use of digital learning resources in the Swedish Social Science classroom. The aim is to find specific patterns in pupils’ subject related interaction and learning when they work with digital learning resources. This is illustrated by means of a Learning Design Sequence - LDS - which is a model for research and analysis developed within the project Digital media and learning design sequences in Swedish schools – user’s perspective, from which the empirical research material derives. The case study has a multimodal perspective on learning and is understood within social semiotic and socio cultural frames, with a focus on didactic design and multimodal analysis. The material consists of multimodally transcribed video recordings from four Learning Design Sequences in Social Science with pupils aged 6 to 11. The result divides the usage into four categories; search for; document; process and present information. Further the result present patterns in pupils’ interaction and learning and tries to understand these specific patterns according to above mentioned theories as well as related research.

Keywords

Learning Design Sequence; education; digital learning resources; modes; ICT; Interaction; multimodality; Social Science
Introduction

This article examines how pupils interact and learn in a Social Science subject area. It will present how digital learning resources are used in the classroom. The result presents some specific patterns in pupils’ interaction in the digital learning environment. This is shown in relation to a Learning Design Sequence – LDS.

In the national curriculum for Social Science, it is expressed that pupils should work with digital learning resources in school. Teachers are not only supposed to use digital media in their own teaching, they are also supposed to teach their pupils how to use digital learning resources as tools for learning (Skolverket, 2000). The digital media itself has to be learned before being used as a tool for learning, equal to other tools, such as the pencil and the paper which is the reason that all schools selected and observed in this study consider themselves as being ahead in education based on digital media. In this article I assume that digital learning resources somehow change pupil’s interaction and learning, I quote Jewitt “…some new technologies help some people learn in some instances.” (2006:1), but how is what this study aims at studying.

Aims and research questions

The aim of the article is to try to scrutinize how digital learning resources are used in schools that are in the forefront of ICT-development. This is examined through studying pupils’ subject related interaction with a focus on the following questions;

- What are pupils using digital learning resources for in the Social Science classroom?
- What patterns of interaction can be found when pupils use digital learning resources in Social Science?
- What patterns of learning can be found when pupils use digital learning resources in Social Science related interaction?

A view of form and content

When pupils work with digital learning resources collaboratively a major part of their interaction tends to be about the digital learning resource and the form of the representation, such as how to save a document correctly or how to design the transition between different slides in Power Point, rather than about what is framed by the subject task given by the teacher. This is probably not specific for digital learning resources; instead it can be seen in all educational settings. McLuhans slogan from 1967 that “the medium is the message” (McLuhan, 1967) and therefore not valuable to examine on its own has become valid again in the era of digital technologies (Levinson, 1999). According to Jewitt (2006) the complex interplay of modes such as images, colours, text, sounds and moving images are right in the middle of digital technologies. It brings forth a wide range of resources that can be used to make meaning of the subject. Pupils have to make many choices in the digital learning environment about how to arrange the resources to make meaning of the task given. Knowledge is thus shaped by design and form and content can as a result not be separated. This article does not consider finding categories for what is content and what is form, yet it focuses on Social Science, looking at pupils’ subject oriented interaction in the Learning Design Sequences. Pupils design their own subject related interaction and learning, giving it a special form by means of sing-making. Social semiotics (van
Leeuwen, 2005) deals with signs as means for making meaning in interaction. When a resource is used for communicational purposes pupils are motivated to use signs to combine content and form to carry meaning. The content always has to be given a form and the form also influences how the users understand it. A seminar with Kress (2006-10-27) resulted in a statement that both form and content is design. The content and the form are united and they mutually influence each other and the form is not just aesthetics, it also carries a meaning (Kress & van Leeuwen, 2001). This implies that the form needs content and content needs a form to be understood or even to be able to exist.

It is likely that different participants in a learning process have different views of the subject related content and about what the aims of the given task actually are. This can have consequences for the video filmed learning situations as well as for the interaction in the interviews. The scenario is frequent in the material of this study and the following shows how all participants understand the subject related content slightly differently. In a Learning Design Sequence called My preschool day the pupils document objects with a digital camera in their pre-school environment. The digital photos are transferred to a computer and the pupils add their own spoken narratives to the photos. The teacher claims that she is thinking of the subject related content as the preschool pupils’ school day. The pronounced task is that the pupils shall show their school day to their parents with the help of digital photos organized in a film with added speech. The pupils on the other hand think the aim is to learn how to use the digital camera and the software whereas I, as a researcher, view the subject related content as pupils’ interaction about the photos.

A view of digital learning resources

McLuhan (Bjurström et al, 2000) suggests that people’s understanding of media also should include communication. The notion ICT (information and communication technology) is used instead of IT in this article. Wiberg (2005) asserts that IT, until recently, mainly was about information but since communication has become a great part of what IT concerns, he would like to change the meaning of the I to interaction instead of information. I think the C for communication solves this problem in a better way since ICT is used both for communication and search for, as well as presentation of, information.

Säljö writes that it is not valuable trying to understand what goes on in a pupil’s head – instead one should try to understand learning in the interaction between pupils and learning resources (2005). ICT usage in education can be divided into three broad categories; ICT as object under study, ICT as support tools and ICT as catalysts for transformation (Rodrigo, 2003). These categories are also used in research about ICT and education. Since this article focuses on pupils’ interaction and learning when using digital learning resources, the second and third ICT categories are examined in this study. According to Kress (2003) the change in media from book to screen and from traditional print-based media to new ICT have three effects: 1) they make it easy to use a multiplicity of modes, 2) they change, by means of their affordances, the potentials for representation and communication since new media is interactive and 3) it permits the user to relate with other texts from all around the world by the notion of hypertextuality.

The concept of digital learning resources in this study is framed by how they are used by the pupils and the teachers in the classroom. It must not necessarily be designed for educational purposes, but used for learning. The view on digital learning resources is wide; it can be a digital camera, a computer or a scanner. It can also be software, the Internet or a digitally produced representation such as Google Earth. From a socio cultural perspective the learning resource, or artefact, is central. Pupils’ thinking is thought to be closely connected to the resources they are using (Säljö, 2005). This is shown in the interaction between pupil and digital learning resource where the pupil for example can manage complicated actions with the computer without being able to verbalise them.
A view of multimodal interaction

Interaction can be described as fundamental social actions which have meaning for other participants (Lindblad & Sahlström, 2001), and it can be seen as a mutual action between how teachers, pupils and learning resources influence each others actions through different communicative expressions. Sometimes the notions of communication and interaction are separated, but in this article the difference between these two notions is not important and interaction is the term used at most occasions. An action can’t be seen as an isolated activity, to act is to inter-act. Interaction is the connected flow of actions (Linderoth, 2004). Learning and development occurs through interaction. It is through interaction people’s thoughts connect to each others. People and their direct social and physical surrounding have a mutual relation. Through interaction people create understanding and knowledge (Säljö, 2000) – therefore most of the pupils in this material are observed when cooperating with each other. There are different components in interaction. Nonverbal parts of interaction such as gesture and body language, paraverbal parts such as intonation and pausing and signals of structure which are supportive words like OK, well and so on are all signs used to interact (Buhl, et al., 2005).

Goodwin (2000) argues that language is not to be isolated from its environment. In this article interaction is looked upon as multimodal and depending on the environment. Goodwin talks about semiotic fields that mutually elaborate each other, something that in this article is referred to as modes (Kress & van Leeuwen, 2001) - a central term when interaction is looked upon from a multimodal perspective. Modes are the elements such as for example words, letters and pictures used to interact. The interaction between pupils during their search for an image to use in a slide show could, for example, be understood better if it is acknowledged that different modes, such as gestures, speech and actions on the screen, are used in this process.

Language is often seen as the central and dominant mode in education whereas pictures, gestures and learning resources are seen as illustrative supports to language (Kress, 2003, Jewitt, 2006). With a multimodal approach interaction is looked upon with its full repertoire of modes; visual, action concentrated and lingual modes. The notion multimode underline that pupils use a great variety of different mediating resources to formulate meaning (Kress et al. 2001). These can for example be spoken language, gestures, mimic and sighs (Lindstråd, 2006). The digital learning resource provides the pupils with affordances which enable them to work and think in special ways (Kress et al 2001). Therefore interaction between pupils and digital learning resources is important to document in order to understand learning and interaction in a Learning Design Sequence. Multimodal interaction is highlighted in the digital learning environment and in the material that this article is based on pupils touch each other and gesticulating, pointing at images and laughing at moving images while working with digital learning resources. Younger pupils tend to point at the screen to draw attention to something special whilst older pupils use the cursor. The following example visualizes how multimodal interaction can appear in Social Science in a pre school setting:

Max, Philip and Sarah are adding speech to their own photos in a software called iMovie and Max continually tries to get the others to understand that they have to talk into the microphone. Max: But you don’t understand but you have to speak into that. He is pointing at the microphone and he talks with a pitch voice. Philip: But I am wondering who is supposed to talk now actuallyyyyyyyyyyyyy? He is singing this out loudly and slowly but the others do not seem to react. Philip: But stop it now, we have to take it away because we have to… He presses a key hard to stop the recording and gesticulates vividly at the microphone looking at his peers. Sarah and Philip turn their gaze at Max.
In the example the pupil is using his body to get attention. This gives effect in contrast to the words with the same message he has uttered a few times before. He could have said a variety of things which probably had had little effect in this specific situation. The peers do not react until he uses a different mode; gesture. This illustrates how gestures are not just supporting language; instead they stand on their own. It is possible that the peers have heard what the pupil said since speech and gestures mutually elaborate each other in the larger sequence of actions (Goodwin, 2000) but it is not until he with his body pushes them to pay attention that they finally do. Pupils use their own modes to communicate but also the affordances provided by the digital learning resource to make meaning, using a wide range of pictures, audio, text and other effects in their representations.

A view of learning

Since learning is the superior notion in the reasoning above, as in this whole article, the notion serves to be elaborated and defined. Learning is thought to have occurred when the pupil is able to experience a certain phenomenon when it appears in a special way in a new situation (Marton et al. 1997:184). From a socio cultural perspective communicative processes are focused and the pupil is supposed to gain knowledge and skills by means of communication (Säljö, 2000:37). Learning is not cognitive inherent but the ability to handle and make use of different form of communication, which is confirmed by the pupil’s own experiences (Alexandersson et. al. 2000:25).

In this study interaction and learning is thought to be multimodal. According to Jewitt (2006) technology-mediated learning is has multimodal characters and pupils are thought to engage with computer applications multimodally: “They point, gesture, gaze at the screen, they move the mouse (or joystick), click on icons and sometimes they talk. Students learn from all the modes present on the screen and around it – not only from what is written and said.” (Jewitt, 2006:7). According to Kress learning is something that comes about in sign-making activities: “The process of inward meaning-making and the resultant change to the state of an inner semiotic resource is called learning.” (Kress, 2003:40).

In this article interaction between pupils and digital learning resources and sometimes teachers is studied by means to understand pupils’ learning and in this activity a model called Learning Design Sequence has been developed and used.

Method – design of study

LDS – Learning Design Sequence

Within my research group a model has been designed, referred to as an LDS – Learning Design Sequence (Engström, Hössjer, Selander & Åkerfeldt, 2006). The model is defined in two aspects; “action and time” as well as “representation and indications of learning”. An LDS is a sequence of learning framed by for example what digital artefacts that are used, the curriculum, rules that run the school as well as unspoken school norms.
The learning process is divided in two transformation units; the primary and the secondary. In the following central notions are explained.

- **Introducing** – The teacher introduces an assignment or a theme (LDS) that he or she has didactically designed. The first LDS phase can include a description of aims and goals, a description of expected activities and the final product the pupils are supposed to design. Also criteria for assessments and marks can be presented.

- **Searching and designing** – During the learning process pupil’s searching and representing of the material they are working with is studied with a special focus on meaning making. What modes and media do pupils use to make meaning? What information is copied, negotiated or transformed? Different activities are supported by the digital learning resource and studied.

- **Group climate and interaction** – The interaction between the participants, such as pupils, teachers and digital learning resources in the learning process is of interest. Who has the initiative, who rules and who prevents the learning process? This is studied in relation to the Social Science subject they are working with.

- **Teacher’s interventions** – During the learning process the teacher is interacting with the pupils. How is this interaction shaped; is the interaction content related or does it include technical tips or do the teacher interrupt the pupils with questions irrelevant to the task?
• **Representations** – All pupil’s representations such as texts, pictures and films are collected and analysed. What media is used, what is centrally or peripherally described, how has the information been transformed and what modes are used in the representations?

• **Signs of learning** – The signs in the pupils’ representations are studied during the process as well as in the final representations. What new explanations, expressions and skills can be seen? These signs of learning can be compared with the teachers’ intentions.

• **Presenting** – In the last phase the LDS is completed through pupils’ presentation of their work in for example a Power Point presentation or a film. Of special interest is how the pupils present their work, how these presentations are received and discussed, how they are assessed and how the process or final product is reflected and evaluated. Teachers and pupils are interviewed in the end of each LDS.

The LDS is designed to study pupils in the age groups from six to nineteen, but it is possible to use in all ages. Although the model is designed for educational settings in school it is possible to study all educational settings and learning processes. The LDS is followed from the teacher’s introduction of a subject area all the way until the same area is ended with the assessment of the pupils’ representations and learning process. Such a Learning Design Sequence can consist of a few hours or several weeks.

With a social semiotic, multimodal research approach it is advantageous to videotape pupils’ interaction since it is crucial to document what the pupils say and do in the LDS. I have documented these sequences with one or two digital video cameras. One to be able to see the pupils’ expressions and gestures from the front and another from behind to able to document what is going on the screen or display of the digital learning resource. After each Learning Design Sequence I have interviewed both teachers and pupils and I have also gathered pupils’ representations. Since I have a multimodal perspective I am interested in documentation of all modes such as speech, gestures, pictures and sound. This paper is concentrated on subject oriented interaction in all phases in the Learning Design Sequence since that is what my research questions concerns.

The material this article builds on is gathered in a larger context, where the research questions of the project¹ have narrowed what is documented. These questions have to do with the digital resource’s design, the usage of the digital resource, representations of understanding and the users’ meta reflections which is the focus of the video films.

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**Presentation of empirical material**

The material this article is based on consists of four different Learning Design Sequences, altogether more than 15 hours of video filmed material. The material is collected in the Stockholm area in schools that define themselves as being ahead in the use of educational ICT. The material used in this article is a part of a larger material (more than 100 hours) collected within a three-year project called *Learning Design Sequences and digital learning resources in Swedish schools – a user’s perspective*. The material analyzed is within the frames of Social Science in Pre School (pupils aged six) and year 1-6 (pupils aged seven to twelve). Part of the material is collected in a class with pupils in need of special support. Depending on the setting and the authorizations signed by the parents I have chosen to film one to four pupils working with a digital learning resource. All pupils’ parents have signed an authorisation of participation in the project and HSFR’s four ethical guidelines² for research have been carefully followed in every detail. The following is a short presentation of each Learning Design Sequence;

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¹ The 3-year (2004-2007) research project is called ”Digital media and learning design sequences in Swedish schools – user’s perspective” and financed by the Swedish Knowledge Foundation’s research program LearnIT.
² The Swedish Research Council and HSFR’s ethical rules for Social Science research (Vetenskapsrådet, 2004); the demand on information, the demand on consent, the demand on confidentiality and the demand on usage.
**My preschool day**
The first Learning Design Sequence is didactically designed as a two week project filmed in a preschool-environment with nine 6-year-old children. The task is to make a film about their school day. Three children cooperate and with a digital camera they document objects in their environment that they want to tell their family about. They use a stationary computer to put pictures into a program called iMovie and record their own spoken narratives about each picture. The video material comprises 685 minutes.

**The dolphin's travel to other countries**
This Learning Design Sequence is from a class of eight pupils with children from year 1-6 with special needs. They work in an integrated language/social science/textile craft-project that runs for a great part of a semester. The task is to make a slide show about an animal that they have made in a textile craft-project. The work is individual and 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 Power Point presentation. The video material comprises 307 minutes.

**The history about me**
The third Learning Design Sequence is filmed in a class of about 20 pupils in year 2 during a couple of months. The pupils are supposed to make a Power Point presentation about their own life and family. They use their own photos which they scan and they also pick pictures from Clipart. They add their own spoken and written narratives to the slide shows. The three filmed pupils work individually but they are also expected to help each other. The video material comprises 143 minutes.

**Myths about Sweden**
The fourth Learning Design Sequence is filmed in a year 4 class where the approximately 25 pupils have Sweden as a theme in Social Science for about ten weeks. The LDS is didactically designed so that two to five pupils cooperate about statements about Sweden – statements that they also test to decide if they are correct or not. They orally document these statements and the motivation to why they are/are not correct. They search for pictures through Google and they scan their own photos. They also photograph objects with a digital camera. The photographs and myths are presented in a photo program and they add music to them. The video material comprises 234 minutes.

**Design of analysis**
The material is analyzed in three levels. The analysis is designed in line with the idea of *critical incidents* (Flanagan, 1954; Tripp, 1993). A critical incident can be a special sequence in the video filmed material that has a defined beginning and a defined ending. A critical incident can for example begin with a question posed by a pupil, continue with a discussion and the search for information to make meaning, and end with an answer to the question. To find critical incidents the entire material of four LDSs is viewed and the sequences to be transcribed are chosen according to the specific research questions. The decisive factor is the focus of pupils’ attention and interaction. The common denominator is that all sequences concerns Social Science oriented interaction between pupils and digital learning resources. A few subject related interactions including the teacher are analyzed.

The first level of analysis is the transcription. Units of analysis are the full repertoire of modes such as visual, action concentrated and lingual modes. According to Goodwin (2000) a framework for analysis is required where speech and other modes are analyzed. I have created a dynamic transcription scheme to transcribe the material multimodally which means that speech and sounds are transcribed, but also activity, gestures and digital learning resource activity. Below is an example of the first row in a multimodal transcription.
The first row in a multimodal transcription chart

<table>
<thead>
<tr>
<th>Time</th>
<th>Pupil</th>
<th>Teacher</th>
<th>Speech</th>
<th>Sounds</th>
<th>Activities</th>
<th>Gestures</th>
<th>Digital learning resource</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.03</td>
<td>Simon talks. Mathilda moves on her chair.</td>
<td>The teacher is walking away.</td>
<td>Simon: HEY! Look at this, what a COOL lion!</td>
<td>Mathilda’s chair squeaks.</td>
<td>Searching in Clip Art for an image of a lion.</td>
<td>Simon is pointing at the screen.</td>
<td>Displays an image of an animated yellow lion with a big mouth.</td>
<td>Another pupil passes by Mathilda, forcing her to move.</td>
</tr>
</tbody>
</table>

All modes are equally important (Kress et al. 2001). A special column for “other” is used to explain sudden shifts in focus when, for example, another pupil enters the learning process or when the bell rings. The second part of analysis is the search for patterns in the transcriptions which is made through reading the transcriptions, often watching the video film simultaneously. A unit of analysis in this phase is three different ingredients in the transcribed interaction; the nonverbal parts, the paraverbal parts and the signals of structure (Toft, 2005).

When interaction is structured in these categories, patterns appear. These patterns can be about how pupils talk to each other or how they talk about the subject or the digital learning resource. The third part of analysis is the analysis of the found patterns including an attempt to understand underlying reasons for these patterns and possible consequences. The tools for analysis are theories and earlier research; the found patterns are compared to research theories and earlier similar research in the field of digital learning resources and education. Excerpts have been designed based on the transcription in order to illustrate the result. All names are erased and personal information (except age and sex) altered and the images have been made unrecognisable.

Results

In the following, examples of patterns found in the empirical material are presented, organized according to the research questions. All examples show subject oriented interaction between pupils and digital learning resources. The examples are mainly from within the frames of the LDS’s primary transformation unit. They show how pupils make meaning with modes and media and how they transform and form their learning and representations.

Digital learning resource usage in the classroom

In these four Learning Design Sequences digital learning resources are used as a tool for learning in different ways, here classified into four categories. How digital media are used in these LDSs varies depending on age but also on how accustomed the pupils are to the digital learning resource. The results indicate that older pupils or pupils that are accustomed to the learning resource tend to use it more as a tool or a resource for learning the subject related content, whereas younger or inexperienced pupils tend to focus on 1) how to handle the learning resource and 2) the form of the presentation. Teachers teaching younger or unaccustomed pupils tend to encourage pupils to focus on learning how to use the digital learning resource as a tool. All four different usages includes subject related learning with a centre of gravity on the transforming – forming phase of the Learning Design Sequence.
Search for information

When pupils use digital media in the LDS’s phase of transforming – to search for information – it is mainly through Google. They write a word in the search window and search for it. This is a complicated task since it is crucial to spell the word right, something that is difficult for younger pupils. Homonyms cause problems and pupils try hard to make meaning of texts and images – a process that can be very time consuming. Pupils search for general information on the web but they also search specially for images, restricting their search to exclude all text based information and only show image based information. Hits in English are ignored. The texts can be transformed by the pupils. They read the text, pick out and discuss important facts which they write or type with their own words. Sometimes they copy and paste the entire text into a slide show or other document on the computer. The found images are used in presentations – either they print images or they copy and paste them. An example from the phase of transforming in the LDS Myths about Sweden shows how pupils are engaged in learning discussions while searching for images.

This illustrates how unexpected information can be incorporated in the pupils work and learning. Searching for information is a learning activity; the pupils take the new information into account, elaborate and discuss it in order to understand it. Even an activity such as “copy&paste” hold potentials for learning since pupils select and delimits the text, insert it into a new context, designs a headline to the text and possibly an image.

Documentation of information

In the LDS’s phase of transforming – forming, pupils use digital media to document information. They can use a digital camera to take still pictures of surroundings, objects, people or their own drawings. They can also film events, surroundings and different acts. The program Word is used for documenting texts that they find on the Internet or for writing their own, but it is also common to write texts in Power Point or other software for presentation. The pupils document information by recording their own voices with the help of digital tools. The following example, from the LDS My preschool day presents a pupil interacting while focusing on the subject related content and documenting information:
Philip runs around in the preschool room with a digital camera around his neck. He talks about what he is thinking and doing. He talks constantly to himself – or possibly to the digital camera – while he photographs the computer and explains why he chooses that artefact as a relevant object: “It might be the computer I want to take a picture of? Such a computer I want!”

Pupils documenting information elaborates the subject meanwhile in sign-making activities through an inward meaning-making and through the interaction with peers and digital learning resources.

### Processing of information

In the phase of transforming – forming, pupils make meaning through processing information in interaction while collecting material or viewing the collected material. The material show how pupils apprehend parts of the subject when it is visualized with the digital media. The digital learning resource facilitates thinking “out of the box” and understanding through the display it in different modes. Pupils develop their representations by communicating their findings with their peers while using the digital media or in direct engagement with the digital learning resource. An example of this is from the LDS *The history about me* where a pupil is eager to communicate the content of the text in the slide show she is processing.

Nathalie tries to draw attention with words like “But, hello!” and “Look. Look here!”’. She reads the text: “This is my dad. His name is Stefan.” Then she probably says giggling:” My dad is a real couch potato.” when looking at the photo she has scanned picturing her dad lying in a hammock. She incorporates this statement into the text and then she reads it again; “This is my dad. His name is Stefan. My dad is a real couch potato. My dad is 41 years old.”

Pupil are processing the content and developing the work while viewing the multimodal screen activity. Learning thus has multimodal characters and the pupils learn by engaging with computer applications multimodally.
Presentation of information

During the part of the LDS that is referred to as the secondary transformation unit, digital media is mainly used to present material. Pupils make meaning and represent their learning and their focus is on constructing a presentation – often a slide show or a film. They, as well as their teachers, concentrate on the aesthetic design of the representation rather than on the subject related content. These digital presentations are presented live to teachers and classmates. They can also be presented to parents live or on the schools home page. Sometimes they are attached to an information letter from the teacher or the school sent to the pupils’ parents. Digital media can be used by the teachers when introducing the pupils to a special Learning Design Sequence. Teachers also use digital media to inform pupils about something in a Learning Design Sequence or show them how to use the digital learning resource as a tool. An example from the LDS The dolphins travel to other countries shows a pupil reading a story she has written herself about a cuddly animal she has made on her own.

“Once upon a time, there was a dolphin named Molly. She jumped five meters high and was very skilled. She wanted to become a pop star. She swam to other countries and showed how skilled she was. But one day she met a boy dolphin called Peter. Then she decided to follow Peter instead and establish a family.”

This is the story of Tanja’s cuddly animal in the slide show which is presented to her teachers and classmates and also on the school web site – open for anyone to view.

Subject related learning occurs while presenting but also while viewing other’s presentations. The digital learning resource facilitates presentation of schoolwork, not only to teachers and peers but also to parents and sometimes an immense audience when presented on the web. The audience on the web, where three of four LDS representations are published, is both unknown and unpredictable, something the teachers do not seem to take into account.

Pupils’ interaction in the digital learning environment

The results of this study indicate that pupils interact in special ways in the digital learning environment. In the following a few patterns will be presented and analysed.

The digital learning resource - a participant in interaction

Pupils talk via the learning resource when working with digital media. They seldom have eye contact, even when asking or answering direct questions, instead they keep their eyes focused on the learning resource. They communicate taking for granted that their peers are viewing the same detail on the screen. Pupils that work with digital learning resources constantly talk to each other or to the digital learning resource. This example is from the LDS My preschool day. It shows a pupil photographing in the LDS phase of transforming at the same time as he reflects loud or talk to the digital learning resource;
Philip is walking around on his own with the camera around his neck: *Hm. Then we’ll take a photo of... YES the builder’s corner! Wooden blocks and lots of... Well, let’s see. What do I want to take a picture of here? YES! I’ll take a photo of... A DINOSAUR! Well, let’s see, maybe this one?* This conversation takes place during almost a minute while Philip walks around in the nursery room picking different objects and gazing into the camera.

The digital learning resource seems to be appreciated as having an agent more than other learning resources. This might depend on that the pupils think that the digital learning resource has its own will and thought. They think it does things “on its own”, when it is auto correcting a word for example. As seen in another example pupils do not only talk to the digital learning resource but also refer to it as *you* or *they*. In school pupils are regularly assigned to search for information. During this activity the learning resource seems to be seen as an equivalent participant where the pupils sometimes trust the contributions made by the learning resource more than the ones made by peers. They are not critical to the information found on the web although their teachers have informed them that they should not trust all sources as being reliable on the web. This kind of interaction hold learning potentials as learning can be understood as the ability to handle and make use of different forms of communication.

**Impulsive interaction**

Spoken interaction is fragmental when pupils are searching the web. The interaction is influenced by images displayed on screen and the main theme can come into periphery. Pupils quickly accept new suggestions and ideas and they encourage each other to engage in the same thing as themselves, although this might have nothing to do with the task they are working with. Pupils frequently shout things out in the open air – often without feed back from peers. Pupils that work with digital learning resources seem to be more interested in telling each other what they have learned than in listening to each other. Sometimes they comment on their own or someone else’s work without any reaction. The following shows two pupils in the *forming* phase of the LDS *The history about me*. One pupil practice on presenting her slide show when a complication turns up. She can not manage the slide show as she had planned and she needs help. A peer is watching and she seems to be listening, but doesn’t help or talk about the problem. Instead she points at a picture in the slide show, commenting on that. It is in the LDS’ secondary transformation unit.

Nathalie shakes her head: *But what? But HELLO! No but, OH!* She looks devastated and is shouting loudly with an exaggerated body language without any visible reaction from the pupil sitting next to her. Nathalie: *Oh, nooo! What happened now then? HELLO, I wanted to...* Mathilda does not seem to care about this outburst but suddenly she leans forward and points at the screen smiling: *YES, Beckham!*
The example illustrates how pupils’ interaction is multimodal – they use gestures, pictures, sounds and other modes to interact with each other. This results in that the communication between pupils seems to be more fragmental than it actually is when only observing them listening to what they say, since other modes than speech, are used in interaction as well.

**Co operative interaction**

In this study teachers divide pupils into groups of two or three where they are supposed to cooperate\(^3\). Pupils working individually are supposed to help each other. The teacher encourages the pupils to help each other which the following example from the LDS *The history about me* shows that they do.

Nathalie: *You know those images? Can... You know these images, where can you get them? : Shall I show you? You write it here and then you press enter. Nathalie: Like princesses or such? And then something comes...?* She sighs: *Boring... Simon shrugs: Everything does not turn up.* During this sequence the Simon takes over the mouse and accomplishes the search himself and while saying the last comment he walks away to his own seat.

Pupils are in need of a lot of help when they work with digital learning resources, thus it is difficult for the teacher to provide enough help. Therefore pupils also try to search help from each other. The help provided by peers has great differences to the help provided by the teacher. When a pupil is helping a peer he or she tells the pupil what to do or even does it for him or her. Pupils do not find out if the peer understood or not, nor is he or she asking questions on what the pupil aims at. Still this helping activity can include learning for both parts. Pupils comment on each others representations which can be encouraging and stimulate subject oriented learning. Pupils tend to divide tasks, maybe due to what they are skilled in. Sometimes the pupil that holds the digital camera or the mouse receives and performs orders from peers but more commonly the pupil that handles the learning resource is the one that makes the decisions.

**Educational interaction**

Initially the teacher introduces pupils to the task in the Learning Design Sequence. The interaction concerns what they are going to do or already have done, but seldom why. The pupils ask the teacher what to do and the teacher answers with modes such as gestures, images, maps, texts and speech. Pupils also instruct each other with different modes and in most cases the instructed pupil accepts and does what he or she is told to do. The following example is from the LDS *The dolphins travel to other countries* in the phase of transforming. It shows a teacher instructing a pupil to photograph with a digital camera.

\(^3\) The LDS *The dolphins travel to other countries* diverges from this since the pupils are in need of special support and work one by one with constant teacher support.
Most instructive interaction concerns the technical or aesthetic design of the representation. Also when pupils are asking the teacher subject related questions the conversation tend to shift focus from content to form. In this study an underlying resound for this shift seems to be divided into two parts; 1) the digital learning resource is new and exciting and 2) pupils and teachers focus on the final product rather than the learning process.

**Pupils’ learning in the digital learning environment**

The results of this study indicate that pupils learn in special ways in the digital learning environment. In the following a few patterns will be presented and analysed.

**Learning by means of affordances in the digital learning environment**

When pupils are working with digital media, focusing on the subject and the task seems to be difficult - they tend to shift their attention span to what appears on the screen. When deeply involved in a subject related conversation, something can appear on the screen with the result that the pupils leave the subject oriented conversation hanging in the air. Learning occurs in such situations as well, but it is not always subject related or even connected to the task. A pupil might be searching for something that is difficult to find, and instead he or she come across something else and read, write and learn about that. Pupils tend to focus on available information and an example of this scenario is seen in the LDS *The history about me* in the phase of transforming – forming.
Nathalie is trying to find pictures from Clip Art to represent her interest in princesses. She wants to add the pictures to her slide show. No picture of a princess appears (probably because of a misspelling). Her classmate Simon who has been trying to help her utters the following: "They don’t understand… He shakes his head: You have to write something easy. I’m going to write tiger which Tomas thought. Would you like to go into tiger? Simon nods and gesticulates with his hands: Tomas thought so. I went into… they understand…"

The helping pupil refers to ClipArt as they and states that they don’t understand all words and that one should choose words according to the learning resources’ understanding. Pupils are sometimes more interested in finding any picture than to actually get hold of something that represents what they initially wanted. This study shows how pupils tend to use information that is available. The final product is a result both of pupils own findings and the affordances provided by the digital learning resource. Pupils act, think and learn according to, and together with, the affordances provided by the digital learning resource – their learning can thus be regarded as ruled by the digital learning resource. Learning might therefore occur at random which doesn’t have to be negative – instead it can enhance learning when the pupil takes new information into account and elaborate it according to their experiences. On the other hand it can result in that the pupil pretends to be interested in, for example tigers, because it was easier to find an image of a tiger than of a princess which responds to the authentic interest. The digital learning resource gives a unique opportunity to grasp and learn practically everything, but it produces such a large amount of information that the pupils have difficulties sifting.

**Learning by facilitation of modes**

The affordances of the digital media facilitate for pupils to visualize, understand and explain complicated material. Pupils can document and visualize things they would not explain in words with a digital camera, a moving image found on the Internet or a sound effect. The computer also seems to facilitate writing and reading of own texts, especially for younger pupils that have not yet developed a readable handwriting or a sense of spelling. An example from the phase of transforming – forming in the LDS *The dolphins’ travel to other countries* visualizes how a digital learning resources can help the pupil to explain the movement when a dolphin jumps up from the water.
The teacher helps Tanja to make the dolphin jump in Power Point. Teacher: *Or maybe we can do something more slowly?* Tanja: *No, I want it to...* Teacher: *It’s jumping ever so much here.* Tanja: *NOOOOO, it is not like that I want...* Teacher: *Then we’ll take it away. Let’s undo it. Let’s choose another then, what do you want? Shall it jump like that?* Tanja nods: *Yes!* Teacher: *Up and to the right like this?* Tanja: *Yes.* During this conversation Tanja and the teacher tries different animation tracks in Power Point to find one that she is satisfied with. They show animations with hand gestures but also with the cursor on the screen.

The digital learning resource facilitates for both the teacher and the pupil to use different modes in the learning process. The range of modes is wide in these Learning Design Sequences; the pupils can show a movement with speech and gestures but also with the cursor, animation tracks, sound effects or other built-in resources in the digital learning resource. These built-in resources are especially helpful in Social Science where pupils are encouraged to use a range of tools on the web such as Google Earth and different websites. In the Social Science classroom pupils are often encouraged to engage in multimodal sources where their learning has rather free frames.

**Learning as creativeness**

Pupils need help when working with digital learning resources. In some Learning Design Sequences, especially in *The dolphin’s travel to other countries*, the pupil turns passive when the teacher is not nearby. Pupils get stuck and frustrated and sometimes angry, they show signs of stress, and they tell each other to hurry up expressing that they haven’t got enough time. Pupils take shortcuts to finish a task, not spending time at elaborating their representations. They are creative in that sense that they have new ideas on how a task can be solved and they also solve tasks in unexpected ways. Following example is from the Learning Design Sequence’s phase of *transforming – forming* in the LDS *Myths about Sweden* where the pupils are elaborating the myth that you can’t swim in Sweden in the winter.

Maria, Jim and Theo record their findings orally on the computer and they hurry each other up. They loose focus and suddenly they start to talk about swimming in the summer due to Internet hits on outdoor bathing places. All pupils are gesticulating vividly with their arms. Jim: *Yes. And in the summers you can take a swim at the beach, in the bath tub and in an indoor pool.* Maria: *Look, I can’t get in, I can’t get in...* Theo: *(sigh) Yes, but, just go!* Maria: *OK. OK (makes the sound of a car).* Jim: *It’s got to be exact.* Theo: *Noooo. Maria: Move the dates...* Theo: *One, two...* Maria: *Wait-wait-wait! OK. Yes! Jim: And in the summer you can swim in...* Maria: *GO-GO-GO!* During this conversation they are all gesticulating a lot. They are smiling, laughing and joking and at the same time they seem stressed and frustrated.
It is likely that a feeling of time pressure is the cause of pupils’ shifting moods as depicted in these LDSs. Pupils laugh a lot and they express that they think it is fun to work with digital media. This is thought to be a key characteristic of creativity and learning. In this study pupils’ creativity seems to be important for learning since the pupils are left with free frames within which to design their own learning and representations. The task is by the pupils sometimes understood as something on a sliding scale between formal and informal learning, which is a possible reason for them challenging the frames of the given task engaging in sign-making activities according to their own interest.

**Findings and conclusions:**

**The digital learning resource – a tool, content and a peer**

This article has shown examples on how digital learning resources are used in educational settings. It has presented patterns of interaction between pupils, digital learning resources and teachers that work with subject related matters as well as significant learning characteristics. The analysed material is extensive and there is a vast amount of results analyzed and discussed, therefore all of them cannot be discussed further. A few interesting findings will be further elaborated and scrutinized.

The result of this article reveals the use of digital learning resources in four categories – searching; documenting; processing and presenting of information. The pupils’ signs of learning indicate that learning and subject related interaction occurs regardless if the digital learning resource is used for searching, documenting, processing or presenting information. Sometimes the specific learning is not expected nor desired by some of the participants in the learning process. This can be because they have different views of what the content or task in the Learning Design Sequence actually is and therefore the article does not measure pupils’ learning according to curriculum goals but instead search for signs of learning in pupils’ Social Science related interaction. The use of ICT to present, publish and communicate is well established according to Loveless (2003) and the ICT-usage in these four Learning Design Sequences is neither unexpected nor uncommon in comparison with other research including *The PISA ICT-report* (Drenoyianni, 2006). The fact that the video filmed material caught all modes that pupils used to communicate and learn and then analyzed multimodally gave a unique opportunity to catch the pupils’ signs of learning (Kress et al. 2001) in all four categories. Learning occurs when pupils communicate the content with each other (Säljö, 2000) and the result shows that pupils are representing and developing the subject related content, also by an activity such as “copy&paste”. Even if they don’t always communicate Social Science with each other they constantly pay attention by means of words, cries of delight, gestures, laughs, sighs and questions on their own or others’ representations. These multimodal signs seldom lead to oral conversations but since meaning-making and learning occur in other modes as well it can be enough for the pupil to present (or get a comment on) his or her idea or findings to notice shortcomings or faults, and therefore further process and develop the representation. This interaction between the pupil and the digital learning resource are meaning making activities according to Loveless (2003), who states that “the maker produces and the work responds”. That scenario is repeated in this study; 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. The result show how pupils learn by the mode of image, which, according to Jewitt (2006) is effective in high lightening overall patterns, demonstrate complicated notions, depict spatial relations and create mood. Pupils also learn by the mode of sound by creating atmospheres, responding to sounds of warnings and to get attention, just as Jewitt (2006) claims.

Furthermore the result shows that pupils inspire each other and are creative when working with digital learning resources. Loveless (2003) states that pupils’ capability in developing ideas, as well as exchanging and sharing information, is developed when they are using digital learning resources. ICT can facilitate pupils to inspire each other with, for example, presentations on the web (Holm-Sorensen...
et al. 2006). In this study pupils inspire each other via the visualization of each others’ representations – pupils are viewing each others multimodal products and then using the same information in their own product; either as inspiration or as a model to copy. This can be seen as part of the phenomena that the digital learning resource influences learning. According to Kress et al (2001) the learning resource’s built-in resources provide the pupils with affordances, enabling them to work and think in special ways. An affordance can for example be a sound, an image or a word presented on the screen or a button on the digital camera. When working with digital learning resources pupils’ learning is sometimes what Wheeler et al (2002) refer to as peripheral or incidental. This means that pupils are faced with facts with different subject content to the one in the task, or to problems concerning the digital learning resource. The result shows that pupils change their representations when engaging with the digital learning resource, which can both enhance as well as hinder subject related learning. In engagement with the digital resource the pupils can be inspired to drift off the subject related task or interaction. An interesting picture, a loud sound or underlined and highlighted hypertext presented in a digital learning environment is likely to attract pupils’ interest and engagement. This results in that the pupils engage in something new and irrelevant to the task given by the teacher. Therefore some of the final representations presented in the end of a Learning Design Sequence include parts that have little or nothing to do with the setting of the Learning Design Sequence and the given task. On the other hand the engagement with the digital learning resource can inspire pupils to think “out of the box” and be able to use a certain phenomenon in a special way in a new situation, which according to Marton et al.(1997) means that the pupils have learned. Pupils are often confronted to obstacles they have to solve in the digital learning environment; it can be technical or subject related problems. When trying to solve problems they are often very creative. The search results that they are confronted with on for example the Internet can be irrelevant to their search but they try hard and creatively to make sense of the hits. They confirm the hits with their own experiences and incorporate the new piece of information and transform and form their representation in interaction. In their multimodal interaction their signs of learning are visible in their ability to handle and make use of different forms of communication which according to Alexandersson et. al. (2000) is to be considered as learning.

The result has given support to Säljö’s (2000) ideas that artefacts enable children to understand and explain complicated information not reachable only with spoken language. Instead pupils engage with computer applications multimodally by pointing, gesturing gazing clicking just as Jewitt (2006) describes learning with digital learning resources. The pupils constantly use the affordances provided by the digital learning resource to make meaning which facilitate learning. This study shows the same result as Mathiassen et al. (2003) who found that pupils’ writing and reading is facilitated by the digital learning resources that are making learning more joyful, something a major part of the pupils express during the learning process in the four Learning Design Sequences.

The pupils in this study seem to work in a rush which is found in other research on digital learning resources as well, where pupils are focused on completion of the task (Wheeler et al 2002) rather than the actual learning process or result. The pupils in Holm Sorensen´s (2006) research say that the most important thing is to “keep up with one´s work and to do all the exercises on time” when working with ICT. This is expressed in this research as well. Pupils show signs of stress in the sense that they have mood swings and take shortcuts to complete the task in time. Time pressure does not have to inhibit learning; instead this study shows how pupils are encouraged to be creative to solve tasks on time. The result indicates that interaction have educational characteristics between pupils and teachers but also between pupils. The instructive language is a known pattern in teacher-pupil interaction and in these Learning Design Sequences pupils accept to be instructed, not only by the teacher but also by a peer. This might be a result of a learning hierarchy (Holm Sorensen et al., 2006) where beginners learn from those with experience. Interaction in most of the Learning Design Sequences shows that the more experienced pupil helps the less experienced but these roles can change according to the task; one pupil can be the experienced in case of the digital learning resource but in need of help with subject related matters. This can lead to the finding that interaction is more equal (Holm Sorensen et al., 2006) and allowing between pupils and also between pupils and teachers.

A pupil can ask a question and instead of answering verbally the peer might point at the screen where the answer is visible in a text or in an image. Therefore pupils seem to be making detached and independent contributions to the interaction. Goodwin (2000) states that it is important for all parts in a social action to recognise the shape and character of what is happening. When not considering the
digital learning resource as an agent and a participator it is impossible to follow and make meaning out of the interaction in the four Learning Design Sequences in this study. The digital learning resource acts as a co-operator in the discussions, and the pupils seem to consider it equal to themselves. The pupils take for granted that their peers are viewing the same information produced by the learning resource. This is comparable to deictic expressions (Goodwin, 2000). Pupils seem to talk to themselves when they work with digital learning resources, but it is likely that the speech actually is aimed at the digital learning resource since they seem to be considering the digital learning resource an equivalent co-operator, referring to it with pronouns as for example you or they. This study thus confirms the statements made by Kress et al. (2001) about how pupils act, think and learn in interaction with the digital learning resources’ affordances. Pupils’ interaction can therefore be said to be guided by the digital learning resource. It is a participant that the pupils interact about, through and also with – they thus ascribe the digital learning resource an agency (Kress et al, 2001). Considering the results discussed above I dare to say that the digital learning resource can be understood as a tool, content and a peer in the learning process.

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Bibliography


