DFL

Designs for Learning: Focus on Special Needs

Designs for Digitalised Literacy Education in a Swedish Lower Primary School

Karin Forsling

The aim of this article is to contribute knowledge about challenges to literacy development in a digitalised learning environment, with focus on *pupils in need of special support*. The paper is based on a section of my doctoral thesis (Forsling, 2017), centring on how digital learning environments and situations were designed and orchestrated in a Swedish lower primary school with the aim to provide all pupils, including children in need of special support, with optimal opportunities for literacy development.

The theoretical and methodological framework is grounded in *design-oriented theories*, with emphasis on how *design* and *orchestration* make affordances for *learning* and *meaning-making*. The ethnographically inspired study is based on observations and interviews at one school in Sweden. Six teachers, one special needs teacher and one literacy-developer participated in the study.

The results show that the teachers' intentions with their designs for learning focused on *children in need of special support*. From a special education perspective, this is a *relational and democratic approach* – an intention to *close gaps*. Nevertheless, the results manifest a parallelism where two special education perspectives appeared side by side. On one hand, the teachers' relational perspective, and on the other hand, the special need teachers' compensatory perspective.

Another result indicates that the unequal allocation of digital tools displayed the school's inadequate fulfilment of its mandate to provide equal education: there were differences between the preschool-class and the lower primary classes, and differences between pupils' home circumstances and the preschool-class.

Introduction

The aim of this article is to contribute knowledge about challenges to literacy education in a digitalized learning environment, with focus on pupils in need of special support. The article is based on a section of data initially collected for my doctoral thesis (Forsling, 2017), which examined how learning environments and situations were designed and orchestrated with the aim to provide pupils in a Swedish lower primary school with optimal opportunities for literacy development. *Design*, in this sense, included cultural and material tools and artefacts, as well as social qualities. Orchestration of environments and processes conducive to learning were involved in the design concept (cf. Jewitt, 2009; Leijon, 2010; Lindstrand, 2006; Selander and Kress, 2010). In the thesis design further entailed critical thinking and reflection about learning, both individually and in interaction with others.

The article is based on data collected during my doctoral studies. Parts of the data material led to increased

curiosity and new research questions. An interesting intersection of perspectives regarding *pupils in need of special support, teachers' intentions for designs and orchestration*, and the *allocation of digital tools* was manifested. This specific focal point needed to be explored and this is the aim of the present article.

The rapid digitalisation in education leads to increased demands on practitioners and researchers (Engeström, 2008). Teachers' need and request for substantial professional development in ICT has increased in schools throughout Sweden, and the school in this study was no exception. The present study, which is a minor field study, may not have captured the diversity of individual teacher's practice, but will serve to highlight aspects of digitalization in early education.

The intentions for design and orchestration of learning environments and situations play an important role in pupils' learning and meaning-making (cf. Aagaard and Lund, 2013; Jewitt, 2009; Kjällander, 2011) and these aspects are even more important for pupils in need of special support (Ahlberg, 2009; Forsling 2010, 2017; Meyer, Rose and Gordon, 2014). To understand and interpret the complexity of these assumptions, the study draws on

Karlstads Universitet Karlstad, SE

karin.forsling@kau.se

perspectives from various domains. The theoretical framework is *designs for learning*, with the contextual focus on *digital learning environments*,[1] in the overall *special educational needs perspectives*. The three domains are further described below.

The study addresses the following research questions:

1. In which ways are digital learning environments and situations designed and orchestrated so that all pupils are supported and challenged in their literacy learning?
2. With which intentions are digital learning environments and situations designed and orchestrated so that all pupils are supported and challenged in their literacy learning?
3. How is learning and meaning-making expressed in the studied learning environments and situations?

Pupils in need of special support were not specifically studied in the thesis – the aim was to include *all* children.[2] This article however, focuses on one of the distinct themes that emerged in the analyses: *challenges for literacy development in a digitalised learning environment, related to pupils in need of special support.*

Institutional Settings – the research Environment

The study (2012–2014) was performed at a primary school in a Swedish small industrial city, a community with economic problems and a considerable migration to bigger cities. The results of the city's national school assessments had been among the lowest in Sweden for a long time. Despite of a strained economy, the politicians in the municipality decided to support digital development in the schools and connected this effort with research and the teachers' professional development. The head director of the schools and the principals established a school developmental project, and created three new kinds of posts to serve all the schools in the municipality, namely *subject developers* related to the areas of language, mathematics and English. Furthermore implementation of digital tools became the foundation for development.

There were seven schools in the municipality. The school reported on in the study lies on the outskirts of the city. The teachers had been using different kinds of methods and learning tools since 2011, when the special needs teacher had been inspired by a university course on the *expanded text concept*.[3] The classes in the study were relatively small for a Swedish context, approximately thirteen to seventeen children in every class. During some semesters the teachers of Grades 1 and 2, at the time of the first interviews, had been developing ways of literacy learning situations in a mix of A whole Language Approach (Kiwi-method,[4] New Zeeland), Writing to Read, WTR[5] (Trageton, Norway), and deepened reading comprehension.

The study was carried out in two phases. Six teachers were chosen for the first interviews and observations (2012–2013), while they attended a course about social media. At the time of the first interviews two of the six interviewed teachers were working in preschool-classes with six-year-old children, two teachers in Grade 1 with seven-year-old children, and two teachers in Grade 2 with eight-year-old children. In the second set of interviews and observations (2014), two Grade 3 teachers, one special needs educator and one subject-coordinator in languages attended.

At the Interface of three Domains

In the following, I highlight the most important factors found in the study related to the domains of *designs for learning*, *digital learning environments* and *special needs education*.

Designs for Learning

Designs for learning is a relatively new and expansive research area based on socio-semiotic and multimodal theories. Design theory is rooted in issues regarding communicative affordances in an increasingly digital environment and how these affordances influence the conditions for knowledge and learning. Rostvall and Selander (2008), Åkerfeldt (2014) and Jewitt (2009) debate the situation that communication and learning are expressed in a wider variation of forms than earlier, and that all these expressions may be seen as meaningful. Furthermore, design theories are based on a broader understanding of text, according to which, graphic text or verbal language are not the only primary expressions for learning and meaning-making. Kress (2009) argues that these theoretical premises draw attention to the ways in which different resources are used (or not used) in social practices.

Learning is a process that relies on a delicate balance between support and resistance to become meaningful (Rose & Meyer, 2002). Didactic design shapes learning processes through which pupils together with teachers transform information and their understanding of subject content into new representations. Teachers' designs and orchestration stimulate, motivate and provide pupils with structure and empowerment for development. From a design oriented perspective, the choices made for designs and orchestration are crucial whether an action is deemed meaningful or not (Jewitt, 2009; Leijon, 2010; Lindstrand, 2006; Selander & Kress, 2010).

In the study, the notion of *design* is used theoretically and analytically in interpreting teachers' design and orchestration of learning environments and learning situations. Designs for learning facilitated the understanding of learning in relation to a context and in relation to the conditions created for learning in different environments and situations (cf. Leijon and Lindstrand, 2012). The intention at the time was not to examine *what* or *how* pupils learn, but, through observations and interviews, to study *in what ways* and with *what intentions* digitalised environments and situations were designed and orchestrated to support and challenge *all* pupils' literacy development.

Digital Learning Environments

Earlier studies show that digitalisation in schools has both positive and negative results. Klerfeldt (2007) and Nissen and Fibiger (2010) have pointed to teachers' lack of expertise and capacity to respond to children's skills and interests as far as digital tools are concerned. Selander (2009) has highlighted problems that tend to arise when

substantial pedagogical freedom reigns regarding choices of organisation, methods and teaching tools.

It appears to be important to embrace a holistic perspective on the role played by digital technologies in learning activities to understand processes of change and development in schools (Erstad, 2011). Buckingham (2009) and Erstad (2011) describe the children of the 2010s as the first generation to grow up in a society characterised by digital media. In the light of this, debates of digital divides (cf. Kress, 2003; Buckingham, 2009), will perhaps return to discuss *first-wave digital divides* with focus on generational differences, rather than *second-wave* questions (class and gender) or *third-wave* questions (access and opportunities to learn in digital learning environments) (cf. Buckingham, 2009; Drotner and Livingstone, 2008; Johnson, Levine and Smith, 2009).

Swedish pupils with writing and reading difficulties/dyslexia do not have sufficient access to alternative tools (Swedish School Inspectorate's, 2011) and even when digital tools are available, barriers occur. Jonsson (2008) observes that many teachers are having difficulty in managing the new technology. The technical, educational and didactic questions are many. The special needs issues can be about the programs to be purchased, how they are handled and supported. Again, teachers' approach matters. Their digital competence is a base for the pupils' opportunities to develop digital competences.

Digital competences can be seen as an umbrella term denoting different social and discursive textual practices related to a society using digital technology (Thomas, 2011). Digital competences rest on basic ICT skills and the notion involves retrieving, assessing, storing, producing and communicating through and with digital media. Creativity and innovation as well as ethical and legal considerations are important. Digital competences not only involve tools, but also our mind-sets, and furthermore the ability to reflect critically on the texts that shape our worlds, lives, identities and cultures (Thomas, 2011). In this regard, didactic design refers to the individual conditions for learning, the technological and social conditions in different learning situations, the areas of knowledge that the learning is aimed at, but also the various factors that relate to education, judgment and wisdom. Critical thinking is important throughout all educational practice, and even more important regarding the design and orchestration of learning environments and situations for children in need of special support.

Perspectives on Special Needs Education

Tjernberg (2013) shows that the central duty of special needs education is to bridge the gaps between pupils' conditions and the demands of society. Teachers should be guided by the principle that *all* pupils have to be successful in school. A report, describing how pupils with writing and reading difficulties/dyslexia experience their situation in school (Swedish Schools Inspectorate, 2011), shows that about two thirds of the activities mapped focus on difficulties experienced by individual pupils. Less attention was paid to the role played by organisation, but Ahlberg (2009) has shown that the organisation of learning situations is vital for pupils in need of specific support. Different educational needs and individuals require different organisations on individual and/or group basis. Special educational resources will be allocated differently; depending on the special educational perspective is used (Myrberg and Lange, 2006).

Swedish special needs education has by tradition been dominated by an instrumental perspective, a so-called *compensatory perspective* (Helldin, 2003). Pupils have been distinguished, investigated and diagnosed. This perspective focuses on individualised learning, designed to reduce obstacles and possible subsequent disability. A common way of dealing with this is that a school organises segregated learning environments for a student or group of students outside the classroom's everyday life. Research reports that this kind of special needs education activity rather preserves the negative effects, than support the child's learning. According to Giota and Lundborg (2007) there is a clear negative correlation between segregating special needs education and students› poor school results. During some decades the compensatory perspective has been challenged by the so called *critical perspective*. This perspective moves the focus from individual to organization, stating that the organization is incapable of fulfilling its mandate to provide equitable education (Nilholm, 2007). The approach criticizes the so called traditional special needs education, describing it as stigmatizing and marginalizing. While the compensatory as well as the critical perspective affords solutions to special needs education problems, the so called *dilemma perspective* highlights a different aspect. Nilholm describes dilemmas as something different from problems. A dilemma is a sort of fundamental contradiction with no completely satisfactory solution, circumstances often related to inclusion and exclusion from a participatory perspective. The right to attend classroom activities versus the right to get individual support is a typical dilemma. The dilemma perspective is related to ethical and power dimensions. The idea of having to find a balance between the different dilemmas leads to humility when realizing that we actually perceive things from different perspectives (Nilholm, 2007).

The organisational role of special needs education, seen from a relational point of view, is to ensure cooperation between all parts of the organisation (Persson, 2008). The *relational perspective* invites all initiatives to have a holistic approach. Such initiatives involve the pupil, the pedagogues and the learning environment, in contrast to the *categorical perspective*, which is pupil-centred (Persson, 2008; Aspelin, 2013). Special needs education from a relational perspective is incorporated and integrated into the school's daily work (Persson, 2008). The focus is on relationships, communication and interaction. Teaching and learning problems are described as problems that can be caused by different phenomena, for example, be a result of how learning environments and learning situations are designed and engineered, or teachers' skills or shortcomings. Persson (2008) points out that the child's condition is understood in relation to the learning environment and the learning environment affects the child's condition.

Digital Devices – compensatory Aids or alternative Tools?

The views on digital learning tools also vary depending on which special needs perspective a view is based. From a compensatory or categorical perspective, the use of digital tools in special needs contexts can be described as *compensatory aids*. The term itself implies that the student has a shortcoming to be identified and then compensated with individual-adapted aids. The compensatory aids, which also consist of software, such as speech synthesis and specially designed spelling programs, would facilitate the teaching and learning of students with writing and reading difficulties (Damsby, 2008).

The Special Needs Education Authority has chosen to use the concept of *alternative tools* instead of compensatory aids (SPSM, 2011). The concept of alternative tools is based on the student's needs of an accessible, inclusive school environment instead of being a mere compensation of a shortcoming (SPSM, 2011).

Method

Since the scope of the study was limited both in terms of the period covered and the data collected, Alvesson's and Deetz's (2000) notion of *partial ethnography* is a suitable description. In partial ethnography, researchers examine specific situations, and the study focuses on the design of learning environments and situations.

The study was conducted between 2012 (phase 1) and 2014 (phase 2) in a lower primary school in a city in central Sweden. The school was chosen because digital tools had been used in teaching. Phase 1 included interviews with two preschool-class teachers, two Grade 1 teachers and two Grade 2 teachers. Since the research design was to study the long-term effect of the teachers' work, phase 2 was implemented according to the plan as a follow-up of phase 1. Phase 2 included interviews with two Grade 3 teachers, one special needs educator and one subject-coordinator in languages, and observations of a Grade 3 class. Digital learning environments and situations were documented through field notes and photographs. As a participating observer I engaged in different teaching situations, sometimes during a whole school day, sometimes during specific selected occasions.

The interviews had a semi-structured character and were conducted with an interview guide. The questions were about the prerequisites for designing and orchestrating learning environments and situations, and the opportunities and challenges experienced when digital tools were used in the classes.

The interviews and observations alternated as the starting point for the various phases. In phase 1, the interviews were in focus and the observations were made at a later stage to serve as a complementary collection method. In phase 2, procedure was reversed. The reason for reversing the procedure was that it allowed me to relate the observations to the interview statements.

Design-oriented concepts were used as tools for analysis of parts of the data material. When it comes to studying how teachers design their activities, and how the designs create meaning and learning, the concepts of *design, setting,*

learning and *meaning-making* were used for analysing, interpreting and understanding. In the analysis of both observations and interviews, the four design-oriented concepts were coded with coloring in field notes and transcriptional documents. The coding was open, i.e. no quantification followed, but the purpose was to break down and examine as well as categorize data by conceptualizing the code (Glaser & Strauss, 1967). To provide an overview of the material the coded areas were then assembled into larger units to structure the texts.

The four concepts were defined as follows.[6]

Firstly, a phenomenon of the empirical material is a *design*, if it is *socially constituted-* and *-constructed*. Design is about people *engaging in any communicative form* that can be *shared with others*. There is *collaboration* and it involves *several actors in different roles*. The design focuses on *learning processes* in relation to both *material and cultural affordances* and it could *support the teachers' orchestration* of the activity and situation. A design is *based on an intention*, which relates to the context: to affordances, and to the institutional framework. In a didactic design *someone gets the opportunity to acquire knowledge and skills*.

Secondly, an occurrence of empirical material is considered *orchestration* if *an idea of how something (the design) is to be processed, performed* and *understood*, is clear. An orchestration consists of *a number of choices* (space, material, tool, time, location, modes, and so on). An orchestration is always *set by someone* and there is always *a form of presentation, or representation.*

Thirdly, *learning* takes place in a *social context* and in *interaction* with others. It is distinguished by *production of signs that transforms the culturally available forms of representation* and *creates new signs*. Learning is an *increased ability to engage in a social domain* or an *increased ability to use a set of signs in a meaningful way*.

Fourthly, an occurrence in the empirical material is *meaning-making* if social *interaction* is visible. Meaning-making is when someone *experiences something meaningful, sensible* or when someone *experiences the meaning of something in a concrete situation as meaningful. Tools* are used to make the world *understandable. Different modes* are used as resources for meaning-making and the *choice of sign systems* is or becomes meaningful, carriers of meaning.

The findings are presented in a narrative mode, blending the interpretations of the teachers' statements and the outcomes from the observations. The excerpts in the following section are translated from Swedish to English with an aim to keep a balance between the oral language and the content.

Results

The study highlights how teachers' design of literacy situations using digital tools either supported or challenged pupils' learning. On one hand, it became obvious that teachers' designs and orchestration stimulated and motivated pupils and provided them with structure and empowerment for development. Teachers' intentions with their design and orchestration of literacy learning situa-

tions using digital tools may be classified into four different categories: *intentions regarding participation, motivation, learning* and *meaning-making*. The dominant factor was *intentions regarding participation*, giving all pupils the opportunity to literacy development in classroom and encompassing different types of equal opportunities.

The lower primary teachers described new methods and digital tools as offering structures for interaction, which afforded more authentic communication of pupils' texts than before. Through the work with blogs and Skype the classrooms participated on local and global levels: the classrooms entered the world and the world entered the classrooms. Skype conversations and class blogs increased interaction with new recipients: parents, teachers, and pupils at other schools. New audiences received the classes' texts, which created a sense of meaningfulness through working with actors outside of their school. The learning situations were socially constituted – and constructed. The children and the teachers shared a communicative form that involved collaboration and several actors in different roles. From a design-oriented perspective, learning takes place in a social context and in interaction with others. The children in the situation were producers of signs that transformed the culturally available forms of representation. Furthermore, learning is seen as an increased ability to engage in a social domain or as an increased ability to use a set of signs in a meaningful way. Different modes and media were used as resources for meaning making in the activities and the choice of sign systems became meaningful. Meaning making happens when someone experiences something meaningful or when someone experiences the meaning of something in a concrete situation as meaningful.

In the phase 1 interviews the teachers described how the work with WTR had helped the pupils in need of support to keep the joy of writing and desire to learn. Pupils with motor difficulties were able to shape texts more easily by using a keyboard, and pupils with concentration difficulties could concentrate easier on their work. Educational flexibility and collective activities offered the pupils opportunities to learn through many different tools and methods, which meant that all pupils could obtain their education in the classroom, together.

> We thought a lot about the children with disabilities, with motoric and concentration difficulties. Children with concentration difficulties often lose motivation. The struggle with letters takes a lot of focus from content. The difference compared to previous classes – now everyone has cracked the code. It is the boys who get the biggest benefit from the different working methods and working with the computer. (Karolin, December 2012)

On the other hand, educational challenges were represented. The challenges for learning were related to both teachers' and pupils' circumstances and to organisation. Four kinds of challenges related to design and settings occurred: *the unequal allocation of digital tools, the digital challenges, education for pupils in need of special support* and *policy challenges*.

Unequal allocation of Digital Tools

The allocation of digital tools had a prominent part in the head directors plan for school development. The school principals had the responsibility for purchase and allocation of the tools. The allocation resulted in seven tablets, four laptops and a projector per class in the primary school and no digital allocation at all in the preschool-classes. Every teacher had access to a personal laptop. The special needs educator used an elderly desktop computer in her classroom.

The principal's allocation did not seem to be related to the variety of pupils' disabilities or other conditions. The unequal situation created educational inequality, and frustration. The preschool-class teachers', expressed concerns that widening digital gaps affect participation. Their intentions to give all pupils equal opportunities to read and write were not fulfilled. All digital activities, such as blogging and Skyping, were performed with the teacher's old laptop.

> The blog is a fantastic tool for communication and organisation, but without a projector we miss a prominent part for literacy education – the children cannot see the text emerge and they have no possibility of visual collaboration. (Betty, November 2012)

The preschool-class teachers expressed disempowerment and exclusion. Yet the blogging was undertaken with much fighting spirit and determination – against all odds. The preschool-class teachers had to cope with a minimum of digital tools and they expressed their fears of inequality, regarding both the pupils' transition to primary school later on and the differences between the facilities in preschool-class and the children's digital home environments. Finally, the teachers had given up convincing the principle and just struggled on with the inadequate digital tools.

Digital Challenges

The interviewees were inspired and eager to try out the digital tools, even if some of them described themselves as not particularly interested in technology. Teachers struggled with the technology per se as well as with questions about how new methods impact on the classroom, in positive and negative ways. Digital devices were not compatible with one another, which caused chaos in the classrooms on many occasions. At the time of the second interviews, there was a distinguishable decline in blog- and Skype-activities. The teachers mentioned the reduction in number of recipients and their responses on the blogs. Finally, technology caused the ending of the activity. The learning situation and the learning tool were not meaningful anymore.

> The technology was troublesome, we could not log in, the internet speed slowed down, and it was getting tedious in Grade 3. That is when Linnea and I lost the desire to go on. (Karolin, June 2014)

Regarding Skype there had been problems with the Skype partner schools which however was more of an organisational than a technological issue.

Pupils in need of Special Support

The teachers discussed possibilities and difficulties of using digital tools. They identified benefits, such as; the development of literacy and digital literacy and the early linguistic awareness.

> I write what they say, if they say "bathe", I say: should I write bathe? "No, we *have* bathed". And here I see a difference, because in the beginning they could not formulate a sentence. Now they get models for how to write. The other day, there was a guy who said, "Hey, look, now I used that comma you've told me about." The bear eats grass, comma. They are 1st graders and it's the boys who pick it up. (Ylva, December 2012)

The teachers also discussed the hindrance for some of the children with disabilities. In Grade 1 there was one pupil diagnosed with Asperger syndrome and dysfunction of phonological awareness. In Grade 2 there were two children with diagnosed autism and ADHD. There were also children with motoric dysfunctions. These children joined in the same activities as the other children most of the time and the teachers said that the children in disabilities mostly gained benefits from the way the learning situations were designed. Some of the children experienced collaboration difficulties, for example. The teachers were aware of this and they explained how they tried different ways to find the optimal solution to including the children in the classroom even though some special arrangements were still needed.

Regarding the National School Tests, one of the teachers stated:

> Those who are having a hard time now – if we had worked differently they would have had it (tougher) later. A boy has enormous reading difficulties, but he is an expert at reading between the lines as he listens when we read aloud. He makes inferences to understand the context. He wrote two very good factual texts on the national test in Grade 3 and passed. Had he been forced to struggle with letters from the beginning (in a traditional way), then I'm sure, he would not have been able to write the texts. (Karolin, June 2014)

From a design-oriented perspective, tools are used to make the world understandable. The teachers' intentions and purposes for designing their learning environments and situations were that all children, regardless of preconditions, should learn to read and write included in the regular class. The teachers also shared the view that the regular special needs training was not enough to teach the children to read and write. The special needs teacher worked individually with a child or sometimes in a group, depending on issues, in a small room at the far end of the school building. The pupils attending had writing and reading difficulties, mathematical difficulties and concentration disorders. In the case of children with concentra-tion difficulties, very little 'teaching was done, it was more important to let the child have a quiet moment. The special needs teacher was content with her digital equipment and wished no more. There was an old internet-connected computer with the program Lexia, word processing, and some games. She described her special educational needs approach as well as the digital tools from a compensatory perspective, arguing, for example, that the pupils should learn to read and write through different computer programs.

Policy challenges

One of the most interesting results of the study is connected to the National School Tests and their design and involves a process that can be described as digital transformation in reverse. Transformation may be seen as the result of events, changes and actions in preparation for foreseen challenges. In the intervening period between the two phases of research, the Grade 3 teachers went *from* using digital tools such as computers and tablets *to* using pencils and paper. Teachers displayed flexibility and ability to adopt new perspectives and contexts. While digital tools were actively employed when pupils were learning how to read and write in Grade 1, they were deemed less useful when preparing for the National School Tests in Grade 3. These tests require pupils to work individually and to put pen to paper. The pupils with special educational needs, however, still chose to use computers for writing different Grade 3 assignments. The use of these digital tools may be regarded as individual, pupil-focused extra help. While handling the digital transformation in reverse, the teachers had to develop a design-didactic transformation, an ability to know when and how to use different tools and methods at different contexts and situations.

Discussion

The aim of this article is to contribute knowledge about challenges to literacy education in a digitalized learning environment, with focus on pupils in need of special support. Learning is a process in which knowledge, skills and competences are shaped and therefore relies on a careful balance between support and resistance. Design theories note that teachers' aims with different tasks are formulated in relation to available resources. Choices made in the design of learning environments and situations may determine whether an action is deemed meaningful or meaningless. This study shows that there were organisational and structural obstacles, which in turn presented pedagogical challenges for the teachers, inviting either of two responses to challenges: a defensive position in which participants responded to challenges with resignation, or a more active stance that stimulated to participatory action.

The compensatory Role of Schools

The school board, the school management and the principal have important roles as agents for school development. Provision of material and cultural conditions for

learning and further training in areas of digital competence as well as allocation of digital tools formed part of the development initiatives. The initiatives were well-intended but inconsistent. Principals in general play an important role in a time characterised by rapid digitalisation: the extent to and ways in which digital tools are used in teaching determine whether digital gaps are created or not. The divide between the worlds of children and their opportunities for informal learning outside the more formal and institutional culture of a school is also of importance. Principals have the responsibility to bridge gaps – not widen them. Gaps may be seen in relation to the so-called third-wave digital divides, in which issues such as access and opportunities to learn in digital learning environments are prominent.

Digital (in)equality may describe inequalities regarding equipment, extent of usage, competence and operation of tools (Samuelsson, 2014). The preschool-class teachers' described the fear that their pupils may not have the same literacy development opportunities due to too few digital tools. This may be deemed a democratic concern. Earlier research shows that the context and motivation as well as attitude and approach of teachers determine the orchestration and use of digital tools (cf. Jacquet, 2016; Klerfelt 2007; Samulesson, 2014). Åkerlund (2014) highlights two easily observable factors that seem essential for success when schools develop the use of digital tools, namely a school management encouraging and supporting changes and at least two teachers who are willing to experiment with different types of digital tools. At the school in the present study, all informants appeared to be strongly motivated to use digital tools. The unequal allocation of digital tools, however, led to the school failing to fulfil its mandate to provide equitable education.

This situation is not unusual in the digitalisation of Swedish schools, but all pupils, regardless of background and skills, should be given the opportunity to achieve syllabus outcomes under similar circumstances (National Agency for Education, 2011). In the Schools Inspectorate's 2012 investigation, Swedish schools are criticised for not fulfilling the democratic task stipulated in the Education Act. One of the initial overarching goals of investing in digital tools in schools was to reduce digital disparity and ensure that all pupils have civic competence and equal citizenship. The compensatory role of schools was emphasised by the National Agency for Education (2015) as an important factor in guaranteeing a cohesive, open and democratic society. However, the school, in the present study, did not manage to compensate for the differences between different pupils' circumstances to the extent required. The analysis shows that the school's inadequate fulfilment of its mandate to provide equal education was two-fold: on the one hand, there was the difference between the preschool-class and the lower primary classes, and on the other, a failure to compensate for differences between pupils' home circumstances and the preschool-class. It is furthermore interesting to note that the allocation of digital tools had no relation to the circumstances of children in need of special support.

Challenging educational situations

At the studied school, the teachers sought to design a school for all, based on a relational special educational needs perspective. The teachers' ability to design an education rich in perspective led to the development of communicative competences. In this context, the concepts of design and orchestration are relevant to broadening the understanding and importance of the teacher's mission to concretise intentions and purposes in various educational contexts using various tools.

Nevertheless, the relational perspective was not the only prevailing perspective at the studied school. The teachers' intentions for inclusion were opposed by the intentions of the special needs teacher whose wish to single out pupils for special needs education reveals her compensatory approach as one of exclusion. This led to a parallelism where the two special educational needs perspectives appeared side by side with a gap between them.

The institutional framework created obstacles that sometimes could be forced – sometimes not. When discussing the hindrances and/or benefits of using digital tools together with children in need of special support, I discovered a kind of two-folded awareness: the teachers noticed the benefits but they were also aware of frustrating situations. In situations for which the writing to read method (WTR), for example, would advocate working in pairs, problems arose for the children with diagnosed autism, Asperger and ADHD, which often involve collaboration difficulties. According to the interviews it seems however, that the teachers tried and found ways to get around the problems through a variation of learning processes.

The more traditional special needs education, i.e. the compensatory approach of letting the child go to another room to train different kinds of skills, did not, according to the teachers, solve any problems. Traditional literacy education requires children to go through two development processes concurrently, that is, the cognitive of learning how to read, and the motor skills of learning how to form letters and write with a pencil. The WTR method involves one process at a time – first cognitive development, then motor skills training. This facilitates literacy learning for many children with disabilities. The interviewed teachers in Grade 2 assumed that the WTR-method had, because of its focus on telling, instead of forming letters by hand, resulted in that some of the children with disabilities still were motivated for school.

The recipient perspective, which is important for meaningful learning and knowledge development, can be related to participation. To let all children have their literacy education together reduced the risk of exclusion and stigmatising for the children with disabilities. The digital tools were not used as compensatory tools, but just as tools for learning, with all their benefits and deficiencies. The teachers seemed to see the problems as challenges, frustrating but surmountable, to be overcome by finding the best way to educate the child. Here lies perhaps one of the greatest challenges for the teachers. Mixing different kinds of methods and tools gives children in need of special support a wider range of opportunities for learning compared to more traditional education.

Professional Development

Based on design theory, the flexibility shown by teachers indicates that they have developed professionally. This process involves their attitudes to the institutional framework, as well as to the tasks that teachers and pupils need to perform and it involves selecting suitable tools, paths of action while maintaining agency in the available room for movement. Kress (2010) argues that communication and learning always take place with the simultaneous aid of available semiotic resources, comprising sign systems and media. In the social context, participants create signs based on their interest and motivation and the resources available to those in the situation. These representations – the designs for learning – is therefore created on the basis of sign-makers' position and context. However – the challenge is to understand how representations become meaningful based from the perspective of sign-makers (Leijon and Lindstrand, 2012). The visualised transformation competence was based on the studied teachers' adaptation to available resources and the social context which highlights teachers' flexibility: *teacher flexibility facilitates the polyphony of learning, specifically regarding the situation for the children in need of special support.*

Pedagogical Implications

At the interface of design theory, digital learning environments and special needs education, the connection between research and practice is important. Research in dialogue with practice invites the intermeshing of different perspectives, which may lead to a generation of new knowledge. The study shows how teachers design and orchestrate literacy development environments and situations using digital tools so that all children may learn how to write and read. In this article I have focused on some of the challenges that were displayed in the statements of the informants and in the observations.

The teachers' intentions were to provide all pupils with the opportunity to achieve literacy success. In this context, Rose and Meyer (2002) raise some issues such as how teachers take into account all pupils when designing their learning environments or whether they instead create barriers for some pupils through their designs. These issues may be addressed through empirical examples from this study showing how support is provided and challenges are encountered. In this regard teachers' flexibility, demonstrated in their development of adaptability, is central. This internalised flexibility or transformation competence takes into account aspects such as differences between pupils and between different learning tools and various contextual events and demands.

The teachers' transformation competence enabled them to transform and develop teaching methods that not only worked for all pupils, but also for the demanding situations and contexts of schools today. This design-didactic transformation ability, a multimodal commutation between different expressions, can be described as an expanded textual understanding from a design-oriented perspective. It may well be one of the teachers' most important skills needed to carry out, the mission of education today – and tomorrow.

Notes

1. In the doctoral study, *digital learning environment* is equated with *a digitalised classroom*, i.e. a classroom in which digital tools, such as computers, tablets, projectors, digital cameras and television screens were available and used. The studied schools were connected to the internet and the teachers had participated in professional development, such as courses in social media and media pedagogy.

2. Here *all pupils* do not refer to quantities, but to inclusiveness from the perspective of special needs education: *all* includes pupils with different physical abilities, dispositions, backgrounds and needs in varying school contexts.

3. In the earlier national curriculum, Lpo 94, the syllabus for the Swedish subject points out the importance of literacy. The pupils need a capacity to interpret, review critically and analyse all kinds of texts. Acquiring and working with texts do not necessarily involve reading, but can also be done through listening, dramatising, role-play, film, video and pictures…. An expanded text concept includes pictures, beside written and spoken texts' (My translation).

4. The Swedish Kiwi-method is developed by A-M Körling, inspired by Reading Recovery, New Zeeland WTR.

5. Writing To Read' is a method developed of Arne Trageton, Norway. This digitally based method lets children in Grade 1 use digital tools to write texts, to discuss and refine them together with class comrades and teachers. Handwriting is postponed to Grade 2.

6. *Design*: Dreier (2003), Edwards and Mackenzie (2005), Jewitt (2009), Selander (2007), Selander and Svärdemo-Åberg (2009) Gynther (2010), Selander and Kress (2010), Leijon and Lindstrand (2012). *Orchestration*: Kress and van Leeuwen (2001), Selander (2007), Selander and Rostvall (2008), Kjällander (2011), Leijon and Lindstrand (2012), Åkerfelt (2014). *Learning*: Vygotskij (1999), Kress (2003, 2009), Selander (2009). *Meaning-making*: Linderoth (2004), Lindstrand (2006), Jewitt (2009), Kress (2010), Leijon (2014).

Competing Interests

The author has no competing interests to declare.

References

Aagaard, T., & **Lund, A.** (2013). Mind the gap: Divergent objects of assessment in technology-rich learning environments. *Nordic Journal of Digital Literacy*, *8*(4), 225–243.

Ahlberg, A. (Red.) (2009). *Specialpedagogisk forskning: En mångfasetterad utmaning*. Lund: Studentlitteratur.

Åkerfeldt, A. (2014). *Didaktisk design med digitala resurser: En studie av kunskapsrepresentationer i en digitaliserad skola*. Doktorsavhandling, Stockholms universitet.

Åkerlund, D. (2014). *Elever syns på nätet: Multimodala texter och autentiska mottagare*. Doktorsavhandling, Åbo: Åbo Akademis förlag.

Alvesson, M., & Deetz, S. (2000). *Kritisk samhällsvetenskaplig metod* (S.-E. Torhell, övers.). Lund: Studentlitteratur.

Buckingham, D. (2009). New media, new childhood's? Children's changing cultural environment in the age of digital technology. I M. J. Kehily (Red.), *An introduction to childhood studies* (s.124–140). London: Open University Press.

Damsby, G. (2008). *Implementering av kompensatoriska datorprogram i undervisningen: Belyst ur specialpeda-gogers perspektiv.* Malmö: FoU-enheten, Habilitering & Hjälpmedel, Region Skåne.

Dreier, O. (2003). Learning in personal trajectories of participation. I N. Stevenson, H. L. Radtke, R. Jorna, & H. Stam (Red.), *Theoretical psychology: Critical contributions* (s.20–29). Toronto: Captus Press.

Drotner, K., & Livingstone, S. (2008). *The international handbook of children, media and culture.* London: Sage.

Edwards, A., & Mackenzie, L. (2005). Steps towards participation: The social support of learning trajectories. *International Journal of Lifelong Education, 24*(4), 287–302. DOI: https://doi.org/10.1080/02601370500169178

Engeström, Y. (2008). Weaving the texture of school change. *Journal of Educational Change, 9*(4), 379–383. DOI: https://doi.org/10.1007/s10833-008-9086-6

Erstad, O. (2011). Digitalt kompetente skoler. I O. Erstad, & T. E. Hauge (Red.), *Skoleutvikling og digitale medier: Kompleksitet, mangfold og ekspansiv lærin* (s.47–63). Oslo: Gyldendal Akademisk.

Forsling, K. (2010). Teachers using an expanded text concept and media pedagogy for children with dyslexia. I S. Kotilainen, & S.-B. Arnolds-Granlund (Red.), *Media literacy education: Nordic perspectives* (s.145–155). Göteborg: International Clearinghouse on Children, Youth and Media, Nordicom, Göteborgs universitet.

Forsling, K. (2017). *Att överbrygga klyftor i ett digitalt lärandelandskap. Design och iscensättning för skriv- och läslärande i förskoleklass och lågstadium.* Doktor-savhandling Åbo Akademi University Press, Åbo: Åbo Akademi. ISBN 978-951-765-858-4.

Giota, J., & Lundborg, O. (2007). *Specialpedagogiskt stöd i grundskolan: Omfattning, former och konsekvenser.* Göteborg: Göteborgs universitet.

Gynther, K. (Red.) (2010). *Didaktik 2.0: Læremiddelkultur mellem tradition og innovation.* Köpenhamn: Akademisk forlag.

Helldin, R. (2003). Specialpedagogiskt perspektivseende, humanvetenskaper och etik. I B. Jonsson, & K. Roth (Red.), *Demokrati och lärande: Om valfrihet, gemenskap och övervägande i skola och samhälle* (s.203–231). Lund: Studentlitteratur.

Jacquet, E. (2016). *Litteracitet i fem högstadieungdomars en-till-en-datorpraktiker.* Doktorsavhandling, Åbo: Åbo Akademis förlag.

Jewitt, C. (2009). *Technology, literacy and learning: A multimodal approach.* London: Routledge.

Johnson, L., Levine, A., & Smith, R. (2009). *The 2009 Horizon report.* Austin, TX: The New Media Consortium.

Kjällander, S. (2011). *Designs for learning in an extended digital environment: Case studies of social interaction in the social science classroom.* Doktorsavhandling, Stockholm: Stockholms universitet.

Klerfelt, A. (2007). *Barns multimediala berättande: En länk mellan mediekultur och pedagogisk praktik.* Doktorsavhandling, Göteborg: Acta Universitatis Gothoburgensis.

Kress, G. (2003). *Literacy in the new media age.* London: Routledge. DOI: https://doi.org/10.4324/9780203299234

Kress, G. (2010). *Multimodality: a social semiotic approach to contemporary communication.* London: Routledge. DOI: https://doi.org/10.4324/9780203970034

Kress, G., & van Leeuwen, T. (2001) *Multimodal discourse: The modes and media of contemporary communication.* London: Arnold.

Leijon, M. (2010). *Att spåra tecken på lärande: Mediere-ception som pedagogisk form och multimodalt meningsskapande över tid.* Malmö: Malmö högskola.

Leijon, M., & Lindstrand, F. (2012). Socialsemiotik och design för lärande: Två multimodala teorier om lärande, representation och teckenskapande. *Pedagogisk Forskning i Sverige, 17*(3–4), 171–192.

Linderoth, J. (2004). *Datorspelandets mening: Bortom idén om den interaktiva illusionen.* Doktorsavhandling, Göteborg: Acta Universitatis Gothoburgensis.

Lindstrand, F. (2006). *Att göra skillnad: Representa-tion, identitet och lärande i ungdomars arbete och berättande med film.* Stockholm: HLS förlag.

Meyer, A., Rose, D. H., & Gordon, D. (2014). *Universal design for learning theory and practice.* Wakefield, MA: CAST Professional Publishing.

Myrberg, M., & Lange, A. (Red.) (2006). *Identifiering, diagnostik samt specialpedagogiska insatser för elever med läs- och skrivsvårigheter: Konsensusprojektet.* Härnösand: Specialpedagogiska institutet.

National Agency for Education/Skolverket. (2015). *It-användning och elevresultat i PISA 2012.* Stockholm: Skolverket. Hämtad från http://www.skolverket.se/publikationer?id=3504

Nilholm, C. (2007) *Perspektiv på Specialpedagogik.* Lund: Studentlitteratur.

Nissen, A., & Fibiger, J. (2010) *Digital literacy: Afrappor-tering af udviklingsarbejde.* Århus: Center for E-læring og Medier VIA University College, CELM. Hämtad från http://docplayer.dk/2139081-Digital-literacy-alice-bonde-nissen-johannes-fibiger.html

Persson, B. (2008). *Elevers olikheter och specialpedagogisk kunskap.* Stockholm: Liber.

Rose, D. H., & Meyer, A. (2002). *Teaching every student in the digital age: Universal design for learning.* Alexandria, VA: Association for Supervision and Curriculum Development.

Rostvall, A.-L., & Selander, S. (Red.) (2008). *Design för lärande.* Stockholm: Norstedts akademiska förlag.

Samulesson, U. (2014). Digital (o)jämlikhet. IKT-användning i skolan och elevers tekniska kapital. Doktorsavhandling, Jönköping: School of Education and Communication.

Schools Inspectorate/Skolinspektionen. (2011). *Läs- och skrivsvårigheter/dyslexi i grundskolan*. Stockholm: Skolinspektionen.

Selander, S. (2007). Didaktisk design: Den dubbla utmaningen. *Nordic Journal of Digital Literacy*, *2*(3), 162–172.

Selander, S. (2009). Didaktisk design. I S. Selander, & E. Svärdemo-Åberg (Red.), *Didaktisk design i digital miljö: Nya möjligheter för lärande* (s.17–36). Stockholm: Liber.

Selander, S., & **Kress, G.** (2010). *Design för lärande: Ett multimodalt perspektiv*. Stockholm: Norstedts Akademiska Förlag.

Selander, S., & **Rostvall, A.-L.** (Red.) (2008). *Design för lärande*. Stockholm: Norstedts Akademiska Förlag.

Selander, S., & **Svärdemo-Åberg, E.** (2009). *Didaktisk design i digital miljö: Nya möjligheter för lärande*. Stockholm: Liber.

SPSM. (2011). *It i lärandet för att nå målen*. Härnösand: Specialpedagogiska skolmyndigheten (SPSM).

Thomas, A. (2011). Towards a transformative digital literacies pedagogy. *Nordic Journal of Digital Literacy*, *6*(1–2), 89–102.

Tjernberg, C. (2013). *Framgångsfaktorer i läs- och skriv- lärande. En praxisorienterad studie med utgångspunkt i skolpraktiken*. Doktorsavhandling. Specialpedagogiska Institutionen. Stockholms universitet.

Vygotskij, L. S. (1999). *Tänkande och språk*. Göteborg: Daidalos.

Designs for Learning, is a peer-reviewed open access journal published by Stockholm University Press.

OPEN ACCESS